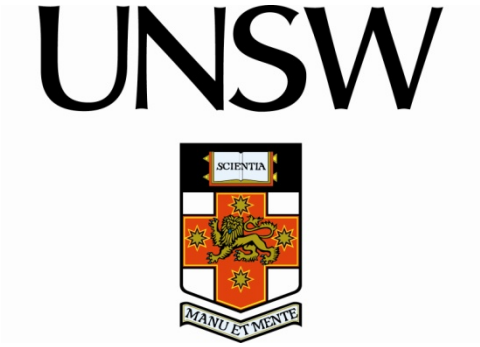

COURSE OUTLINE

School of Photovoltaic and Renewable Energy Engineering

SOLA 5053
Wind Energy Converters
Term 1, 2019

Course Co-ordinator:
Dr Merlinde Kay
Room: 215 TETB
email: m.kay@unsw.edu.au

Contents

1. Staff Contact Details

Course Co-Ordinator
Dr. Merlinde Kay
Room: 215 TETB
Phone: 9385-4031
Email: m.kay@unsw.edu.au

A/Prof Iain MacGill and Prof John Fletcher will also be involved in the course giving lectures on wind energy integration, Liam Reid (ex-Infigen) will give the lecture on Economics of wind farms.

2. Course Details

Moodle Website: https://moodle.telt.unsw.edu.au/login/index.php
Credit Points: 6 units

Summary 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.

Developed Competencies

The Engineers Australia policy on Accreditation of Professional Engineering programs requires that all programs ensure that their engineering graduates develop Stage 1 elements of competency (see: http://www.engineersaustralia.org.au/membership/assessment/assessment_home.cfm). Listed below are the activities in this course that will help students to achieve at least some of these elements of competency. Note: that not all elements of competency are relevant to each course.

Professional Engineering Stage 1 Elements of Competencies	Activities used to Develop Competency
Knowledge Base	
PE1.1 Knowledge of Science and Engineering Fundamentals	Lectures on theory underlying aerodynamic principles and energy conversion and generation.
PE1.2 In-depth technical competence in at least one engineering discipline	Lectures on wind farm design and turbine development.
PE1.3 Techniques and resources	Tutorial exercises which use actual weather data to determine wind characteristics. Assignment tasks which require understanding of the wind resource, turbine design specifications and techniques for siting wind farms.
Engineering Ability	
PE2.1 Ability to undertake problem identification, formulation, and solution	Assignment tasks requiring problem analysis. Understanding electrical aspects of energy conversion.
PE2.2 Understanding of social, cultural, global and environmental responsibilities and the need to employ principles of sustainable development	Lectures/discussions on future trends and environmental aspects and impacts of wind farm development.
PE2.3 Ability to utilise a systems approach to complex problems and to design and operational performance	Tutorial and major assignment tasks in which a methodical approach is needed in understanding the multidisciplinary area of wind farm assessment.
PE2.4 Proficiency in engineering design	Major assessment project designing the layout of a wind farm as part of a wind farm assessment
PE2.5 Ability to conduct and engineering project	Major group assessment – wind farm feasibility study. Working effectively as a team to choose a site, design the layout, investigate social, economic and environmental aspects. Choose turbines and address any integration issues.
PE2.6 Understanding of the business environment	Lectures on the economics of wind turbines and large scale wind farms, including economic analysis methods and market applications.
Professional Attributes	

PE3.1 Ability to communicate effectively, with the engineering team and with the community at large	Preparing written assignments. Major group work project requiring a team effort. Presentation of final report.
PE3.2 Ability to manage information and documentation	Tutorial and assignment tasks requiring effective representation of data. Manipulating and interpreting large data sets.
PE3.5 Ability to function effectively as an individual and in multidisciplinary and multicultural teams, as a team leader or manager as well as an effective team member	Team assignments which require group planning and effective communication between team members.

3. Rationale for the Inclusion of Content and Teaching Approach

The growth of the wind industry has seen a greater need for information on the theory and practical applications of wind energy technology. This course provides a broad overview of aspects associated with planning and understanding the operation of a large scale wind farm along with the fundamentals of aerodynamics and energy conversion. Each topic allows students to competently perform a wind farm feasibility study utilising a multidisciplinary approach and encouraging further learning. Case Studies provide students with expose to real situation.

4. Teaching Strategies

- Lectures – to provide fundamental knowledge relevant to wind energy systems
- Tutorials – 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 tutorial sessions. Students are also strongly encouraged to use the discussion group on Moodle to assist their learning. Tutors will monitor the discussions and help answer posted questions.

5. Assessment

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

Assessment	**Weight**
Tutorial Quiz week 3	1%
Tutorial Assignment 1 handed out week 3 due week 5	15%
Tutorial Assignment/Quiz week 7	5%
Group Assignment – breakdown given on assignment sheet	50% (this includes an individual component)
Final Exam	29%
Total	100%

The major group assignment is a wind farm feasibility study – more details will be given on the briefing sheet.
3% for site proposal (due week 2)
5% for literature review (due week 7)

10% for poster presentation (due week 11 – location and time TBA)
27% for final report – mark broken down as follows:
12% for group final mark, 15% individual contribution mark. Students will note which sections of the report they researched/wrote
5% continuous assessment of group participation (individual)

1. *All* material presented during the session on the *Moodle* site will be examinable unless otherwise noted.

2. Assignments are due as listed on the course syllabus.

3. All assignments must be submitted with a completed cover page. The sheet can be downloaded from the SPREE Undergraduate site on:
http://www.engineering.unsw.edu.au/energy-engineering/sites/photo/files/u12/forms/individualcoversheet.pdf
http://www.engineering.unsw.edu.au/energy-engineering/sites/photo/files/u12/forms/groupcoversheet.pdf

The major group assignment 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.

Parallel Teaching
Undergraduate and Postgraduate students will attend the same lectures and tutorials. Postgraduates will sit a separate end of session exam.

6. Lecture Times and Locations
This course comprises three-four hours of formal contact per week. The timing and rooms are given below. Monday are lecture classes (with additional lectures in weeks 2,3,9and 10), and the tutorial sessions are assigned for group work and assignments.

Day of the Week	Time	Lecture Room	
Monday	**2.00 – 4.00**	**TETB G16**	**Lecture (see syllabus for additional lecture days/times)**

Tutorial groupings broken up as below:

TUT	Mon 14-17 (w6, TETB G16); Wed 11 (w4-5,7, TETB G16); Thu 10-12 (w1-10, Sqhouse115) Comb/w SOLA5053-PGRD
TUT	Mon 14-17 (w6, TETB G16); Tue 13-15 (w1-10, Quad G046); Wed 11 (w4-5,7, TETB G16) Comb/w SOLA5053-PGRD
TUT	Mon 14-17 (w6, TETB G16); Tue 15-17 (w1-10, Webst 250); Wed 11 (w4-5,7, TETB G16) Comb/w SOLA5053-PGRD
TUT	Mon 14-17 (w6, TETB G16); Wed 11 (w4-5,7, TETB G16); Wed 13-15 (w1-10, SEB B27) Comb/w SOLA5053-PGRD

7. Resources for Students

Textbooks/Resources, Lecture Notes and Blackboard

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, tutorials and assignments, will be distributed via the official site for this course.

8. Course Evaluation and Development

At the end of the course, you will be asked to complete two evaluation forms – one for the course and one for the course coordinator using the UNSW's My Experience Process. Your feedback is much appreciated and taken very seriously. Continual improvements are made to the course based in part on such feedback and this helps us to improve the course for future students

9. Student Responsibilities and Class Policies

1. Late assignments will be penalized 50% plus 5% per day that the work is late. Late Assignments will be accepted; however, the later they are handed in the less chance of a pass mark.

2. **Attendance and Attention**. Responsibility for earning marks rests solely with the student. It is advised to attend lectures, to avail yourself of the subject resources, to complete your assignments on time and to the best of your ability, participate in the tutes, and to be fully aware of the course syllabus, including any announcements or changes to that syllabus. It is advisable to make use of the discussion board on Moodle.

3. Plagiarism. All assignments and tutorials are for individual effort and individual assessment only, with a few exceptions that will be clearly noted. You are expected to be aware of, and you will be subject to, the UNSW and School policies that cover plagiarism of written work (see the PV Undergraduate site). Students *will* be penalised for plagiarism in tutorial, assignment and exam work. See below.

What is Plagiarism?

Plagiarism is the presentation of the thoughts or work of another as one's own.* Examples include:

- direct duplication of the thoughts or work of another, including by copying material, ideas or concepts from a book, article, report or other written document (whether published or unpublished),

composition, artwork, design, drawing, circuitry, computer program or software, web site, Internet, other electronic resource, or another person's assignment without appropriate acknowledgement;

- paraphrasing another person's work with very minor changes keeping the meaning, form and/or
  progression of ideas of the original;

- piecing together sections of the work of others into a new whole;

- presenting an assessment item as independent work when it has been produced in whole or part in collusion with other people, for example, another student or a tutor; and

- claiming credit for a proportion a work contributed to a group assessment item that is greater than that actually contributed.†

For the purposes of this policy, submitting an assessment item that has already been submitted for academic credit elsewhere may be considered plagiarism.

Knowingly permitting your work to be copied by another student may also be considered to be plagiarism.

Note that an assessment item produced in oral, not written, form, or involving live presentation, may similarly contain plagiarised material.

The inclusion of the thoughts or work of another with attribution appropriate to the academic discipline does *not* amount to plagiarism.

The Learning Centre website is main repository for resources for staff and students on plagiarism and academic honesty. These resources can be located via:
www.lc.unsw.edu.au/plagiarism

The Learning Centre also provides substantial educational written materials, workshops, and tutorials to aid students, for example, in:
- correct referencing practices;
- paraphrasing, summarising, essay writing, and time management;
- appropriate use of, and attribution for, a range of materials including text, images, formulae and concepts.

Individual assistance is available on request from The Learning Centre.

Students 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 items.

* Based on that proposed to the University of Newcastle by the St James Ethics Centre. Used with kind permission from the University of Newcastle

† Adapted with kind permission from the University of Melbourne.

10. Other Information

Special Consideration for Illness or Misadventure

If you are unable to submit a piece of assessment on time, or to participate fully in laboratory sessions, due to illness or some other event which was beyond your control, you must follow the central UNSW procedures for seeking special consideration. Details of these can be found at https://my.unsw.edu.au/student/atoz/SpecialConsideration.html.
Please be aware that requests for special consideration need to be submitted to UNSW Student Central as soon as is practicable after the problem occurs and within three working days of the due date of the relevant assessment task.

Penalties for Late Submission of Work

Where a student submits a piece of assessment late, and a request for special consideration has not been approved, the student will be penalised by a deduction of marks.
Late written work will be penalized 50% for up to the first day late (% of the value of the assessment task), plus an additional 5% per additional day, up to a maximum of 100% of the total value of the assessment task. Once solutions are provided for the assessment task the maximum penalty will apply. Requests for special consideration should be submitted, as for all other subjects, through the Registrar. An extension of time may only be granted under exceptional circumstances beyond the student's control.

Disability Support

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 coordinator prior to, or at the commencement of, their course, with the Equity and Disability Officer in the school office (9385 7993) or with the Equity Officer (Disability) in the Equity and Disability Unit (EADU) 9385 4734. 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.
Further information for students with disabilities is available at:
http://www.studentequity.unsw.edu.au/disabil.html.

Note the course outline below is a rough guide of topics taught each week – this may be subject to change

Week	***DATE***	***Lecture Syllabus***	***Tutorial Syllabus***	***Assessment Syllabus***
1	**18th February**	**Introduction Wind Turbine Components and concepts**	**Group Assignment Briefing (tutorial briefing sheet handed out)**	
2	**25th February** **27th February**	**The Wind Resource** **Generators**	**See Tutorial briefing sheet handed out week 1 for tutorial syllabus**	**Tutorial Assignment 1 uploaded to Moodle 27th February**
3	**4th March** **6th March**	**Wind Resource continued/wake effects** **Generators**		**Online quiz – you must bring a laptop to class as the quiz is done via moodle**
4	**11th March**	**Economics**	**1 x 2 hour tutorial** **1 x 1 hour tutorial**	
5	**18th March**	**Aerodynamics/wake loss models**		**Tutorial Assignment 1 due Tuesday 19th March 10am**
6	**25th March** **27th March**	**No lectures – group design update and aerodynamics tutorials**	**1 x 3 hours** **1 x hours**	
7	**1st April**	**Wind Energy Integration I**	**1 x 2 hour tutorial** **1 x 1 hour tutorial**	Short aerodynamics in class open book quiz in 1 hour tutorial time worth 5%
8	**8th April**	**Wind Energy Integration II**		
9	**15th April** **17th April**	**Social/Environmental Context** **Social/Enviro continued and resources**		
10 **11 (public holiday Monday week 10)**	**24th April** **29th April**	**forecasting** **Turbine Components/Materials and design - overview**	**1 hour** **2 hour** **Poster session to be announced week 11.**	**Report due Friday week 10, 26th April by 5pm**