SOLA9103

Renewable Energy System Modelling & Analysis

Term 2, 2022

Course Overview

Staff Contact Details

Convenors

Name	Email	Availability	Location	Phone
Merlinde Kay	m.kay@unsw.edu.au	Please email to make an appointment	TETB Room 215	

Course Details

Units of Credit 6

Summary of the Course

The purpose of this course is to provide students with fundamental knowledge and relevant skills for energy system performance analysis, modelling and monitoring. Students taking this course will develop a competency in using these techniques for energy system performance assessment, understanding losses, diagnostics and forecasting for renewable energy and building systems. There is a focus on the use of statistical techniques and handling large data sets. Students will apply these techniques to real systems.

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This course will try to answer these and many more questions by providing students with fundamental knowledge and relevant skills for renewable energy system performance analysis, modelling and monitoring. Students taking this course will develop a competency in using techniques for resource and energy performance assessment, understanding losses, diagnostics, monitoring and forecasting of renewable energy systems. There is a focus on the use of statistical techniques, data exploration and handling large data sets. Students will apply these techniques to real systems.

The course aims to provide students with the opportunity to explore and gain further understanding of Renewable Energy (RE) system modelling through the investigation and impact of model assumptions and uncertainties with a direct emphasis on their application to real world datasets from the field of renewable energy engineering. Students who take this course should become familiar with analysis techniques required to carry out resource and operational performance assessments of RE systems.

Course Aims

- Techniques for energy system performance analysis and monitoring,
- Mathematical models for renewable energy and building energy modeling
- Performance assessment, understanding losses, diagnostics
- Short-term and long-term forecasting
- Data cleaning and handling large datasets

Course Learning Outcomes

1. Use analysis and modelling techniques to evaluate renewable energy system performance, and express performance in terms of the standard derived parameters.
2. Use general and RE specific data analysis and modelling techniques to understand, interrogate, question and challenge assumptions in RE modelling.
3. Use statistical methods and modelling techniques to evaluate and understand system losses,

degradation and diagnose system faults.

4. Apply appropriate data management, data cleaning and data visualisation techniques to manage, query, explore and communicate information from large weather and energy data sets.
5.

lectures will introduce concepts related to renewable energy system modelling and analysis, through the combined use of online resources, case studies, and worked examples. Workshops will build on the theory presented in the lectures.

The workshops are designed to engage students with the course material, and to help students successfully complete the course assignments. The workshops provide students with the opportunity to develop, practice, and apply their knowledge and modelling and analysis skills to real world RE modelling and analysis tasks.

A variety of additional resources are available through Moodle, including non-assessable practice quizzes, bonus activities, links to webinars, and journal and magazine articles. Students can use these

Assessment

Assessment task	Weight	Due Date	Course Learning Outcomes Assessed
1. Data exploration and visualisation	10%	17/06/2022 05:00 PM	2, 4
2. PV system performance analysis	20%	15/07/2022 05:00 PM	1, 2, 3, 4
3. Resource assessment	30%	05/08/2022 05:00 PM	2, 4, 5
4. Final Exam	40%	To be confirmed	1, 2, 3, 5

Assessment 1: Data exploration and visualisation

Assessment length: 4 pages maximum
Due date: 17/06/2022 05:00 PM
Deadline for absolute fail: The due dates for both items
Marks returned: 2 weeks after submission

Students will undertake data exploration of an unspecified data source in order to provide three key insights of the data for renewable energy modelling.

This assignment is submitted through Turnitin and students can see Turnitin similarity reports.

Assessment criteria

Submission Due: 5pm, Friday Week 3 - 17th June

Peer Assessment Due: 5pm, Thursday Week 4 - 23rd June

This assignment will provide students with the opportunity to apply knowledge covered in the lectures and practice skills in the workshops in relation to weather data, data analysis and data visualisation.

Students will undertake data exploration of an unspecified data sources in order to provide three key insights of the data for Renewable Energy modelling. Data will be provided.

This assessment is to be done individually, and will be peer assessed, with a report to be submitted via Moodle. Marks will be awarded based on the completeness and quality of your submission, and how well you complete the peer assessment process.

No late reports will be accepted for this assessment task and a grade of zero will be awarded if a student does not complete the peer assessment section of the assignment.

Assessment 2: PV system performance analysis

Assessment length: 15 pages maximum
Due date: 15/07/2022 05:00 PM

Deadline for absolute fail: 23rd July by 5pm
Marks returned: within 2 weeks after submission

Report of the method and results assessing the performance of 1 year of PV system data.

This assignment is submitted through Turnitin and students can see Turnitin similarity reports.

Assessment criteria

Due: 5pm, Friday Week 7

This assignment will provide students with the opportunity to apply knowledge and practice skills related to weather data, data analysis and visualisation, bankable datasets, resource assessment, uncertainty, and PV system modelling.

Students will undertake a resource and energy production assessment for a proposed PV farm.

This assessment is to be done individually with a report to be submitted via Moodle.

Final exam to be held during the exam period.

Resources

Recommended Resources

Software

• PVsyst – Photovoltaic modelling software: https://www.pvsyst.com/

• Microsoft Excel – Students can download Microsoft Excel as part of Microsoft Office 365 available via UNSW IT: https://www.myit.unsw.edu.au/services/students

• Anaconda – A desktop platform to run Jupyter Notebooks and Python: https://www.anaconda.com/

Reference Books

• Solar Energy Forecasting and Resource Assessment by Jan Kleissel

• Modelling Solar Radiation at the Earth's Surface by Viorel Badescu

Online Resources

Links to additional online resources and research publications will be made available through Moodle.

• UNSW Library website: https://www.library.unsw.edu.au/

• UNSW IT website for students: https://www.myit.unsw.edu.au/services/students

• Moodle: https://moodle.telt.unsw.edu.au/login/index.php

• PV Performance Modelling Collaborative: https://pvpmc.sandia.gov/

• NREL's Solar Position Algorithm Calculator: http://www.nrel.gov/midc/solpos/spa.html

• Australian Bureau of Meteorology: http://www.bom.gov.au/

• NASA – The POWER Project: https://power.larc.nasa.gov/

• EnergyPlus Weather Data:

https://energyplus.net/weather

• The Australian Renewable Energy Mapping Infrastructure (AREMI):

https://nationalmap.gov.au/renewables/

• The World Bank Group Global Solar Atlas: https://globalsolaratlas.info/map

• The World Bank Group Global Wind Atlas: https://globalwindatlas.info/

• PV Education by C.B. Honsberg and S. Bowden https://www.pveducation.org/

Course Evaluation and Development

Feedback on the course is gathered periodically using various means, including the UNSW myExperience process, informal discussion in the final class for the course, and the School's Student/Staff meetings. Your feedback is taken seriously, and continual improvements are made to the course based, in part, on such feedback.

In this course, recent improvements resulting from student feedback included the introduction of Python/Jupyter Notebook workshop activities. 2020 was the first time that students were offered the choice between completing the workshop activities in Microsoft Excel or via Python/Jupyter Notebooks. 2020 also saw the introduction of a set of Week 0 Assumed Knowledge lessons, including review lessons on basic statistics and solar resource basics.

Student feedback from the 2021 iteration of the course has led to further improvements of the workshopl resources for both the Microsoft Excel and Python learning streams; and the introduction of the online Course Book, available on Moodle.

Submission of Assessment Tasks

Work submitted late without an approved special consideration or extension by the course coordinator or delegated authority is subject to a late penalty of 5% mark reduction per day, capped at five days (120 hours) from the assessment deadline, after which a student cannot submit an assessment, consistent with UNSW Assessment Implementation Procedure.

The late penalty is applied per calendar day (including weekends and public holidays) that the assessment is overdue. There is no pro-rata of the late penalty for submissions made part way through a day.

Work submitted after the ‘deadline for absolute fail’ is not accepted and a mark of zero will be awarded for that assessment item.

For some assessment items, a late penalty may not be appropriate. These are clearly indicated in the course outline, and such assessments receive a mark of zero if not completed by the specified date. Examples include:

a. Weekly online tests or laboratory work worth a small proportion of the subject mark, or

b. Online quizzes where answers are released to students on completion, or

c. Professional assessment tasks, where the intention is to create an authentic assessment that has an absolute submission date, or

d. Pass/Fail assessment tasks.

Academic Honesty and Plagiarism

UNSW has an ongoing commitment to fostering a culture of learning informed by academic integrity. All UNSW students have a responsibility to adhere to this principle of academic integrity. Plagiarism undermines academic integrity and is not tolerated at UNSW. *Nj_eg_pgqk _r SLQU gq bcdglcb _q sqgle rfc umpbq mp gbc_q md mrfcpq _lb n_qqgle rfck mdd _q wmsp mul,*

Plagiarism is a type of intellectual theft. It can take many forms, from deliberate cheating to accidentally copying from a source without acknowledgement. UNSW has produced a website with a wealth of resources to support students to understand and avoid plagiarism, visit: student.unsw.edu.au/plagiarism. The Learning Centre assists students with understanding academic integrity and how not to plagiarise. They also hold workshops and can help students one-on-one.

You are also reminded that careful time management is an important part of study and one of the identified causes of plagiarism is poor time management. Students should allow sufficient time for