UNSW Course Outline

SOLA9120 Advanced Photovoltaic Manufacturing - 2024

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General Course Information

Course Code : SOLA9120
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

Silicon photovoltaic solar cells have reached the modern age of high-volume manufacturing. Solar cell manufacturing capacity has expanded more than 100-fold in the past 15 years, and has reached 300+ gigawatts of annual production. Photovoltaics engineers, scientists and managers

must have a good working understanding of how solar cells are manufactured, improved and sustained in real solar cell factories, in order to succeed in their fields.

Students enrolled in this class will learn about the manufacture of silicon solar cells, specifically about engineering in the manufacturing environment. The course covers several engineering tools/methods used by engineers to improve solar cell performance and reduce solar cell cost in manufacturing, namely statistical decision making, cost modelling and regression modelling. Students will use data generated by a virtual cell factory. The exercises will generate the conditions needed to turn a company from losing money to making money.

Course Aims

Students who successfully complete this course will have a practical understanding of the PV manufacturing engineering skills/tools that engineers use to make improvements in cost and performance in a real solar cell factory environment.

Course Learning Outcomes

Course Learning Outcomes
CLO1 : Apply PV manufacturing process-cost modelling to construct a process-cost model from cost inputs of throughput, yield, materials and labour.
CLO2 : Explain PV-related product cost accounting methods and be able to construct cost behaviours models, transactions/conversions, T-accounts, COGM/COGS computations, and financial summary statements.
CLO3 : Apply single and multiple-factor polynomial regression models to make decisions about PV engineering improvements/changes and to optimize PV production process.
CLO4 : Apply 1-3 above in order to make statistical-plus-cost based decisions about PV engineering improvements and changes.
CLO5 : Demonstrate data sampling and analysis skills.
CLO6 : Present (written and oral presentation) data, analysis, and discussion in a concise, compelling argument that supports engineering decisions in a PV manufacturing environment.

Course Learning Outcomes	Assessment Item
CLO1 : Apply PV manufacturing process-cost modelling to construct a process-cost model from cost inputs of throughput, yield, materials and labour.	• Assignment • Workshop exercises • Final exam
CLO2 : Explain PV-related product cost accounting methods and be able to construct cost behaviours models, transactions/conversions, T-accounts, COGM/COGS computations, and financial summary statements.	• Assignment • Workshop exercises • Final exam
CLO3 : Apply single and multiple-factor polynomial regression models to make decisions about PV engineering improvements/changes and to optimize PV production process.	• Assignment • Workshop exercises • Final exam
CLO4 : Apply 1-3 above in order to make statistical-plus-cost based decisions about PV engineering improvements and changes.	• Assignment • Workshop exercises • Final exam
CLO5 : Demonstrate data sampling and analysis skills.	• Assignment • Workshop exercises • Final exam
CLO6 : Present (written and oral presentation) data, analysis, and discussion in a concise, compelling argument that supports engineering decisions in a PV manufacturing environment.	• Assignment • Workshop exercises • Final exam

Learning and Teaching Technologies

Moodle - Learning Management System

Assessments

Assessment Structure

Assessment Item	Weight	Relevant Dates
Assignment Assessment Format: Individual	50%	Start Date: Not Applicable Due Date: Not Applicable
Workshop exercises Assessment Format: Individual	10%	Start Date: Not Applicable Due Date: Not Applicable
Final exam Assessment Format: Individual	40%	Start Date: Not Applicable Due Date: Not Applicable

Assessment Details

Assignment

Assessment Overview

The assignment has three parts. They will based on the material presented in different lectures/ workshops across the term. Expected length of the report is 5 - 10 pages. Work will be marked against assessment criteria. Feedback will be provided within 10 days of the relevant submission date through the learning management system.

Course Learning Outcomes

- CLO1 : Apply PV manufacturing process-cost modelling to construct a process-cost model from cost inputs of throughput, yield, materials and labour.
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- CLO3 : Apply single and multiple-factor polynomial regression models to make decisions about PV engineering improvements/changes and to optimize PV production process.
- CLO4 : Apply 1-3 above in order to make statistical-plus-cost based decisions about PV engineering improvements and changes.
- CLO5 : Demonstrate data sampling and analysis skills.
- CLO6 : Present (written and oral presentation) data, analysis, and discussion in a concise, compelling argument that supports engineering decisions in a PV manufacturing environment.

Assignment submission Turnitin type

Not Applicable

Generative AI Permission Level

Assistance with Attribution

This assessment requires you to write/create a first iteration of your submission yourself. You are then permitted to use generative AI tools, software or services to improve your submission in the ways set out below.
Any output of generative AI tools, software or services that is used within your assessment must be attributed with full referencing.
If outputs of generative AI tools, software or services form part of your submission and are not appropriately attributed, your Convenor will determine whether the omission is significant. If so, you may be asked to explain your submission. If you are unable to satisfactorily demonstrate your understanding of your submission you may be referred to UNSW Conduct & Integrity Office for investigation for academic misconduct and possible penalties.
For more information on Generative AI and permitted use please see here.

Workshop exercises

Assessment Overview

Students submit solutions to 6 workshop problems over the term. Each exercise expected to take between 2 – 4 hours (higher effort for the exercises later in the term). Work will be marked against assessment criteria. Feedback will be provided within 10 days of the respective submission date through the learning management system.

Course Learning Outcomes

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- CLO4 : Apply 1-3 above in order to make statistical-plus-cost based decisions about PV engineering improvements and changes.
- CLO5 : Demonstrate data sampling and analysis skills.
- CLO6 : Present (written and oral presentation) data, analysis, and discussion in a concise, compelling argument that supports engineering decisions in a PV manufacturing environment.

Assignment submission Turnitin type

Not Applicable

Generative AI Permission Level

Planning/Design Assistance

You are permitted to use generative AI tools, software or services to generate initial ideas, structures, or outlines. However, you must develop or edit those ideas to such a significant extent that what is submitted is your own work, i.e., what is generated by the tool, software or service should not be a part of your final submission. You should keep copies of your iterations to show your Course Authority if there is any uncertainty about the originality of your work.
If your Convenor has concerns that your answer contains passages of AI-generated text or media that have not been sufficiently modified you may be asked to explain your work, but we recognise that you are permitted to use AI generated text and media as a starting point and some traces may remain. If you are unable to satisfactorily demonstrate your understanding of your submission you may be referred to UNSW Conduct & Integrity Office for investigation for academic misconduct and possible penalties.
For more information on Generative AI and permitted use please see here.

Final exam

Assessment Overview

Final exam during the exam period.

Course Learning Outcomes

- CLO1 : Apply PV manufacturing process-cost modelling to construct a process-cost model from cost inputs of throughput, yield, materials and labour.
- CLO2 : Explain PV-related product cost accounting methods and be able to construct cost behaviours models, transactions/conversions, T-accounts, COGM/COGS computations, and financial summary statements.
- CLO3 : Apply single and multiple-factor polynomial regression models to make decisions about PV engineering improvements/changes and to optimize PV production process.
- CLO4 : Apply 1-3 above in order to make statistical-plus-cost based decisions about PV engineering improvements and changes.
- CLO5 : Demonstrate data sampling and analysis skills.
- CLO6 : Present (written and oral presentation) data, analysis, and discussion in a concise, compelling argument that supports engineering decisions in a PV manufacturing environment.

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.

For more information on Generative AI and permitted use please see here.

General Assessment Information

Grading Basis

Standard

Course Schedule

Attendance Requirements

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

Course Resources

Prescribed Resources

Texts and Reference Materials. The main text for this course is:

Introduction to Photovoltaics Manufacturing Science and Technology by Jeffrey Cotter (2015)

A pdf download will be available during the course.

Hardware and Software Applications. The workshops of this course use the following hardware/ software:

- Windows PC (laptop suggested) or Apple Mac with a Windows shell
- “Virtual Manufacturing Execution System (VMES)” software: Download link will be posted on Moodle.
- Microsoft Excel or equivalent
- Minitab: Download link and instructions will be posted on Moodle.

Lecture Notes will be made available on Moodle as they are presented in the class.

Recommended Resources

In addition, the following reference materials may be helpful:

- PV-Manufacturing.org: A free online resource about photovoltaic manufacturing
- PVEducation.org: A free online resource about solar cell basics.
- Applied Photovoltaics by Stuart R Wenham, Martin A Green, Muriel E Watt and Richard Corkish
- Engineering Statistics Books: There are a number of good engineering statistics books, some suggestions:

- Design and Analysis of Experiments by Douglas C Montgomery
- Engineering Statistics by Douglas C Montgomery, George C Runger and Norma F Hubele

- Cost Accounting Books: Accounting is a wide field, if you're looking for a book, check for a chapter on Process Costing or Product Costing, in addition to basic info on cost behaviours, T-accounting and financial statements. For example:
  - Cost Accounting by Cecily A Raiborn, Michael R Kinney and Jenic Prather-Kinsey

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.

Staff Details

Position	Name	Email	Location	Phone	Availability	Equitable Learning Services Contact	Primary Contact
Demonstrator	S.M. Raiyan Chowdhury					No	No
Convenor	Ashraf Uddin					No	Yes

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.