Photovoltaic and Renewable Energy Engineering

Course Outline

Term 2 2021

SOLA2051

Project in Photovoltaics and Renewable Energy

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1. Staff contact details

Contact details and consultation times for course convenor

Name: Ivan Perez Wurfl
Office location: TETB 128
Email: ivanpw@unsw.edu.au
Moodle: https://moodle.telt.unsw.edu.au/course/view.php?id=51699
Consultation times: Tuesdays 2-3 pm (other times possible by appointment).

Contact details and consultation times for additional lecturers/demonstrators/lab staff

Lab demonstrators will be available during laboratory sessions to assist students with experiments, design and construction work. The following individuals will be your lab demonstrators:

Ryan Hall (ryan.n.hall@unsw.edu.au)

Ryan Pun (r.pun@unsw.edu.au)

2. Important links

- Moodle
- UNSW Timetable
- UNSW Handbook
- Get involved!
- Student Resources
- UNSW Photovoltaic and Renewable Energy Engineering

3. Course details

Credit points

This is a 6 unit-of-credit (UoC) course and involves 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 an average of 15 h/w on this course. Keep in mind that some weeks may require less hours, and some may require a few more. The additional time should be spent in making sure that you understand the lecture material, completing the set assignments, further reading, working on lab activities, final project and final report.

Contact hours

Lecture (1 day/week), Laboratory (2 days/week)

Day of the Week	Time	Weeks	Lecture Room	Content
Monday	3pm-5pm	1-10	Online	Lecture
Wednesday	11am – 1pm or 1pm – 3pm	1-9	TETB LG10/Online	Laboratory
Thursday	11am – 1pm or 1pm – 3pm	1-9	TETB LG10/Online	Laboratory
Wednesday and Thursday	11am – 2pm	10	TETB LG10/Online	Laboratory

Please refer to your class timetable for the learning activities you are enrolled in and attend only those classes.

Summary and Aims of the course

SOLA2051 is a core courses in the Photovoltaics and Solar Energy and Renewable Energy Engineering (programs SOLAAH3707 and SOLABH3707). It is intended to introduce some basic engineering technical skills that you will then expand in DESN2000. You'll be assigned to a group in SOLA2051 that you should strive to turn into a team. The team that you put together will carry forward to DESN2000. Therefore, students should ensure that they have enrolled in both SOLA2051 Project in Photovoltaics and Renewable Energy 1 (T2), and DESN2000 Engineering Design and Professional Practice (T3) on the same year. Each of these courses has a unit of credit value of 6. The main emphasis of the second year group project course is hands-on project engineering. It is possible to complete all the required hands-on work of this course anywhere you may be with the material included in the SOLA2051 lab kit that you will get on loan plus the consumables you will buy from CREATE. Please note that a portable computer will be essential for all work (theoretical and practical) to be undertaken in this course.

SOLA2051 has a lecture component covering theoretical principles specific to the project work to be undertaken. The course also has two weekly 2-hour project sessions (that we will refer from here on as labs). The project of the course comprises a training component done mainly individually, and a research component, a planning and design component, a construction component, and a presentation/reporting component all done mainly in a group. Students will be assigned to specific groups of up to 4 members, with the intention of having a diversity of skills and backgrounds in each group.

Students will find that project work is inherently different to the usual class work, homework, assignments, tutorials and exams. You will encounter a whole new set of challenges that make project work interesting and exciting. Please realise that this set of new obstacles, challenges and tasks is precisely the aim of this course – how you overcome, solve and manage them is exactly what you are here to learn and forms part of what you are being assessed on. Forty per cent of your mark will depend purely on individual effort while the rest will depend on yours

and your group effort. Peer assessment will determine how the group marks are distributed. You should make sure to devote a good amount of energy making your group become an actual team. Leverage particular skills of each member but be sure to split the work evenly from the beginning. Investing time developing good team dynamics will pay off at the end of the term; work will be more manageable, your project result will be of higher quality and your second term will be that much more fun.

One of the best ways to learn is based on necessity. You will be given the basic tools to undertake the labs and project but you'll find you'll need to go beyond these basic concepts to achieve great results. Therefore, a significant amount of self-learning is to be expected. A key engineering skill is to be able to identify what knowledge is needed for a particular task and to then be able to learn and apply concepts based on this need. One of the main obstacles for learning new things is the fear of not being able to do this on your own. You'll find that working in a team multiplies your abilities by giving you a chance to explain to your peers things that you understand best but also by receiving help and instruction from the other members when appropriate.

Student learning outcomes

This course is designed to address the learning outcomes below and the corresponding Engineers Australia Stage 1 Competency Standards for Professional Engineers as shown. The full list of Stage 1 Competency Standards may be found in Appendix A.

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

Learning Outcome		**EA Stage 1 Competencies**
1	**Analyse** simple data acquisition systems based on debugging and designing simple electronic circuits.	PE1.1, PE1.2
2	**Calculate and explain** the functioning and engineering aspects of photovoltaic cells and modules, concentrators, boost converters and systems for thermal management.	PE1.1, PE1.2, PE1.3
3	**Demonstrate** awareness of occupational health and safety concerns while undertaking tasks on a technical project.	PE1.5, PE2.4, PE3.5
4	**Design** a PV system by building and evaluating the performance of a solar panel and boost circuit.	PE1.5, PE2.4, PE3.3, PE3.6
5	**Demonstrate effective** communication skills by preparing a documentary video and writing a project report.	PE3.2

4. Teaching strategies

Students will attend one 2-hr lecture each week where practical demonstrations will be presented for the students to establish the connections between theoretical and real-world working models. The lectures will also encourage students to develop self-learning strategies that will be applied in the laboratory. The demonstration lectures will introduce

basic skills and knowledge. The first four laboratory session will focus on guided or semi-guided laboratories to assist in the development of basic skills to tackle complex projects in the future. In the remaining laboratory sessions, the students will be given a groups project to be solved based on the skills and knowledge acquired thus far. The students will be responsible for further broadening their skills and knowledge by self-learning in order to successfully complete the laboratory projects. Group and individual work will be assessed based on online quizzes, laboratory reports and video presentations.

5. Course schedule

Wk	Lecture	Laboratory	Expected milestones in lab	Prelab	Lab	System Test	Final Report	Final Exam
1	Intro to LabView and Arduino	Get SOLA2051 lab kit. Set up computer software needed for the course.	Check SOLA2051 lab kit. Install LabVIEW, Linx and LTSpice. Learn basic LabVIEW programming.					
2	*I-V* curves and data fitting. Circuit modelling using LTSpice.	Guided lab1: Measure temperature using thermistor.	Individual lab report. Learn how to connect Arduino to computer using LabVIEW. Measure a voltage and calculate temperature.	✓	✓			
3	Solar cell properties, characterisation and analysis. Solar cell modelling using LTSpice,	Guided lab2: Measure IV of LED	Individual lab report. Arduino output and input to measure IV of LED. Fit data of IV.	✓	✓			
4	Boost circuits	Semi-guided lab 3: Measure IV of solar panel.	Individual lab report: Using an Arduino controlled IV tester to measure IV of solar panel. Fit solar panel IV.	✓	✓			
5	Solar panel and boost circuit integration	Guided lab4: boost circuit on breadboard.	Individual lab report. Build a small boost converter on a breadboard and understand its basic functionality.	✓	✓			
6								
7	System analysis, design and control.	Design and implementation of boost circuit with solar panel (Student design).	Group mini-project. Design and start construction of a USB charger using a solar panel and a boost converter.					
8	Thermal Modelling and management	Boost circuit with solar panel team (preliminary data logging and LabVIEW Virtual Instrument).	Test the system integration. Minimum goal is to be able to upload to the cloud data of real time measured performance of solar charger.					
9	Final project system integration (LTSpice modelling of system)	Test system 2nd iteration (Data logging test to cloud with virtual boost, improved LabVIEW Virtual Instrument).	Improve system integration. Test data logging and improve from previous week.					
10	Check list for final test	Final Test.	System ready for final test run.			✓	✓	
TBD	**FINAL EXAM (Video presentation)**							✓

6. Assessment

Assessment overview

Assessment	Group Project? (# Students per group)	Length	Weight	Learning outcomes assessed	Assessment criteria	Due date and submission requirements	Deadline for absolute fail	Marks returned
Design project (Demonstration and report).	Yes (3 to 4)*	2hr demonstration plus 7500 word report	45%	4 and 5	M*eeting design brief requirements: hardware, software and quality of data. Report will be marked according to marking criteria available in Moodle*	Practical: Wk 10 (Wed) Report: Wk 10 (Sunday)	1 *week after assessment is due.*	Two weeks after submission
Individual Prelabs (4)	No	V*aries*	20%	1 and 2	Lecture material from weeks 1-5	Week 2 -5 before the lab session	1 *week after assessment is due.*	Immediately upon completion
Individual Lab Reports (4)	No	V*aries*	20%	1, 2 and 3	Lecture material from weeks 1-5	Week 2 -5, *Sunday midnight after* the lab session	1 *week after assessment is due.*	The week after each assessment is due
Final exam	Yes (3 to 4)*	3 hours	15%	5	Video	Exam period, date TBC	N/A	Upon release of final results

* Note: 50% of the mark depends on formal Peer Assessment.

This course will include the following hurdle requirements that are closely linked to a set of learning outcomes which demonstrate that you have acquired the required skills and competencies within this discipline:

- Students must demonstrate understanding of circuit building and debugging, circuit simulation and analysis using LTSpice, basic LabVIEW programming, Arduino use as a data acquisition system, extraction of information from measured data and practical use of all aforementioned. A minimum mark of 50% must be obtained for the individual lab reports and final demo and report in order to pass this subject. Failure to achieve this minimum mark will result in an unsatisfactory fail (UF) grade, regardless of the performance in the rest of the course.

Assignments

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.

Submission

Work submitted late without an approved extension by the course coordinator or delegated authority is subject to a late penalty of 30% of the maximum possible mark for the assessment item on the due date, plus 10% per 24 hours after that.

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.

Marking

Marking guidelines for the final report will be provided at the same time as the final report 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.

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 submitting an assessment or sitting an exam.

Please note that UNSW now has a Fit to Sit / Submit rule, which means that if you sit an exam or submit a piece of assessment, 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.

7. Expected resources for students

While there is no compulsory textbook for this course some useful reference materials includes:

- SOLA2051 Moodle on-line handbook.
- Report Writing, The Learning Centre UNSW: https://student.unsw.edu.au/report-writing-support
- Collins Cobuild English Language Dictionary. Collins Birmingham University (1991) (this is an excellent dictionary for non-native speakers of English, and includes grammar notes, thesaurus notes and real examples of the word in use).
- R. Felder's Handouts for Engineering Students (http://www4.ncsu.edu/unity/lockers/users/f/felder/public/Student_handouts.html
- Harvard Referencing for electronic sources: (http://www.lc.unsw.edu.au/onlib/ref.html)
- UNSW Library Skills: (http://www.library.unsw.edu.au/links/Research_and_Study_Skills)
- ESL Cafè (http://www.eslcafe.com)
- Writing Exercises for Engineers and Science students. (http://www.writing.engr.psu.edu/exercises/)
- *Engineering Design: A Project-Based Introduction, Second Edition* by Clive L. Dym and Patrick Little.
- Reiss, G. (1995). Project Management Demystified (2nd ed.). London and New York: Spon Press.
  Lock, D. (1996). The Essentials of Project Management. Aldershot: Gower.
  Wysocki, R. K., Beck, R. J., & Crane, D. B. (1995). Effective Project Management. New York: Wiley.
- Smith, N. J. (Ed.). (2002). Engineering Project Management (2nd ed.). Oxford: Blackwell.
- Solar Engineering of Thermal Processes by John A. Duffie

UNSW Library website: https://www.library.unsw.edu.au/
Moodle: https://moodle.telt.unsw.edu.au/login/index.php

8. 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.

9. 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

10. 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

Appendix A: Engineers Australia (EA) Competencies

Stage 1 Competencies for Professional Engineers

	Program Intended Learning Outcomes
PE1: Knowledge and Skill Base	PE1.1 Comprehensive, theory-based understanding of underpinning fundamentals
	PE1.2 Conceptual understanding of underpinning maths, analysis, statistics, computing
	PE1.3 In-depth understanding of specialist bodies of knowledge
	PE1.4 Discernment of knowledge development and research directions
	PE1.5 Knowledge of engineering design practice
	PE1.6 Understanding of scope, principles, norms, accountabilities of sustainable engineering practice
PE2: Engineering Application Ability	PE2.1 Application of established engineering methods to complex 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
PE3: Professional and Personal Attributes	PE3.1 Ethical conduct and professional accountability
	PE3.2 Effective oral and written communication (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