UNSW AUSTRALIA

Never Stand Still | Engineering | Mechanical and Manufacturing Engineering

GSOE9340

LIFE CYCLE ENGINEERING

Contents

1. Staff Contact Details

Contact details and consultation times for course convenor

Professor Sami Kara (Lecturer In-charge)
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Consultation concerning this course is available on Monday–Wednesday 0930–1700 whenever I am not otherwise engaged. Please use email as a first resort for consultation. Strictly no consultations will be held on Thursday and Friday.

Contact details and consultation times for demonstrators

Dr. Wen Li
Room 408G, Ainsworth Building
Ph: 9385 4126
Email: wen.li@unsw.edu.au

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Room 408G, Ainsworth Building
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2. Course details

Credit Points:

This is a 6 unit-of-credit (UoC) course, and involves 3 hours per week (h/w) of face-to-face contact.

The UNSW website states “The normal workload expectations of a student are approximately 25 hours per semester for each UoC, including class contact hours, other learning activities, preparation and time spent on all assessable work. Thus, for a full-time enrolled student, the normal workload, averaged across the 16 weeks of teaching, study and examination periods, is about 37.5 hours per week.”

This means that you should aim to spend about 9 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

	Day	Time	Location
Lectures	Wednesday	6 - 8pm	G02, Ainsworth Building
Demonstrations	Wednesday	8pm – 9pm	G02, Ainsworth Building

Summary of the Course

Manufacturing has always been by far the largest contributor to waste generation in our society and therefore provides a huge potential for waste reduction. This is due to the fact that current manufacturing systems are considered to be of an open loop style, where by manufacturers main interests are focused in the areas of design, development, sales and distribution. A shift to a closed loop manufacturing system is proposed to enable manufacturers to take into account the whole product life cycle and move away from open loop manufacturing. This will require engineering of the whole product life cycle of a product from raw material selection, production, usage to disposal in order to reduce the environmental impact of industrial society

Aims of the Course

The aim this course is to introduce the tools and techniques associated with engineering of a product life cycle to postgraduate students from technical backgrounds so that they can have an in-depth understanding how to engineer and manage the entire life of a product from material selection to disposal.

This course is designed to provide postgraduate students with high level knowledge of Life Cycle Engineering principles and practices. The course will follow a typical product life cycle and the associated tools and techniques available. It starts with defining the concept of life cycle engineering, history and potential benefits (ecological and environmental). It then introduces the drivers behind this concept such as legislation and standards, environmental requirements. Next, the concepts of life cycle thinking, Cradle-to-Grave, Cradle-to-Cradle, Energy and Eco-efficiency are introduced. In the following section, generic environmental impact assessment tools and the concept of sustainable product development and the associated eco-design tools are introduced. The course continues with concepts related to usage and the end-of-life stages of product life cycle. These topics include Product collection, Reverse logistics and End-of-Life decision making, Tools and technologies, Disassemble sequence planning, Disassembly technologies, Reuse and remanufacturing principles, product monitoring and testing, materials recycling techniques. The course finally finishes with economics and future trends such as Economic models, Life Cycle Costing (LCC) and Product Service Systems (PSS).

Student learning outcomes

This course is designed to address the below learning outcomes 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.	Have gained knowledge in the inter-disciplinary field of Life Cycle Engineering	PE1.3, PE1.5, PE1.6
2.	Develop in-depth understanding of various tools and techniques associated with engineering and managing the whole life cycle of a product	PE2.2
3.	Develop an appreciation of the future trends in the area of triple bottom line of sustainability (economic, ecological and social)	PE1.4

3. Teaching strategies

This course is included to give you the skills to appreciate the engineering of product life cycles in order to reduce environmental impact and ultimately to achieve the three pillars of sustainability; namely economic, environmental and social sustainability. The content reflects my experience as a lecturer as well as my practical experience in manufacturing environment, and practical examples drawn from that experience are used throughout the lectures and demonstrations. Effective learning is supported when you are actively engaged in the learning process and by a climate of enquiry, and these are both achieved in the lectures and demonstrations by way of practical case studies. You become more engaged in the learning process if you can see the relevance of your studies to professional, disciplinary and/or personal contexts, and the relevance is shown in all parts of the lectures and assignments by way of examples drawn from industry.

Dialogue is encouraged between you, others in the class and the lecturers. Diversity of experiences is acknowledged, as some students in each class have prior experience in manufacturing environment. Your experiences are drawn on to illustrate various aspects, and this helps to increase motivation and engagement.

It is expected that assignments will be marked and handed back as soon as possible. You will have feedback and discussion, while the assignment is fresh in your mind, to improve the learning experience.

The subject will be presented in the form of lectures and demonstrations. Each weekly class will consist of a 1-1.5 hrs lecture followed by a demonstration example or case study related to the material covered in the lecture. A typical session would consist of a lecture covering the main elements of the topic for the week, interspersed with a number of individual or

group exercises. Students are advised to read the relevant Units of the subject material BEFORE attending the class. Some of the exercises appearing in the subject material will be discussed in class. In other cases (particularly numerical exercises) worked solutions will be handed out separately.

4. Course schedule

Lectures in this course are given by Prof. S. Kara and Dr W. Li unless stated otherwise. All lectures and demonstrations will be carried out on Wednesday, 18:00-21:00. All readings will be uploaded on the Moodle

Topic	Date	Location	Lecture Content	Demonstration Content	Suggested Readings
Unit 1: Introduction	29/7/15	G02, Ainsworth Building	Introduction to the subject and key drivers of change	N/A	Readings 1 and 2
Unit 2: Life Cycle Strategy and Management	5/8/15	G02, Ainsworth Building	EMS, ISO14000, PAS2050, Cleaner Production and Product Stewardship	N/A	Readings 3 and 4
Unit 3: Energy and Resource Efficiency of Product and Processes	12/8/15	G02, Ainsworth Building	Efficiency, Effectiveness, Star rating at the process and factory level	Energy Efficiency Assessment	Reading 5 and 6
Unit 4: Environmental Footprint of Product and Processes	19/8/15	G02, Ainsworth Building	LCA and application, Four basic steps, LCA tools	LCA Demonstration	Readings 7, 8, 9
Unit 5: Life Cycle Costing and Eco-efficiency	26/8/15	G02, Ainsworth Building	Costing and LCC, how to conduct LCC, MFCA and Eco-efficiency	LCC Demonstration	Readings 10, 11, 12
Unit 6: Environmentally Sustainable Product Development -1	2/9/15	G02, Ainsworth Building	Eco-design, Design for Environment	N/A	Readings 13 and 14

Unit 7: Environmentally Sustainable Product Development -2	9/9/15	G02, Ainsworth Building	Implementation of Eco-design and industrial approaches	Eco-efficiency demonstration	Readings 15 and 16
Unit 8: Product Usage	16/9/15	G02, Ainsworth Building	Data collection and processing, Smart Products	N/A	Readings 17 and 18
Unit 9: Product Collection and Recovery	23/9/15	G02, Ainsworth Building	Close loop product cycle, reverse logistics and network design	N/A	Readings 19 and 20
Session Break	**30/9/15**				
Unit 10: Product End-of-Life Management -1	7/10/15	G02, Ainsworth Building	EOL decision making, remaining lifetime prediction	N/A	Readings 21
Unit 11: Product End-of-Life Management -2	14/10/15	G02, Ainsworth Building	Disassembly, reuse and recycling	N/A	Readings 21 and 22
Unit 12: Information Management and Future Trends	21/10/15	G02, Ainsworth Building	Product service system, Product Life Cycle Management	N/A	Readings 23 and 24
Review of Lecture Material	28/10/15	G02, Ainsworth Building			

The schedule shown may be subject to change at short notice to suit exigencies.

5. Assessment

You are assessed by way of assignments and examinations which involve both descriptive material and hands on application of the lecture material. Two large assignments are designed to test your ability to demonstrate applied knowledge. In addition, a number of small assignments will be given based on the course material. These assignments will be given. There will be one mid-session test in Week 6 on the material covered in weeks 1 to 5, a further test in week 13 covering materials covered in weeks 6-12. Details of the assignments, detail assessment criteria and the due dates will be uploaded in the Moodle prior to the assignment.

Assessment task	**Length**	**Weight**	**Learning outcomes assessed**	**Assessment criteria**	**Due date, time, and submission requirements**
Group assignment 1	2500 words	25%	1 and 2	A detail assessment criteria will be uploaded in Moodle	Class time, Wednesday 9th September
Group assignment 2	2500 words	25%	2 and 3	A detail assessment criteria will be uploaded in Moodle	Class time, Wednesday 14th October
Midsession Test 1	10 short answer questions	25%	1 and 2	Course content from week 1-5	In the classroom
Midsession Test 2	10 short answer questions	25%	2 and 3	Course content from weeks 6-12	In the classroom

Assignments

Presentation

All submissions should have a standard School cover sheet which is available from this subject's Moodle page.

All submissions are expected to be neat, and clearly set out. Your results are the pinnacle of all your hard work. Presenting them clearly gives the marker the best chance of understanding your method; even if the numerical results are incorrect.

Submission

Late submissions will be penalised 5 marks per calendar day (including weekends). An extension may only be granted in exceptional circumstances. Where an assessment task is

worth less than 20% of the total course mark and you have a compelling reason for being unable to submit your work on time, you must seek approval for an extension from the course convenor ***before the due date***. Special consideration for assessment tasks of 20% or greater must be processed through https://student.unsw.edu.au/special-consideration.

It is always worth submitting late assessment tasks when possible. Completion of the work, even late, may be taken into account in cases of special consideration.

Assessment Criteria

A detail assessment criteria will be provided with the Assignment hand outs and uploaded on Moodle

Examinations

There is no final exam in this course. However there will be two midsession tests. You must be available for all tests. Please see the assessments table for further details.

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 shown at https://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 School Office or the Engineering Student Centre prior to the examination. Calculators not bearing an "Approved" sticker will not be allowed into the examination room.

Special Consideration and Supplementary Assessment

For details of applying for special consideration and conditions for the award of supplementary assessment, see Administrative Matters, available on the School website and on Moodle, and the information on UNSW's Special Consideration page.

6. Expected Resources for students

Textbook
None.

Other Reference Books
List of reference books will be provided during the course delivery. Some of which can be found in the UNSW library (http://info.library.unsw.edu.au/web/services/services.html)

List of required and suggested additional readings and availability (in bookshop, UNSW library, MyCourse)

Additional readings will be handed out during the each class.

Additional materials provided in Moodle

Course will be administered by using Moodle. Therefore course administration and some lecture materials may be uploaded to Moodle. Students are advised to use Moodle for class communications.

7. Course evaluation and development

Feedback on the course is gathered periodically using various means, including the Course and Teaching Evaluation and Improvement (CATEI) 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 changing the guest lecturers, more demonstrations and taking into account diverse student background through different demonstrations.

8. 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: https://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: http://www.gs.unsw.edu.au/policy/documents/studentmisconductprocedures.pdf

Further information on School policy and procedures in the event of plagiarism is presented in a School handout, Administrative Matters, available on the School website.

9. Administrative Matters

You are expected to have read and be familiar with *Administrative Matters*, available on the School website: https://www.engineering.unsw.edu.au/mechanical-engineering/sites/mech/files/u41/S2-2015-Administrative-Matters_20150721.pdf

This document contains important information on student responsibilities and support, including special consideration, assessment, health and safety, and student equity and diversity.

Prof. S. Kara
20/7/2015

Appendix A: Engineers Australia (EA) Professional Engineer Competency Standards

	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