SOLA5053

Wind Energy Converters

Term 1, 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	9065 5520

Demonstrators

Name	Email	Availability	Location	Phone
Dimitri Lazos	dimitris.lazos@unsw.edu.au	Please contact via MS Teams or email		
Shukla Poddar	s.poddar@unsw.edu.au	Please contact via MS Teams or email		
Rob Underwood	rob.underwood@unsw.edu.au	Please contact via MS Teams or email		

School Contact Information

School of Photovoltaic and Renewable Energy Engineering

Email: spreeteaching@unsw.edu.au

Course Details

Units of Credit 6

Summary of the Course

This course will cover the principles of wind energy and wind power, as well as the design and operation of different types of wind energy converters. It will include machines for water pumping, remote area power supply and grid electricity generation. It will cover issues of site selection, monitoring and analysing wind data, estimating output from wind generators, integrating wind generators into hybrid power systems or the grid, economics, standards and environmental impact.

Course Aims

To provide students with fundamental knowledge and relevant skills for engineers designing and developing wind energy systems. It will largely focus on gridconnected wind farms. Topics will include the physics of the wind resource, wind turbine technologies, wind farm development issues, the integration of wind farms into power systems, and wider economic and social issues.

Course Learning Outcomes

After successfully completing this course, you should be able to:

Learning Outcome	EA Stage 1 Competencies
1. Explain the key underlying science of wind energy, and engineering aspects of wind turbines and wind farms, and their integration into power systems	PE1.1, PE1.2, PE1.3, PE2.1
2. Be able to demonstrate some key techniques and skills required for designing and siting wind energy systems as well as perform a full wind farm assessment	PE1.3, PE1.5, PE2.1, PE2.2, PE2.3, PE2.4, PE3.3
3. Have a good appreciation of some of the wider economic, social and environmental aspects of wind energy systems	PE1.6, PE3.2, PE3.6

Teaching Strategies

- Lectures – to provide fundamental knowledge relevant to wind energy systems
- Workshops – to develop relevant problem solving techniques
- Assignments – to give practice in problem solving, and to assess your progress
- Group Assignment – to encourage broader interdisciplinary thinking and design in a group context
- Exam – final assessment of understanding

Undergraduate and postgraduate students will attend the same lectures and workshop sessions. Students are also strongly encouraged to use the discussion group on Moodle to assist their learning. Demonstrators will monitor the discussions and help answer posted questions.

Additional Course Information

Credit points

This is a 6 unit-of-credit (UoC) course and involves between 4 - 6 hours per week (h/w) of face-to-face contact.

The normal workload expectations of a student are approximately 25 hours per term for each UOC, including class contact hours, other learning activities, preparation and time spent on all assessable work.

You should aim to spend about 6 h/w on this course. The additional time should be spent in making sure that you understand the lecture material, completing the set assignments, further reading, and revising for any examinations.

Contact hours

This course comprises three-four hours of formal contact per week. The timing and rooms are given below. Tuesday are lecture classes (with additional lectures in weeks 2,3,9 and 10), and the workshop sessions are assigned for revision of key aspects, questions, group work and assignments. All lectures will be given online via teams:

SOLA5053 MS Teams Link

Lectures/Workshop	week	Time	Location	Name Group
Lecture	1-5, 7-10	Tuesday 10-12	Online	
Lecture	2-3, 6, 9-10	Thursday 1-2	Online	
Workshop	1-10	Wednesday 10-12	Blockhouse G16	W10A
	4-5, 7	Friday 10-11	SEB B27	
	6	Friday 2-5	TETB G16/online	
Workshop	1-10	Tuesday 3-5	Online	T15A
	4-5, 7	Friday 11-12	Online	
	6	Friday 2-5	Online	
Workshop	1-10	Wednesday 2-4	Blockhouse G6	W14A
	4-5, 7	Friday 2-3	Quad G046	
	6	Friday 2-5	TETB G16/online	

Please refer to your class timetable for the learning activities you are enrolled in and attend only those classes.Additional revision sessions will be hosted during stuvac and closer to the exam.

Week 6 all groups will come together for a revision session and group work

Summary and Aims of the course

The purpose of this course is to provide students with fundamental knowledge and relevant skills for engineers designing and developing wind energy systems. It will largely focus on grid-connected wind farms. Students will be given an overview of wind energy technology, exploring the advances in wind turbine development over the years. An understanding of the wind resource and characteristics of weather phenomena relevant to wind turbine performance is investigated, along with outlining the aerodynamic principles and mechanics of the wind turbine. Turbine siting and integration issues are

covered as well as the wider social and economic issues associated with wind farms. All the topics covered give background information necessary for completion of the major design project – creating a full wind farm feasibility study.

Student learning outcomes

At the end of the course students should be able to:

1. Explain the key underlying science of wind energy, and engineering aspects of wind turbines and wind farms, and their integration into power systems.
2. Be able to demonstrate key techniques and skills required for designing and siting wind energy systems as well as perform a full wind farm assessment.
3. Have a good understanding of the wider economic, social and environmental aspects of wind energy systems.

Syllabus

The course will cover topics including:

- The nature of the wind and its use for the production of mechanical and electrical energy
- Components of wind turbines
- Wind turbine aerodynamics
- Mechanical design of components
- Different generator types
- Power system connection of wind turbines
- Operational control of wind turbines
- Wind turbine and wind farm planning and design considerations including community perceptions and environmental issues
- Wind energy economics

Assumed Knowledge

Students should have a good working knowledge of university level physics and mathematics. A basic knowledge of energy systems or renewable energy technologies is useful.

Graduate Attributes

This course will assist students in their development of the following UNSW graduate attributes (as listed at https://my.unsw.edu.au/student/atoz/GraduateAttributes.html):

1. Understanding their discipline in its interdisciplinary context;
2. Able to apply their knowledge and skills to solving problems;
3. Capable of effective communication;
4. Information literate.

Assessment

Assessment overview

The assessment of the course consists of one major group assignment, workshop participation and quiz, two workshop assignments and a final examination paper.

Assessment	Weight
Workshop Quiz week 3	5%
Workshop Assignment 1 handed out week 2 due week 5	15%
Workshop Assignment/Quiz week 7	5%
Group Assignment – breakdown given on assignment sheet	45% (this includes an individual and peer assessment component)
Final Exam	30%
Total	100%

Presentation

All submissions are expected to be neat and clearly set out. Your results are the pinnacle of all your hard work and should be treated with due respect. Presenting results clearly gives the marker the best chance of understanding your method; even if the numerical results are incorrect. All submissions must be typed- no handwritten assignments accepted. All submission must have a cover sheet, stating that the work is your own.

https://www.unsw.edu.au/engineering//sites/default/files/documents/groupcoversheet.pdf

https://www.unsw.edu.au/engineering//sites/default/files/documents/individualcoversheet.pdf

Marking

Marking guidelines for assignment submissions will be provided at the same time as assignment details to assist with meeting assessable requirements. Submissions will be marked according to the marking guidelines provided.

Examinations

You must be available for all quizzes, tests and examinations.

Final examinations for each course are held during the University examination periods: February for Summer Term, May for T1, August for T2, and November/December for T3.

Please visit myUNSW for Provisional Examination timetable publish dates.

For further information on exams, please see the Exams webpage.

Calculators

You will need to provide your own calculator of a make and model approved by UNSW for the examinations. The list of approved calculators is available at

student.unsw.edu.au/exam-approved-calculators-and-computers

It is your responsibility to ensure that your calculator is of an approved make and model, and to obtain an "Approved" sticker for it from the Engineering Student Supper Services Centre prior to the examination. Calculators not bearing an "Approved" sticker will not be allowed into the examination room.

Assessment task	Weight	Due Date	Course Learning Outcomes Assessed
1. In Class Quiz	5%	Not Applicable	1
2. Assignment 1	15%	17/03/2022 05:00 PM	1, 2
3. Group Project	45%	Every week a sub-task will be due	1, 2, 3
4. Assignment 2	5%	01/04/2022 10:00 AM	2
5. Final Exam	30%	Not Applicable	1, 2, 3

Assessment 1: In Class Quiz

Assessment length: 10 multiple choice questions
Submission notes: Quiz will be accessed via Moodle
Marks returned: As soon as quiz is submitted

A quiz to be taken during your workshop time. The quiz will consist of 10 multiple choice questions covering material from weeks 1-3.

Assessment criteria

Details will be available on Moodle - multiple choice answers.

Assessment 2: Assignment 1

Assessment length: 5 questions
Submission notes: Submit to Moodle - The assignment must be typed, no handwritten submissions accepted
Due date: 17/03/2022 05:00 PM
Deadline for absolute fail: 5 days after submission date
Marks returned: 2 weeks after last submission

An assignment covering weeks 1-3, with a strong focus on the fundamentals of wind data resource assessment.

Assignment 1 – handed out end of week 2 due week 5	*5 questions – 9 pages*	*Worth 15%*	*Will cover Lecture material from weeks 1-3*	*Due: 17th March by 5pm to Moodle*

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

Assessment criteria

Marking criteria will be shown on the assignment brief.

Assessment 3: Group Project

Assessment length: See details on project sheet for specific deliverables each week
Submission notes: Submit sub-tasks to your group portfolio on Moodle and email a copy to your demonstrator
Due date: Every week a sub-task will be due
Marks returned: 2 weeks after submission

The major group assignment is a wind farm feasibility study. This project is intended to encourage interdisciplinary thinking and engineering design in a group context. The key to success is establishing and maintaining good group dynamics, initiative, research and presentation of your work.

This assignment will give you the opportunity to make use of what you have learnt in the lectures, as well as develop research skills to be able to put together a wind farm feasibility study for the design of a commercial wind farm. Assessment will focus on whether you have identified the various considerations, and then how well you address them in your planning and design. More details given on assignment sheet with specific deliverables.

Assessment criteria

Students will be assigned into groups of 4-5 students. Detailed marking criteria will be contained in the Project brief. There will be 10 sub-tasks with one submitted per week to become your wind portfolio. A peer assessment component at the end of the major project will be used to moderate the final group mark.

Assessment 4: Assignment 2

Assessment length: 1 long question
Submission notes: Submit to Moodle
Due date: 01/04/2022 10:00 AM
Marks returned: 2 weeks after submission date

Workshop Assignment 2 - aerodynamics	*1 long question*	*5%*	*Lecture material from week 4 and 5*	*Opens 31st March 10am week 7, closes 1st April 10am*

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

Assessment criteria

Details given on assignment sheet

Assessment 5: Final Exam

Assessment length: TBC
Submission notes: Exam will be submitted to Moodle

The final exam will cover all course content over the 10 week period.

Hurdle requirement

A student must pass the final exam to pass the course.

Attendance Requirements

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

Course Schedule

View class timetable

Timetable

Date	Type	Content
Week 1: 14 February - 18 February	Lecture	**15th February - Introduction to wind turbine components and concepts**
	Workshop	**Group Assignment Briefing (Workshop Briefing Sheet handed out)**
Week 2: 21 February - 25 February	Lecture	**22nd February - The wind resource** **24th February (1 hour) - The wind resource continued**
	Workshop	**See Workshop Briefing Sheet handed out week 1 for workshop syllabus** **Assignment 1 uploaded to Moodle 26th February**
Week 3: 28 February - 4 March	Lecture	**1st March - Generators** **3rd March - Wind Resource continued/wake effects**
	Assessment	**Online quiz – you must bring a laptop to class as the quiz is done via moodle in your workshop time**
	Workshop	**See workshop syllabus for details**
Week 4: 7 March - 11 March	Lecture	**8th March - Finance/Economics of Wind**
	Workshop	**1 x 2 hour workshop – assignment/project help**

		1 x 1 hour workshop
Week 5: 14 March - 18 March	Lecture	**15th March - Aerodynamics**
	Workshop	**1 x 2 hour workshop- aerodynamics** **1 x 1 hour workshop**
	Assessment	**Assignment 1 due Thursday 17th March 5pm**
Week 6: 21 March - 25 March	Intensive	**No lectures - Intensive revision workshops Friday 25th March 2-5pm** ***Flexibility Week**
	Workshop	**As usual**
Week 7: 28 March - 1 April	Lecture	**29th March - Wind Energy Integration I**
	Workshop	**1 x 2 hour workshpp** **1 x 1 hour workshop -aerodynamics assessment revision**
	Assessment	**Short aerodynamics assignment worth 5% - open for 24 hours. Opens 31st March at 10am closes 1st April 10am**
Week 8: 4 April - 8 April	Lecture	**5th April - Wind Energy Integration II**
	Workshop	**Following syllabus**
Week 9: 11 April - 15 April	Lecture	**12th April - Social/Environmental Context** **14th April (1 hour) - Social/Enviro continued and resources**
	Workshop	**Following syllabus**
Week 10: 18 April - 22 April	Lecture	**19th April - Turbine Components/Materials and design - overview** **21st April (1 hour) Forecasting and revision**
	Workshop	**Following syllabus**
Study Week: 25 April - 28 April	Assessment	**Wind Report Executive Summary due Monday, 25th April by 12pm (midday)**

Resources

Prescribed Resources

1. Textbooks. A basic introduction to wind energy can be found in:
Godfrey Boyle, “Renewable Energy: Power for a Sustainable Future,” Second edition, Oxford University Press, 2004.

The recommended text for this course is “Wind Energy Explained: Theory, Design and Application” by J.F. Manwell, J.G. McGowan and A.L. Rogers. Copies are available for purchase from the University Bookshop, for loan from the UNSW library open reserve and physical sciences section.

Other suggested reading: “Renewable Electricity and the Grid, the challenge of variability” edited by Godfrey Boyle.

Other texts and relevant supplements for this course will be discussed within the relevant lectures

2. Lecture Notes. Lecture notes will be made available on the Moodle site shortly after they are covered.

3. Moodle Site. All handout materials, including lecture notes, workshops and assignments, will be distributed via the official site for this course.

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

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

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 include:

More workshops questions and revision session moved to mid-term.

Changing the format of the Major Project to deliverables every week as opposed to one large submission at the end of term.

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 5% mark reduction per day, consistent with other SPREE courses, and capped at 5 days (120 hours), after which a student cannot submit an assessment.

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. *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.

If plagiarism is found in your work when you are in first year, your lecturer will offer you assistance to improve your academic skills. They may ask you to look at some online resources, attend the Learning Centre, or sometimes resubmit your work with the problem fixed. However more serious instances in first year, such as stealing another student's work or paying someone to do your work, may be investigated under the Student Misconduct Procedures.

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) even suspension from the university. The Student Misconduct Procedures are available here:

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

Academic Information

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.

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

CRICOS

CRICOS Provider Code: 00098G

Acknowledgement of Country

We acknowledge the Bedegal people who are the traditional custodians of the lands on which UNSW Kensington campus is located.

Appendix: Engineers Australia (EA) Professional Engineer Competency Standard

Program Intended Learning Outcomes	
Knowledge and skill base	
PE1.1 Comprehensive, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline	✓
PE1.2 Conceptual understanding of the mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline	✓
PE1.3 In-depth understanding of specialist bodies of knowledge within the engineering discipline	✓
PE1.4 Discernment of knowledge development and research directions within the engineering discipline	
PE1.5 Knowledge of engineering design practice and contextual factors impacting the engineering discipline	✓
PE1.6 Understanding of the scope, principles, norms, accountabilities and bounds of sustainable engineering practice in the specific discipline	✓
Engineering application ability	
PE2.1 Application of established engineering methods to complex engineering problem solving	✓
PE2.2 Fluent application of engineering techniques, tools and resources	✓
PE2.3 Application of systematic engineering synthesis and design processes	✓
PE2.4 Application of systematic approaches to the conduct and management of engineering projects	✓
Professional and personal attributes	
PE3.1 Ethical conduct and professional accountability	
PE3.2 Effective oral and written communication in professional and lay domains	✓
PE3.3 Creative, innovative and pro-active demeanour	✓
PE3.4 Professional use and management of information	
PE3.5 Orderly management of self, and professional conduct	
PE3.6 Effective team membership and team leadership	✓