[redacted]

Prescription

This course introduces the electricity industry and its components along with techniques for modern electric power system modelling and analysis. Topics include transmission line models, transformers and per unit systems, generator models, network matrices, power flow analysis and computation, real and reactive power control, voltage control, and protection. The course incorporates lab and simulation based exercises, an industrial tour, and an industrial project.

Course learning objectives

Students who pass this course should be able to:

1. Describe how the working of the electricity market affects the operation of the power system.
2. Describe the working and interaction of the various components of a power system.
3. Develop network models and analyse power flows.
4. Analyse power system static behaviours and contingencies.
5. Make design decisions with respect to criteria such as overall system stability and cost.

Course content

The course is primarily offered in-person, but there will also be a remote option and there will be online alternatives for all the components of the course for students who cannot attend in-person.

Students taking this course remotely must have access to a computer with camera and microphone and a reliable high speed internet connection that will support real-time video plus audio connections and screen sharing. Students must be able to use Zoom; other communication applications may also be used. A mobile phone connection only is not considered sufficient. The computer must be adequate to support the programming required by the course: almost any modern windows, macintosh, or unix laptop or desktop computer will be sufficient, but an Android or IOS tablet will not.

If the assessment of the course includes tests, the tests will generally be run in-person on the Kelburn campus. There will be a remote option for students who cannot attend in-person and who have a strong justification (for example, being enrolled from overseas).
The remote test option will use Zoom for online supervision of the tests and you must be able to use Zoom with a camera, microphone, and screen-sharing. Students who will need to use the remote test option must contact the course coordinator in the first two weeks to get permission and make arrangements.

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The course comprises of the following components: First, it gives students with a good understanding of the basic principles of single and three-phase power, power transfer, and power indices. Second, it provides a deeper understanding of the components of power systems, and how to conduct per unit calculations, as well as power flow analyses. The techniques are then utilised to analyse, and understand, power system stability, faults, and protection. The integration of solar and wind generation, and storage in various parts of power systems, is examined in all of these components. Finally, the students are exposed to the working of the electricity market, in New Zealand and other parts of the world, and how the kind of market affects the technical power system.

Withdrawal from Course

Withdrawal dates and process:
https://www.wgtn.ac.nz/students/study/course-additions-withdrawals

Lecturers

Daniel Burmester (Coordinator)

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404 Alan MacDiarmid Building, Kelburn

Alan Brent

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413 Alan MacDiarmid Building, Kelburn

Jim Hinkley

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227 Alan MacDiarmid Building, Kelburn

Ramesh Rayudu

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421 Alan MacDiarmid Building, Kelburn

Teaching Format

This course will be offered in-person and online. For students in Wellington, there will be a combination of in-person components and web/internet based resources. It will also be possible to take the course entirely online for those who cannot attend on campus, with all the components provided in-person also made available online.

During the trimester there are weekly contact lectures, tutorials, and laboratory sessions. In terms of the latter, the practical work involves simulations with PowerFactory (www.digsilent.de). Two individual projects are undertaken, which entail the modelling of the power system at different levels. Additional information and discussions are also facilitated online via Blackboard.

Student feedback

Student feedback on University courses may be found at:
www.cad.vuw.ac.nz/feedback/feedback_display.php

Dates (trimester, teaching & break dates)

- Teaching: 05 July 2021 - 08 October 2021
- Break: 16 August 2021 - 29 August 2021
- Study period: 11 October 2021 - 14 October 2021
- Exam period: 15 October 2021 - 06 November 2021

Class Times and Room Numbers

05 July 2021 - 15 August 2021

- **Tuesday** 14:10 - 15:00 – 407, Alan MacDiarmid Building, Kelburn
- **Friday** 14:10 - 15:00 – 407, Alan MacDiarmid Building, Kelburn

30 August 2021 - 10 October 2021

- **Tuesday** 14:10 - 15:00 – 407, Alan MacDiarmid Building, Kelburn
- **Friday** 14:10 - 15:00 – 407, Alan MacDiarmid Building, Kelburn

Set Texts and Recommended Readings

Required

An e-book version of the recommended text is available from the library.

Additional material is made available online, via Blackboard, to assist with understanding the various concepts and the current debate around the renewable energy technology systems, which include: webinars, explanation videos, and other resources. Journal papers are made available via Talis Aspire with specific case studies and academic literature that are discussed and/or from part of the tutorials. In some weeks students are required to identify relevant literature, as part of online discussions, through the University library.

- Glover JD, Overbye TJ, 2016. *Power System Analysis and Design* – SI Edition. 6th edition, Cengage Learning, Mason.

Mandatory Course Requirements

In addition to achieving an overall pass mark of at least 50%, students must:

- Achieve an average of at least 40% on the assignments.

If you believe that exceptional circumstances may prevent you from meeting the mandatory course requirements, contact the Course Coordinator for advice as soon as possible.

Assessment

The assessment is largely based on the modelling excercises and assignments, using the PowerFactory software. The fundamental, technical principles of the course material are assessed through one in-class test.

Assessment Item	Due Date or Test Date	CLO(s)	Percentage
Assignment 1 – electricity market analysis	Week 6	CLO: 1	25%
Assignment 2 – Protection and stability	Week 9	CLO: 2,4	25%
Assignment 3 – simulation model and report	Week 14	CLO: 2,3,4,5	25%
Five laboratory exercises	Week 8	CLO: 2,3	25%

Penalties

Late assessment will be penalised at the rate of 10% for every working day the assessment is late. The lecturer may refuse to mark work that has been handed in over a week late, and may also refuse if the assessment has been marked and returned to the class. In such instances, a zero grade for that

assessment shall result.

Extensions

Individual extensions will only be granted in exceptional personal circumstances, and should be negotiated with the course coordinator before the deadline whenever possible. Documentation (eg, medical certificate) may be required.

Submission & Return

All the assessment items are submitted on Blackboard, and feedback will be provided electronically and discussed in class as appropriate.

Marking Criteria

The modelling assignments will be marked according to the robustness of the developed simulation models.

Workload

Although the workload varies from week to week, students are expected to spend approximately 10 hours per week on the course, to give a total of 150 hours study time over the trimester. A plausible breakdown for these hours would be: lectures (2 hours); tutorials (1 hour); laboratories (2 hours); reading, review and online discussions (2 hours); and modelling and written assignments (3 hours).

Teaching Plan

The learning areas/lectures and other activities over the teaching period comprise of the following:

Week 0

Lecture	Power system control

Week 1

Lecture	Course Introduction
Lecture	Power system introduction
Laboratory	Introduction to the PowerFactory modelling package and exercises, and the Slack, and bus bars

Week 2

Lecture	Generators, and system loads/storage
Tutorial	Generator Tutorial
Laboratory	PowerFactory tutorial, and transformers

Week 3

Lecture	Introduction to the power market and analysis
Tutorial	Assignment 1
Laboratory	PowerFactory tutorial, and transmission lines

Week 4

Lecture	Power system control
Laboratory	PowerFactory tutorial, and power flow analysis

Week 5

Lecture	System stability
Lecture	System stability
Laboratory	Contingency analysis

Week 6

Lecture	Power system protection
Tutorial	Assignment 2
Laboratory	Lab project

Week 7

Lecture	Guest lecture
Laboratory	Lab project

Week 8

Lecture	Guest lecture
Laboratory	Lab project

Week 9

Lecture	Guest lecture
Tutorial	Assignment 3
Laboratory	Lab project

Week 10

Lecture	Guest lecture
Laboratory	Lab project

Week 11

Lecture	Guest lecture
Laboratory	Lab project

Week 12

Lecture	Guest lecture
Laboratory	Lab project

Communication of Additional Information

Any additional information regarding this course will be posted on Blackboard.

Links to General Course Information

- Academic Integrity and Plagiarism: https://www.wgtn.ac.nz/students/study/exams/integrity-plagiarism
- Academic Progress: https://www.wgtn.ac.nz/students/study/progress/academic-progess (including restrictions and non-engagement)
- Dates and deadlines: https://www.wgtn.ac.nz/students/study/dates
- Grades: https://www.wgtn.ac.nz/students/study/progress/grades
- Special passes: Refer to the Assessment Handbook, at https://www.wgtn.ac.nz/documents/policy/staff-policy/assessment-handbook.pdf
- Statutes and policies, e.g. Student Conduct Statute: https://www.wgtn.ac.nz/about/governance/strategy
- Student support: https://www.wgtn.ac.nz/students/support

- Students with disabilities: https://www.wgtn.ac.nz/st_services/disability/
- Student Charter: https://www.wgtn.ac.nz/learning-teaching/learning-partnerships/student-charter
- Terms and Conditions: https://www.wgtn.ac.nz/study/apply-enrol/terms-conditions/student-contract
- Turnitin: http://www.cad.vuw.ac.nz/wiki/index.php/Turnitin
- University structure: https://www.wgtn.ac.nz/about/governance/structure
- VUWSA: http://www.vuwsa.org.nz

Offering CRN: 31173

Points: 15
Prerequisites: RESE 313; ECEN 202, 203
Duration: 05 July 2021 - 07 November 2021
Starts: Trimester 2
Campus: Kelburn