Engineering for Sustainable Development (MECH 4400)

Semester 1 2009 Credit: 6 points

James Trevelyan
http://www.mech.uwa.edu.au/unit/MECH4400/

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UNIT DESCRIPTION

This course focuses on sustainability, one of the central aspects of engineering practice. Till now most of the course work you have done has prepared you for technical analysis: an essential foundation for making accurate predictions.

In engineering practice you will rely on other people for everything you do and you need to understand how economic, political and environmental issues drive engineering decisions. As an engineer, the technical considerations will be relatively easy parts of your work in comparison to the need to coordinate people and influencing their actions.

Successful engineering practice brings three rewards: 1) satisfaction in seeing something that reflects your personal efforts, 2) personal reputation among your peers, and 3) money. All rely on being able to deliver a sustainable result: that's why sustainability is so important.

This unit will cover the following:

- How engineers work with social, political, economic and environmental constraints
- How to work with other people, including engineers and non-engineers in your community
- How to use engineering management systems (e.g. ISO 14001, 18000 and 9000)
- Risk management (assessment, controls, communication), especially in the context of environmental impact.
- Project and team management and negotiation techniques.

There are two team projects which through which you can learn and have some fun at the same time. You will be introduced to typical engineering project stakeholders and their different perspectives so you can learn how to engineer sustainable projects that keep most people happy.

Important stakeholders include:

- Yourself
- Companies (CEOs, boards of directors, shareholders), their employees (operators/maintainers, engineers, management, legal, finance)
- Government institutions and regulatory agencies (State – Department of Environment and Conservation, Department of Industries and Resources, Commonwealth – Department of the Environment, Water, Heritage and the Arts)
- Community (action groups, individuals, other industries, NGOs and local politicians)

Main Learning Outcomes

On completion of this unit, you should be able to:

- Understand and explain current community and international debates on environmental and sustainability issues such as climate change, water and energy supplies, and environmental regulations.

  (learned through reading, lectures, tutorial discussions, and assessed by essay question in exam)

- Understand and explain how engineers work within social, political, economic and environmental constraints.

(learned through team projects, assessed by reflective report on project participation and exam questions)

- Understand how one or more stakeholders think about engineering projects and perform their role in simulated negotiations for a major engineering project.

  (lecture presentations by stakeholder representatives, reading, tutorial discussions, participation in simulated negotiation, assessed by reflective report on project participation and exam questions)

- Understand and apply the basic elements of engineering management systems for risk management for safety and environmental protection.

  (lectures, tutorial discussion, team project, assessed by reflective report on project participation)

Teaching Staff

Margot Jupp has worked for the last 21 years in the minerals and gas industry. She graduated in Chemical Engineering from Queen's University in Canada. She joined UWA staff in 2003 part-time as a senior adjunct lecturer. Margot has worked as a chemical engineer and an environmental engineer in the mineral sands, alumina, and gas industries in Canada, Denmark and Australia. She now shares her time between Woodside, the UWA CEED office and teaching chemical engineering and sustainability.

Jeremy Leggoe directs the CEED programme at UWA. After 4 years with the WA Water Authority he worked on his PhD at UWA until 1996 and continued his research career at the Los Alamos Laboratory in New Mexico. He joined Texas Tech University and taught in the Chemical Engineering department before returning to Perth in 2008.

Chris Rowles presents the unit Introduction to Professional Engineering – recently he received a teaching excellence award for his work. He has long experience in different fields of engineering and is currently working towards a PhD in biomedical engineering.

Sabbia Tilli has a masters degree in political economy from UWA and has taught in the engineering school since 2001 part-time and has received a teaching excellence award. She works as a full-time researcher in the Engineering Learning and Practice Research group at UWA.

James Trevelyan (unit coordinator) joined the School of Mechanical Engineering in 1992. He worked in the aerospace industry for 5 years and then developed sheep shearing robots for the Australian wool industry, based at UWA. He now leads the Engineering Learning and Practice Research group at UWA. He has won several teaching awards, and is internationally recognized for his research in robotics, landmine clearance, remote access laboratories and engineering practice.

Contact Details

Name	Room	Tel	Email	Consultation Times
James Trevelyan	ENCM 2.64	3058	WebCT only	Mon pm, Wed pm (except Faculty mtgs)
Margot Jupp	ENCM G.12	3127	margot@mech.uwa.edu.au	To be announced in tutorial
Sabbia Tilli	ENCM G.32	3058	sabbia@mech.uwa.edu.au	To be announced in tutorial
Chris Rowles	ENCM 1.06	8778	chrisr@mech.uwa.edu.au	To be announced in tutorial
Jeremy Leggoe	ENCM 1.08A	7315	jeremy.leggoe@uwa.edu.au	Tue, Thur 10 am – 12 noon

Only use E-mail for personal issues: for all other matters use WebCT forums to ask questions so others can see the replies.

UNIT STRUCTURE AND SCHEDULE

Overview

- Lectures
  - 3 lectures per week by visiting speakers and university staff at 12 noon:
    - Monday: Weatherburn Lecture Theatre (Maths)
    - Wednesday: Engineering Lecture Theatre 1
    - Thursday: Tattersall Lecture Theatre (near Guild building)
  - Lectures will be recorded when possible.
  - After most lectures by visiting speakers, two students will be invited to have lunch with the visiting speaker at the UWA club (paid for by UWA*). Invitations will depend on performance in class discussions, written work, and attendance at lectures.
- Tutorials
  - The main tutorial for each week runs on Thursdays or Fridays (T2): use the campus OLCR system at the UWA timetable web pages to reserve your preferred tutorial time http://www.timetable.uwa.edu.au/. Tutorials start in the second week of semester.
  - Wednesday afternoon tutorials (T1) will be used to enable project teams to meet. Some will be supervised. Details will be announced on the WebCT pages.
- Practicals
  - The main practical will take place on Friday afternoon April 24. Attendance is required. Team operations will commence at 1.30 pm.
  - Other practicals on March 30 and April 3 (2 - 5 pm) are for team practice for the April 24 practical. Teams can arrange alternative dates and times if they want to.

* There is an English saying “There is no such thing as a free lunch” This means that accepting an invitation for a free lunch normally means you should be prepared to reciprocate … eventually … when you are a wealthy and successful engineer.

ASSESSMENT

Full details on the requirements for each aspect of assessment will be provided with handouts. The information here is only a summary.

Item	Weight(%)
Practical project: Wastewater Transport	25
Simulated project negotiation	20
Class participation	15
Examination	40
Total	100

Details

Waste Water Transport (indicative only – check handouts carefully)

- Description – The class will be divided into teams (waste producer, transport companies, shires and waste treatment company). The object is to transport and treat the waste in a sustainable manner across the campus.
- Assignment - In accordance with the lecture/s on risk assessments conduct a risk assessment of your team's wastewater operations. Based this risk assessment develop the operational controls and emergency preparation including communication plan for the high risks in addition to other elements of a management system. Marks will also be awarded for participation in the practical on April 24.
- Assessment – team procedures (team report due April 10) and compliance with procedures, personal report, peer assessment (individual report due April 27).

Major Project Negotiation (indicative only – check handouts carefully)

- Description – This assignment is based on documentation from an actual project in Western Australia. The class will be divided up into different stakeholder groups such as proponent, engineering design/construct consultants, unions, NGOs, and government departments. Each stakeholder group represents the concerns of their constituents. All stakeholder groups work together towards an agreed list of conditions by which the project can move ahead.
- Assessment
    - Position paper – detail your team's interests and position. Team assignment, approx 8 pages, due around of 9th week of semester.
    - Agreement – the position reached by the group of all stakeholders on each of the issues raised. Team assignment, approx 3000 words, due around of 12th week of semester.
    - Reflective report on your personal experience and learnings, individual assignment, due around13th week of semester.

Class Participation

- Short essays done in tutorial class, short answers to questions based on lectures.

Exam

The examination will consist of one or more essay questions on sustainability-related issues such as sustainable water supplies and distribution. There will be a wide choice of topics and the list of topics will be announced before the final examination.

Supplementary examinations will only be available for this unit for students who have completed the assessment requirements for the team projects and class participation.

This unit marks may be scaled in line with the Faculty of Engineering, Computing and Mathematics policy on Assessment Practices and Procedures. Check this link: http://www.ecm.uwa.edu.au/for/students/assess.

Special Circumstances

The university policy on special consideration has been altered so that from 2009 on, applications for consideration, deferral of tests or exams or extensions of time for assignments on medical, personal or other grounds must be lodged with the faculty office no later than three working days after the due date for the assessment in question. This rule will apply to all students, except in exceptional circumstances ('exceptional' does mean 'exceptional', not 'just didn't have time to get around to it').

Penalties

A penalty of 10% per week or part thereof may be applied to any late assignment submissions, up to a maximum of 30%. A 40% penalty will apply if submissions are handed in after other students have received their marked work back. These penalties may be waived or reduced in cases of sickness or other special circumstances, and written evidence must be submitted to the Faculty Office (and a brief note summarising the circumstances must be sent to the unit coordinator).

In the event of disproportionate participation in the group assignment marks may be modified.

TEXTBOOK(S) & RESOURCES

Unit Website

http://www.mech.uwa.edu.au/unit/MECH4400/ (includes recommended web links for further reading)

Recommended References

- Hargroves, K. C., & Smith, M. H. (Eds.). (2005). *The Natural Advantage of Nations* (Paperback ed.). London: Earthscan.
- Gore, A. (2006) An Inconvenient Truth. (Film or book)
- Jared Diamond (2005), Collapse - How Societies Choose to Fail or Succeed
- Tim Flannery (2005), Weathermakers
- Paul Kennedy (1993), Preparing for the 21st Century

Additional resources & reading material

- See unit WebCT site

UNIVERSITY POLICIES

Use of student feedback

WebCT will provide an anonymous feedback discussion forum which you can use to make comments on how the course could be improved. SURF, SPOT and possibly other surveys will be used to collect your evaluation of the course.

Scaling

This unit's marks may be scaled in line with the Faculty of Engineering. Computing and Mathematics policy on Assessment Practices and Procedures

see http://www.ecm.uwa.edu.au/for/students/assess

University Guidelines on Academic Misconduct

see http://www.ecm.uwa.edu.au/for/students/plagiarism

Faculty Policy for Appeals

see http://www.ecm.uwa.edu.au/for/students/exams

Charter of Student Rights

See http://www.secretariat.uwa.edu.au/home/policies/charter

UNIT OUTCOMES

Institution of Engineers

Ability to apply knowledge of basic science and engineering fundamentals	Practical exercise reinforces this ability.
Ability to communicate effectively, not only with engineers but also with the community at large	Assessed through practical exercise and simulated negotiations.
In-depth technical competence in at least one engineering discipline	Required for the course.
Ability to undertake problem identification, formulation and solution	Assessed through practical exercise and simulated negotiations.
Ability to utilise systems approach to design and operational performance	Assessed through practical exercise and simulated negotiations.
Ability to function effectively as an individual and in multi-disciplinary and multi-cultural teams, with the capacity to be leader or manager as well as an effective team member	Assessed through practical exercise and simulated negotiations.
Understanding of the social, cultural, global and environmental responsibilities of the professional engineer and the need for sustainable development	Assessed through practical exercises and examination.
Understanding of the principles of sustainable	Assessed through practical exercises and examination.

design and development	
Understanding of professional and ethical responsibilities and commitment to them	Assessed through practical exercises and examination.
Expectation of the need to undertake life-long learning and capacity to do so	Most of the technical information you need to complete the project work is not explicitly covered in lectures and tutorials. You need to be able to find this for yourself and in doing so you will acquire self-learning skills that will be essential for you as an engineer.

UWA Engineering

Engineering-specific Generic Skills	
Appreciation of Engineering beyond the narrow discipline; ability to develop links between different areas.	Management systems content address this issue - the need to understand function in the broader engineering context before deciding how to implement function.
Appreciation of the changing nature of the engineering context.	Addressed in case studies
Understanding of non-technical constraints in achieving engineering solutions.	Practical, simulated negotiation exercise.
Human interface skills.	Risk communication content.
Understanding of professional and ethical responsibility and of the impact of engineering solutions in a global and societal context.	Whole course addresses this issue.
Understanding the nature, needs, and importance of research, both fundamental and applied.	Research feeds into the unit – students are required to read research results.
Project management skills, including environmental, financial and human factors.	Project work in practicals builds skills for project management
Design skills.	Not applicable
Instrumentation and data processing skills.	Not applicable
Risk management skills.	Practical exercise covers this issue.
Technical Skills	
Understanding of dimensions of physical and engineering quantities; ability to make order-of-magnitude estimates.	Not applicable
Understanding the difference between analog and digital.	Not applicable
Understanding the difference between continuum and discrete.	Not applicable
Ability to develop a simplified physical and/or mathematical model of a phenomenon or a process.	Not applicable
Visualisation and graphics skills.	Skills are reinforced in design and practical exercises and reports
Appropriate practical "workshop" skills.	Practical exercise provides an opportunity for this.
Programming and computing skills.	Not applicable
Basic mathematical skills (see Attachment).	Not applicable
Appreciation of Mechanics, Electronics and Signal Processing.	Not applicable
Knowledge and understanding of principal physical and chemical properties of matter.	Not applicable
Understanding health and safety issues.	Practical provides direct exposure to this.
Understanding codes and specifications.	Practical provides direct exposure to this.
Understanding of legislative aspects of engineering activities.	Practical provides direct exposure to this.

REVISION HISTORY

Revision	Description	Date	Prepared by
1	2007 Course	Jan 2007	M Jupp
2	2007 Course	Feb 2007	J Trevelyan
3	2007 Course	Feb 28 2007	J Trevelyan
4	2008 Course	Feb 2008	M Jupp
5	2009 Course	Feb 2009	J Trevelyan