UNSW Course Outline

SOLA9104 Hybrid Renewable Energy Systems - 2024

Published on the 10 Sep 2024

General Course Information

Course Code : SOLA9104
Year : 2024
Term : Term 3
Teaching Period : T3
Is a multi-term course? : No
Faculty : Faculty of Engineering
Academic Unit : School of Photovoltaic and Renewable Engineering
Delivery Mode : In Person
Delivery Format : Standard
Delivery Location : Kensington
Campus : Sydney
Study Level : Postgraduate
Units of Credit : 6

Useful Links

Handbook Class Timetable

Course Details & Outcomes

Course Description

Energy services are critical for health, livelihoods, and enabling productive activities. However, more than a billion people around the world in rural areas and urban slums do not have access to modern energy. Hybrid renewable energy systems can deliver these energy services cost-

effectively, but there are a number of challenges related to their design, and the integration of high penetration of renewables. During this course you will develop the skills and knowledge required for designing, sizing, and specifying hybrid renewable energy systems. You will also learn how to build HRES implementation models and develop control strategies to optimise HRES operation. This course uses project-based learning.

Course Aims

The aims of this course are to:

- Introduce students to many of the technical and non-technical issues related to the delivery of accessible, affordable and appropriate energy services and infrastructure in developing countries and other remote disadvantaged communities.
- Develop and apply skills and approaches for assessing, designing and specifying sustainable rural energy projects, including understanding context, appropriate design and technology selection, implementation models and capacity building for sustainable projects.
- Develop and apply skills for building hybrid energy system models: developing a load curve, preparing weather data, modelling the technical characteristics of system components, and demand-side and economic optimisation.

Course Learning Outcomes

Course Learning Outcomes
CLO1 : Describe the technical characteristics of components in HRES, including loads, storage, and generation technologies.
CLO2 : Interpret a brief, present proposals for feedback and assessment in a large range of written, oral and visual formats individually and as part of a team.
CLO3 : Identify and assess electricity supply options to meet demand to an appropriate reliability standard according to the local context.
CLO4 : Design, size and specify hybrid renewable energy systems using first principles and advanced simulations tools.
CLO5 : Optimise a hybrid renewable energy system and its control strategy using appropriate dispatchability principles and techno-economic analysis.

Course Learning Outcomes	Assessment Item
CLO1 : Describe the technical characteristics of components in HRES, including loads, storage, and generation technologies.	• Case Study Report • Major project (team component) • Online quizzes
CLO2 : Interpret a brief, present proposals for feedback and assessment in a large range of written, oral and visual formats individually and as part of a team.	• Laboratory Report • Case Study Report • Major project (team component)
CLO3 : Identify and assess electricity supply options to meet demand to an appropriate reliability standard according to the local context.	• Laboratory Report • Online quizzes • Case Study Report • Major project (team component)
CLO4 : Design, size and specify hybrid renewable energy systems using first principles and advanced simulations tools.	• Laboratory Report • Case Study Report • Major project (team component)
CLO5 : Optimise a hybrid renewable energy system and its control strategy using appropriate dispatchability principles and techno-economic analysis.	• Major project (team component)

Learning and Teaching Technologies

Moodle - Learning Management System | Microsoft Teams

Assessments

Assessment Structure

Assessment Item	Weight	Relevant Dates
Laboratory Report Assessment Format: Individual	15%	Start Date: 09/10/2024 12:00 AM Due Date: 21/10/2024 11:59 PM
Case Study Report Assessment Format: Individual	50%	Start Date: Not Applicable Due Date: 04/11/2024 12:00 AM
Major project (team component) Assessment Format: Group	20%	Start Date: Not Applicable Due Date: 18/11/2024 12:00 AM
Online quizzes Assessment Format: Individual	15%	Start Date: Not Applicable Due Date: Not Applicable

Assessment Details

Laboratory Report

Assessment Overview

This (online) laboratory will be based on the minigrid in the TETB. You will have to study the system configuration, examine the design, and produce a complete Single Line Diagram (SLD) of the system. You will also be provided with data from the system that must be analysed and presented in graphical form. You will submit a 4-page report including drawings. The work will be marked against assessment criteria and feedback will be provided within 10 days of the submission date through the learning management system.

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

Course Learning Outcomes

- CLO2 : Interpret a brief, present proposals for feedback and assessment in a large range of written, oral and visual formats individually and as part of a team.
- CLO3 : Identify and assess electricity supply options to meet demand to an appropriate reliability standard according to the local context.
- CLO4 : Design, size and specify hybrid renewable energy systems using first principles and advanced simulations tools.

Detailed Assessment Description

This laboratory is in person, not online. See project brief on Moodle.

Assessment Length

See project brief on Moodle

Submission notes

See project brief on Moodle

Assessment information

See project brief on Moodle

Assignment submission Turnitin type

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

Generative AI Permission Level

No Assistance

This assessment is designed for you to complete without the use of any generative AI. You are not permitted to use any generative AI tools, software or service to search for or generate information or answers.
For more information on Generative AI and permitted use please see here.

Case Study Report

Assessment Overview

For this assignment you will work on a case study of a hybrid RE system. With the data available, you will assess the energy services required for the local community and identify potential solutions, which will allow you to carry out a high-level system design using HOMER Pro®. The deliverable will include the load assessment and the load curves used to design the hybrid RE system and you will present the economic assessment of your energy system design using HOMER Pro®. You will submit a 6-page report plus attachments. Work will be marked against assessment criteria. Feedback will be provided within 10 days of the submission date through the learning management system.

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

As part of this assessment, students will also complete a mini-HOMER exercise in class. The mark obtained in the mini-HOMER exercise will be used to adjust the final mark for this assessment.

Course Learning Outcomes

- CLO1 : Describe the technical characteristics of components in HRES, including loads, storage, and generation technologies.
- CLO2 : Interpret a brief, present proposals for feedback and assessment in a large range of written, oral and visual formats individually and as part of a team.

- CLO3 : Identify and assess electricity supply options to meet demand to an appropriate reliability standard according to the local context.
- CLO4 : Design, size and specify hybrid renewable energy systems using first principles and advanced simulations tools.

Detailed Assessment Description

See project brief on Moodle

Assessment Length

See project brief on Moodle

Submission notes

See project brief on Moodle

Assessment information

See project brief on Moodle

Assignment submission Turnitin type

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

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Major project (team component)

Assessment Overview

The major project is designed to give you a chance to apply your knowledge to real-world problems relating to the design of a sustainable hybrid minigrid. Details of assessment criteria and expectations for the project will be provided separately in the project brief. Students will work in teams of around 4 on the project. The outcome of this project is a detailed system design of. hybrid RE system using Australian Standard as a reference. Team evaluation will be used to allocate individual marks based on contribution to the final report. Work will be marked against marking criteria and feedback will be provided within 10 days of the submission date through the learning management system.

Course Learning Outcomes

- CLO1 : Describe the technical characteristics of components in HRES, including loads, storage, and generation technologies.
- CLO2 : Interpret a brief, present proposals for feedback and assessment in a large range of written, oral and visual formats individually and as part of a team.
- CLO3 : Identify and assess electricity supply options to meet demand to an appropriate reliability standard according to the local context.
- CLO4 : Design, size and specify hybrid renewable energy systems using first principles and advanced simulations tools.
- CLO5 : Optimise a hybrid renewable energy system and its control strategy using appropriate dispatchability principles and techno-economic analysis.

Detailed Assessment Description

See project brief on Moodle

Assessment Length

See project brief on Moodle

Submission notes

See project brief on Moodle

Assessment information

See project brief on Moodle

Assignment submission Turnitin type

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Online quizzes

Assessment Overview

You will have to complete seven online quizzes, from weeks 2 to 5 and weeks 7 to 9. The quizzes will test your learning from the content in the online lessons. The quizzes are strictly individual and can be done online at any time after you have completed the online lessons. The

online quiz of a respective week will be open in Moodle until Friday 12 pm after this time the quiz cannot be attempted. Work will be marked against assessment criteria. Feedback for quizzes will be provided after the respective submission date through the learning management system.

Course Learning Outcomes

- CLO1 : Describe the technical characteristics of components in HRES, including loads, storage, and generation technologies.
- CLO3 : Identify and assess electricity supply options to meet demand to an appropriate reliability standard according to the local context.

Detailed Assessment Description

See Moodle for more details

Assessment Length

Quizzes are available for 1 hour

Submission notes

See Moodle for more details

Assessment information

See Moodle for more details

Assignment submission Turnitin type

Not Applicable

Generative AI Permission Level

No Assistance

This assessment is designed for you to complete without the use of any generative AI. You are not permitted to use any generative AI tools, software or service to search for or generate information or answers.
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General Assessment Information

Grading Basis

Standard

Course Schedule

Teaching Week/Module	Activity Type	Content
Week 1 : 9 September - 15 September	Lecture	Welcome and introduction Course overview Introduction to minigrids
	Workshop	Course assessments Introduction to HOMER HOMER case study – Tagai State College #1 • Create a project • Adding a load
Week 2 : 16 September - 22 September	Lecture	Introduction to minigrids • generation and storage Minigrid design steps • Defining the problem • RE resource assessment • Load assessment
	Workshop	HOMER case study – Tagai State College #2 • Adding an RE resource • Adding diesel generators • Adding PV system • Adding a battery • Assumptions/parameters • Run simulation • Analyse results
	Other	Consultation hour for project work
Week 3 : 23 September - 29 September	Lecture	Minigrid design steps • Diesel generators and sizing • PV system sizing • Battery sizing
	Workshop	HOMER case study – Tagai State College #3 • Diesel sizing • PV system sizing • Battery sizing
	Other	Consultation hour for project work
Week 4 : 30 September - 6 October	Lecture	HOMER: • Optimisation and search space • Parameter adjustment and sensitivity analysis
	Workshop	HOMER case study – Tagai State College #4 • Optimisation and search space • Parameter adjustment and results/sensitivity analysis
	Other	Consultation hour for project work
Week 5 : 7 October - 13 October	Lecture	Batteries Advanced grid and Matlab module in HOMER Note: Monday 7 October 2024 is a public holiday and there will be no in-person lecture. A recording of the week-5 lecture will be provided to students.
	Workshop	HOMER case study – Tagai State College #5 • Advanced grid module • Matlab module • Parameter adjustment and results/sensitivity analysis
	Other	Consultation hour for project work
Week 6 : 14 October - 20 October	Other	Flexibility week - no lecture, workshop, or consultation hour.
Week 7 : 21 October - 27 October	Laboratory	HRES laboratory
	Workshop	HOMER case study – Tagai State College #5 (continued) • Advanced grid module • Matlab module • Parameter adjustment and results/sensitivity analysis
	Other	Consultation hour for project work
Week 8 : 28 October - 3 November	Lecture	HRES architecture, control, and protection
	Workshop	HRES architecture, control, and protection
	Other	Consultation hour for project work
Week 9 : 4 November - 10 November	Lecture	Project management Standards Accreditation
	Workshop	Project management Standards

		Accreditation
	Other	Consultation hour for project work
Week 10 : 11 November - 17 November	Lecture	Policy Business models Value stacking
	Workshop	Assessment #2 - In class HOMER exercise
	Other	Consultation hour for project work

Attendance Requirements

Students are strongly encouraged to attend all classes and review lecture recordings.

General Schedule Information

Lecture:

- Mon 15:00 - 17:00 (Weeks:1-4,6-10)
- UNSW Business School 119 (K-E12-119)

Consultation:

- Tue 16:00 - 17:00 (Weeks: 2-10)
- Old Main Building 150 (K-K15-150)
- Opportunity to ask questions, discuss project work, etc. with the lecturer and work on your group project.

Workshop:

- Wed 12:00 - 14:00 (Weeks:1-10)
- Tyree Energy Technology G16 (K-H6-G16)

Course Resources

Prescribed Resources

HOMER Energy - Hybrid Renewable and Distributed Generation Power System Design and Optimization http://www.homerenergy.com/

HOMER can be accessed through UNSW MyAccess: https://www.myaccess.unsw.edu.au/

Recommended Resources

Reference Books

- Stand Alone Power Systems, Design and Installation – GSES
- Solar/Diesel Minigrid Handbook – PowerWater Corportation

Online resources

- UNSW Library website - https://www.library.unsw.edu.au/
- Australian Bureau of Meteorology - http://www.bom.gov.au/climate/
- NASA (weather data) - https://power.larc.nasa.gov/
- NREL National Solar Radiation Database (weather data) - https://nsrdb.nrel.gov/
- Renewables Ninja - https://www.renewables.ninja/
- APVI Solar Maps - http://pv-map.apvi.org.au/
- Nearmap tool (via UNSW Network) - http://au.nearmap.com/
- Clean Energy Council - http://www.cleanenergycouncil.org.au/
- PVeducation - http://www.pveducation.org/pvcdrom

Design Tools

- PVSYST - Software for photovoltaic Systems
- SAM - System Advisory Model
- RETScreen - Clean Energy Management Software system for energy efficiency

Standards (via UNSW Library)

- Building Code of Australia
- AS/NZS 1170.2:2011 - Structural design actions - Wind actions
- AS/NZS 1768:2007 - Lightning Protection
- AS/NZS 3000:2007 - Electrical Wiring Rules
- AS/NZS 3008.1.1:2017 - Electrical installations - Selection of cables
- AS/NZS 4777.1:2016 - Grid connection of energy systems via inverters - Installation requirements
- AS/NZS 4777.2:2015 - Grid Connections of Energy Systems via Inverters - Inverter requirements
- AS/NZS 5033:2014 - Installation and safety requirements for photovoltaic (PV) arrays

Course Evaluation and Development

Official feedback on the course is gathered using the UNSW myExperience process. Although feedback is welcome at any stage. Your feedback is taken seriously, and continual improvements are made to the course based, in part, on such feedback.

Staff Details

Position	Name	Email	Location	Phone	Availability	Equitable Learning Services Contact	Primary Contact
Convenor	Simon Heslop		TETB313			No	Yes
Demonstrator	Jinyi Guo					No	No

Other Useful Information

Academic Information

I. Special consideration and supplementary assessment

If you have experienced an illness or misadventure beyond your control that will interfere with your assessment performance, you are eligible to apply for Special Consideration prior to, or within 3 working days of, submitting an assessment or sitting an exam.

Please note that UNSW has a Fit to Sit rule, which means that if you sit an exam, you are declaring yourself fit enough to do so and cannot later apply for Special Consideration.

For details of applying for Special Consideration and conditions for the award of supplementary assessment, please see the information on UNSW's Special Consideration page.

II. Administrative matters and links

All students are expected to read and be familiar with UNSW guidelines and polices. In particular, students should be familiar with the following:

- Attendance
- UNSW Email Address
- Special Consideration
- Exams
- Approved Calculators
- Academic Honesty and Plagiarism
- Equitable Learning Services

III. Equity and diversity

Those students who have a disability that requires some adjustment in their teaching or learning environment are encouraged to discuss their study needs with the course convener prior to, or at the commencement of, their course, or with the Equity Officer (Disability) in the Equitable Learning Services. Issues to be discussed may include access to materials, signers or note-takers, the provision of services and additional exam and assessment arrangements. Early notification is essential to enable any necessary adjustments to be made.

IV. Professional Outcomes and Program Design

Students are able to review the relevant professional outcomes and program designs for their streams by going to the following link: https://www.unsw.edu.au/engineering/student-life/student-resources/program-design.

Note: This course outline sets out the description of classes at the date the Course Outline is published. The nature of classes may change during the Term after the Course Outline is published. Moodle or your primary learning management system (LMS) should be consulted for the up-to-date class descriptions. If there is any inconsistency in the description of activities between the University timetable and the Course Outline/Moodle/LMS, the description in the Course Outline/Moodle/LMS applies.

Academic Honesty and Plagarism

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. *Plagiarism at UNSW is defined as using the words or ideas of others and passing them off as your own.*

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 research, drafting and the proper referencing of sources in preparing all assessment tasks.

Repeated plagiarism (even in first year), plagiarism after first year, or serious instances, may also be investigated under the Student Misconduct Procedures. The penalties under the procedures can include a reduction in marks, failing a course or for the most serious matters (like plagiarism in an honours thesis or contract cheating) even suspension from the university. The Student Misconduct Procedures are available here:

www.gs.unsw.edu.au/policy/documents/studentmisconductprocedures.pdf

Submission of Assessment Tasks

Work submitted late without an approved extension by the course coordinator or delegated authority is subject to a late penalty of five percent (5%) of the maximum mark possible for that assessment item, per calendar day.

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. This is for all assessments where a penalty applies.

Work submitted after five days (120 hours) will not be 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 will be clearly indicated in the course outline, and such assessments will receive a mark of zero if not completed by the specified date. Examples include:

- Weekly online tests or laboratory work worth a small proportion of the subject mark;
- Exams, peer feedback and team evaluation surveys;
- Online quizzes where answers are released to students on completion;
- Professional assessment tasks, where the intention is to create an authentic assessment that has an absolute submission date; and,
- Pass/Fail assessment tasks.

Faculty-specific Information

Engineering Student Support Services – The Nucleus - enrolment, progression checks, clash requests, course issues or program-related queries

Engineering Industrial Training – Industrial training questions

UNSW Study Abroad – study abroad student enquiries (for inbound students)

UNSW Exchange – student exchange enquiries (for inbound students)

UNSW Future Students – potential student enquiries e.g. admissions, fees, programs, credit transfer

Phone

(+61 2) 9385 8500 – Nucleus Student Hub

(+61 2) 9385 7661 – Engineering Industrial Training

(+61 2) 9385 3179 – UNSW Study Abroad and UNSW Exchange (for inbound students)

School-specific Information

SPREE Student Information Hub

Students are welcome to visit the SPREE Student Information Hub for information such as sample study plans, course outlines, thesis project, industrial training etc.

School Contact Information

For course-related matters, please contact course convenor directly via emails. Please email spreeteaching@unsw.edu.au for any other matters.