



THE UNIVERSITY OF
NEW SOUTH WALES

FACULTY OF ENGINEERING

ENGG1000

ENGINEERING DESIGN AND INNOVATION

Course Outline

This outline tells you how this course will be run.

If you need more help...

Ask at the School that you are enrolled in
or ask at the Engineering Student Centre

Once you are enrolled, the Moodle Learning Management site has more specific information for this
course

<http://moodle.eng.unsw.edu.au/moodle>

SEMESTER 1 2011

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Quick-start To-Do List

when	action	location
Monday Week 1 (Mon 28 th Feb, 2:00pm)	Attend Introductory lecture	Clancy Auditorium
Thursday Week 1 3 rd Mar, 2pm or 3pm as allocated in first lecture – see column 3 if lost!	Participate in Impromptu Design activity (this activity is assessable)	Various locations and one of two times as allocated in Intro Lecture, and in Moodle or meet outside Engineering Student Centre at 2pm if lost
before end of Week 1 (Fri 4 th Mar)	Finalise your decision on the project you want to select; if you make a mistake contact your project coordinator (Page 4)	Via Moodle
Monday Week 2 (Mon 7 th Mar, 2:00pm)	Attend lecture on Impromptu Design (includes Assessable task)	Clancy Auditorium
Thursday Week 2 and onwards 10 th Mar 2.00pm	Join the School corresponding to the project you have chosen	See timetable on Moodle website (check for changes)

Course staff

The course is coordinated by the Faculty of Engineering; most of it will be run by the schools within the Faculty plus Materials Science and Engineering in the Faculty of Science.

Course Convenor for the Faculty

Dr Chris Daly
 Location: Room OMB G36
 Phone: 9385 4514
 Email: c.daly@unsw.edu.au

Contacts for the ten schools that are running projects in this course

School	Coordinator and contact details
Chemical Engineering	Dr Graeme Bushell g.bushell@unsw.edu.au Room AS308 ph 9385 5921
Computer Science and Engineering	Dr Tim Lambert lambert.en1000@cse.unsw.edu.au Room K17-510B ph 9385 6496 discuss at: www.cse.edu.au/~en1000
Civil and Environmental Engineering	Associate Professor Ian Turner ian.turner@unsw.edu.au Room CE106 ph 9385 5381
Electrical Engineering and Telecommunications	Mr Alex von Brasch a.vonbrasch@unsw.edu.au Room EE338 ph 9385 4933
Graduate School of Biomedical Engineering	Dr Ross Odell r.odell@unsw.edu.au Room GSBME507 ph 9385 3920
Materials Science and Engineering	Dr Sean Li sean.li@unsw.edu.au Room BLD.E8: 217 ph 9385 5986
Mechanical and Manufacturing Engineering	Dr Tim White white@unsw.edu.au Room ME216 ph 9385 5158
Mining Engineering	Dr Chris Daly c.daly@unsw.edu.au Room OMB G36 ph 9385 4514
Petroleum Engineering	Dr Peter Neal peter.neal@unsw.edu.au Room D12 401C ph 9385 4261
Photovoltaic and Renewable Energy Engineering	Dr Stephen Bremner spbremner@unsw.edu.au Room EE 105 ph 9385 7890

Course information

Course size

This course is 6 units of credit.

Units of credit indicate the nominal workload for students. The normal workload expectations at UNSW are 25-30 hours per session for each unit of credit; including class contact hours, preparation and time spent on all assessable work. For a six unit of credit course with no formal examinations, like ENGG1000, this means a typical average total workload of 11 to 13 hours per week.

Course organisation

This course is coordinated by the Faculty of Engineering which also arranges some common lectures. Most of the course is run in ten project strands by schools of the Faculty of Engineering and the Faculty of Science (Materials Science and Engineering). Learning activities will vary between project strands. Although there are differences in presentations, the course is coordinated to ensure equivalence. All the projects are done in groups.

You may select any of the projects, independently of your preferred field of study. **It is not mandatory to do the project associated with your chosen discipline. This is a common engineering course!**

Project selection

Project selections are to be finalised by the end of week 1. Descriptions of each of the projects are attached to this outline. You will be given more information to help you finalise your project selection during the first Faculty lecture in Week 1 of the course. Project descriptions and course outlines are available on Moodle. **Make sure you are certain of which project you wish to enrol in before committing yourself to the online selection option.**

How this course fits with others in your program

This course looks at what it means to be an engineering designer. You will see the big picture and how all your studies, such as mathematics and science, fit together. It will also look at some of the non-technical issues which are just as vital to a successful engineering career as the technical ones.

You will study and experience Engineering Design as a multi-faceted activity, which requires considerable creativity, as well as judgment, decision making and problem solving skills. You will see the need to take context into account and be able to complete design projects on time and within budget. The problem solving and project management skills that you learn in this course will be invaluable for later courses in your degree, in your career and for life in general.

Learning and teaching philosophy

This course is, first and foremost, an exercise in experiential learning, with emphasis on reflection on the design process. You will work together in teams to design a solution to a specified but open-ended problem. This project will be supported with a variety of additional student experiences to help you acquire individual and group skills in areas needed for communicating the design, including graphical representation, collaboration, report writing and any necessary discipline-specific knowledge.

Aims

1. Introduce you to the principles and methods of engineering design.
2. Involve you in hands-on design and engineering projects.
3. Help you gain skills in written expression.
4. Introduce you to the way a professional engineer works.
5. Provide a team-based environment so you can experience and learn collaborative skills.
6. Help you learn the professional use of information resources.

What you are expected to learn

After you have completed this course, you will be expected to have the following capabilities.

- Be familiar with the process of engineering design and the use of design methods for defining an open-ended design problem, generating alternative conceptual solutions, evaluating these solutions and implementing them.
- Understand the basic elements of project management and be able to plan and schedule work activities in accordance with standard practice.
- Understand the dynamics of collaborative teams and how to work effectively within a team to accomplish tasks within given deadlines.
- Be able to organise, conduct and record engineering meetings.
- Be able to effectively convey your thoughts and ideas in an engineering design report.
- Be able to understand the issues of quality, safety, diversity and equal opportunity as they apply to university and professional life.
- Understand some of the roles and responsibilities of a professional engineer.

Teaching strategies

Teaching in this course is centred on the project. For example, you will develop communication skills by communicating about the project; you will develop teamwork and project management skills in the context of your project team; and you will experience the kinds of technical problems resolved by engineers in your selected project area.

How this will work out in detail will depend upon the particular school presenting a particular project. You will receive a separate handout describing this once you have finalised your choice. If you want to see details earlier, refer to the Moodle site for this course.

Learning Outcomes and Assessment Framework

ENGG1000 has been designed to ensure there is equivalence and alignment between the various Schools' implementation of the course. Each School operates within an agreed framework of learning outcomes as indicated in the following table.

Learning Outcome	Weight
Development of engineering design skills for creative solutions to open ended problems	30% - 50%
Communication skills in technical report writing, graphical communications and experience in public presentation.	30% - 50%
The development of teamwork and project management skills	10% - 30%
Information gathering and evaluation skills to support the design process.	10% - 30%
School-selected discipline knowledge component	0 - 20%

Full details of each School's specific assessment activities and their weightings are provided in the project outlines available on the Moodle site. You are encouraged to preview these and download them for future reference.

Because of differences between each School's specific learning and assessment activities it may be necessary to adjust marks (up or down) to ensure fairness. This will be done after all the results are available at the end of the session.

Academic honesty and plagiarism

According to the UNSW website www.lc.unsw.edu.au/plagiarism

Plagiarism is taking the ideas or words of others and passing them off as your own.
Plagiarism is a type of intellectual theft.

Plagiarism happens for a number of reasons—one is because some students decide consciously to gain credit for the work of others. However, most incidents of plagiarism are the product not of deliberate cheating, but of underdeveloped academic skills.

This course will be an important opportunity for you to develop skills in writing and referencing your sources so that you avoid plagiarism. Look at the website above for help, or see the resources available through The Learning Centre.

A standard UNSW statement on plagiarism is given 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.

Course schedule

Shaded items below are Faculty-wide activities

Week	Monday	Thursday
1	Introductions and project descriptions	Impromptu Design (everyone, assessable)
2	Review Impromptu Design including assessable task	School projects begin. Refer to your School Course Outlines for Timetable
3	project activities in Schools	project activities in Schools
4	project activities in Schools	project activities in Schools
5	project activities in Schools	project activities in Schools
6	project activities in Schools	project activities in Schools
7	project activities in Schools	project activities in Schools
8	project activities in Schools	project activities in Schools
	Easter Break	Easter Break
9	project activities in Schools	project activities in Schools
10	project activities in Schools	project activities in Schools
11	project activities in Schools	project activities in Schools
12	project activities in Schools	Celebrate!

Times and rooms

Dates, times and rooms for common Faculty activities are given below. Dates, times and rooms for the project that you select (Thursday, Week 2 onwards) are available via the Moodle site.

NOTE: Clancy Auditorium is for Monday weeks 1, and 2 only. All other times you will be somewhere else. Timetables will be available via Moodle so please check them before the end of week 1.

Resources for students

The eLearning Moodle site for this course is a vital and integrated part of the learning environment. eLearning is the web-based learning environment at UNSW. You can access eLearning via:

<http://moodle.eng.unsw.edu.au/moodle> and select Login to Moodle using your zPass.

The recommended textbook for this course is:

Dym, Clive L., Engineering Design A Project Based Introduction, 3rd Edition

It is available as a text and as an accompanying eBook from the Bookshop.

You should have some access to a copy as it provides useful reading on a number of relevant topics.

There are copies available for purchase from the University Book Store and available in the University Library Reserved Collection. The coordinator of your selected project will tell you if alternative or additional textbooks are recommended. References specific to a particular project are given in the School outlines that will be supplied after you have finalised your decision and may be previewed on the eLearning site for this course.

Continual course improvement

Engineering Design is a team effort and we are particularly interested in your feedback. We want your suggestions of what is good and should be retained, and what is not so good and should be improved (with ideas on how to do it). In addition to the standard UNSW Course and Teaching Evaluation and Improvement (CATEI) surveys we will be asking for your feedback in other ways during your studies. Do make attempts to communicate constructive feedback to your lecturers.

Administrative matters

For most of you this will be your first session at UNSW. We are a large, complex organisation and you will have much to become familiar with. Take time to review the documentation on processes and procedures that you will have received at enrolment and from your School. Additional Administrative Matters documentation for this course will be posted on the Moodle site.

Expectations of students

UNSW expects regular attendance at lectures and tutorials/laboratory classes/seminars. Although exceptions may be made for special circumstances, we do expect University commitments to take precedence over regular work activities, holidays etc.

UNSW has rules for computer use, for example, for email and online discussion forums. You will have to agree to them when you first access the UNSW network.

We expect everyone – staff and students – to treat each other with respect.

Procedures for submission of assignments

Instructions will be supplied by the School concerned during lectures and within the respective course outlines.

Occupational Health and Safety

Like the wider community, UNSW has strict policies and expectations on Occupational Health and Safety and you should read these. They may be accessed on:

www.policy.unsw.edu.au/classification/risk.htm

Your School will also have policies that you must get to know and follow.

Examination procedures and advice concerning illness or misadventure

There are no formal examinations in this course. However, if you find that your performance in an assessable component has been significantly affected by illness or other unexpected circumstance, then you should make an application for special consideration as soon as possible after the event by visiting UNSW Student Central. Talk to your course convenor too. Note that considerations are not granted automatically.

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 Equity and Diversity Unit (9385 4734 or www.studentequity.unsw.edu.au/). 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.

Project Information for ENGG1000

Once you have read this booklet and decided upon a project that is of interest to you, you can then visit Moodle's ENGG1000 course module (<http://moodle.eng.unsw.edu.au/moodle>) to select a project.

It's recommended that you have a look at the **Course Videos** first to get an idea of how the course runs. Other videos are available via <http://www.youtube.com/> Search on ENGG1000 for a number of short videos on completed projects. The next step is to go into the **Project Description and Selection Page** and research the different projects that are available. When there is no doubt in your mind which project you want to do, click on the signup tool icon. You may select any of the projects, independently of your preferred field of study. It is not mandatory to do the project associated with your chosen discipline. **If you make a mistake please contact the Faculty Course Coordinator via the email address given at the beginning of this outline.**

Introduction to the Projects

Why projects?

We want you to experience the engineering design process as well as hear about it and reflect upon it. So, in this course you will learn by doing; by working on tasks connected with a project.

Performance of your design will be one important part of the assessment, the other marks will be awarded for process (what you do) and your reflection (thinking about and showing that you have understood what you do).

Range of projects and project selection

Projects fall within the topic areas listed below. Some areas have more than one project. You may choose a topic in any area, irrespective of the program you are enrolled in. All selections are subject to quotas. **Selections may be changed on-line up to the end of week 2. Changing after that is not recommended because project activities will have begun. For exceptional circumstances please contact the relevant School coordinator.**

Topic area	Project title(s)	Page
Chemical Engineering	ChemEng: Batteries for Electric Cars	12
Computer Science and Engineering	CompSci: Robo Rescue	13
Civil and Environmental Engineering	CivEnvEng-01: Model Bridge Structure	14
	CivEnvEng-02: Water for a Cambodian Village	15
	CivEnvEng-03: Wave Energy from the Oceans	16
Electrical Engineering and Telecommunications	ElecEng: The Minesweeper Challenge	17
Graduate School of Biomedical Engineering	BiomedEng: Bionic Hand	18
Materials Science and Engineering	Materials: Advanced Application of Shape Memory Effects	19
Mechanical and Manufacturing Engineering	MechEng: Warman Design Competition "Project PASS"	20
Mining Engineering	Mining: Student Developed Project	21
Petroleum Engineering	PetEng: Geological storage of greenhouse gases	22
Photovoltaic Engineering	Solar: Space Elevator	23

Commonality of teaching/learning schemes

Each topic area is run by a different school. Because schools have differing requirements there are variations in approach and in details of assessment. However, as described above, we will coordinate results for fairness and consistency.

More details

You can get more details on projects by:

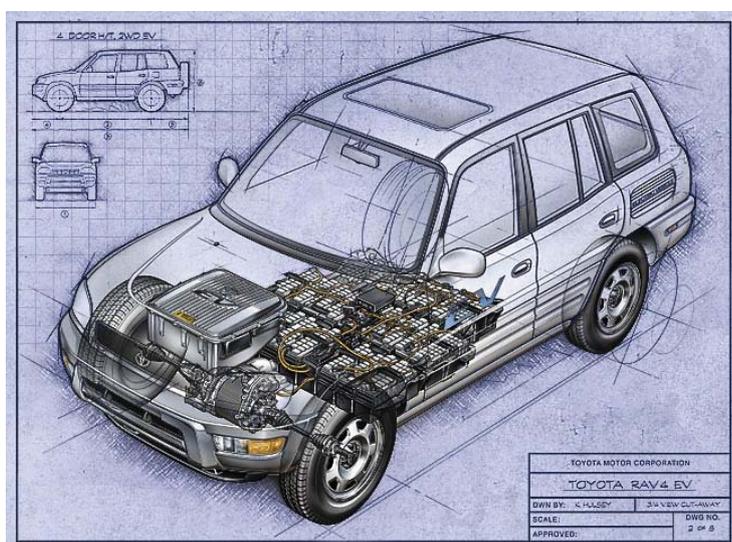
1. attending the first Faculty lecture on Monday of week 1
2. reviewing the project information pages on Moodle for ENGG1000
3. attending the relevant School project information session on Thursday of week 2

School of Chemical Engineering

ChemEng: Batteries for Electric Cars

The human race appears to be facing a number of converging crises in the 21st century including climate change, damage to natural ecosystems, energy security and resource scarcity – in short, the sustainability of our current way of life. These represent huge social, political and technical challenges for society in general and for engineering graduates in particular.

One of the many issues is our transport system, which is almost entirely dependent on crude oil as a primary energy source. Now that the problems with continued reliance on crude oil are becoming increasingly obvious to all, there is renewed interest in electrically powered transport as an alternative. Once transport is electrified, renewable energy can be used to power it. Batteries, the *sine qua non* of more widespread electric transport, are however not yet up to the task. Existing battery technologies are generally too heavy, too expensive, or both – i.e., they represent a key technical barrier.



Battery research and development are some of the many things that chemical engineers and industrial chemists do. Your challenge will be to design, build and test a battery for electric transport. There is no “right” answer to this problem, rather there are many ways this might be achieved. The “best” design in the context of this project is the one that best satisfies the design goals of the testing regime and as are laid out in the design brief.

Figure 1 - RAV4EV cutaway view, courtesy of dontcrush.com, via Toyota Motor Corporation.¹

¹ <http://en.wikipedia.org/wiki/Image:Rav4evdrawing.jpg> This image is copyrighted. However, the copyright holder has irrevocably released all rights to it, allowing it to be freely reproduced, distributed, transmitted, used, modified, built upon, or otherwise exploited in any way by anyone for any purpose, commercial or non-commercial, with or without attribution of the author, as if in the public domain.

School of Computer Science and Engineering

CompSci: Robo Rescue

Design Task

Your team will build a robot to navigate through a maze, find a small bottle, pick it up, and then exit the maze.

Your team will:

design and construct a robot using the Lego Mindstorms Robotic Invention Set

1. program a Lego RCX microcontroller brick to read the robot's touch and light sensors and control its motors
2. create a maze to test your robot and those of other groups

You are limited to one RCX brick, three motors, three light sensors and two touch sensors and the brick itself only has 32k of memory, so you must make efficient use of the hardware and memory.

Design Objectives

The robot must:

- Complete the task within a 3 minute time limit
- Be less than the size and weight limits
- The program that controls the robot must be well organized and well documented.
- The maze you create must be challenging and look good.



For more information see <http://www.cse.unsw.edu.au/~en1000>



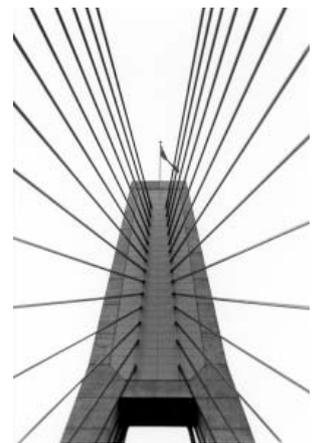
School of Civil and Environmental Engineering

**ENGG1000: CIVIL INFRASTRUCTURE
(LE PONT DE PAILLE BRIDGE)**

**PROJECT
CVEN01**

Objectives: The objectives of this project is to introduce you to the profession of Infrastructure Engineering through the studies of engineering design and innovation whilst maintaining context to the profession of Civil Engineering and the role and practices of Engineers in a modern profession. An important aspect in contemporary design is design for a sustainable future and, thus, infrastructure lifecycle design is a key characteristic in the professions modern development. To this end, a series of lectures on developing sustainable infrastructure is integrated into the key project lectures. Whilst taking on serious issues and reviewing the role of Engineers within a societal context, the subject is also designed to be a bit of fun!

Design Task: Students in groups will design and construct a bridge to withstand a load generated by a truck loaded to 5 kg rolling from a height of 0.5 metres above the structure. Allowable materials for the superstructure of your construction are cardboard, paper, sticky tape, glue and string. For the roadway surface also, only cardboard or paper should be used. The total mass of the structure (including road surface) is not to exceed 450 grams.



Marks will be awarded based on construction and aesthetics as well as performance. The design report will include sections on:

- the design philosophy – why the chosen design?
- a 2D elastic simulation of the structure indicating highly loaded members or regions
- a CAD drawing of the structure showing a plan, elevations and important details
- the performance test results
- an appraisal on the performance of the structure

Details of the project are given in Appendix A.

Project Lectures

You will be presented with a series of lectures will be used to complement the project and are outlined in Table 1 and presented in detail in the School course profile.

Table 1: Lecture template for Project 1

Project 1 Specific Lectures	Lectures in common with Projects 2 & 3
Why things don't fall down! Structural modelling tools and how to justify my design. Triangulated and cabled structures. Smart materials and smart structures.	Teamwork Sustainable design and construction technologies and practices. Societal and environmental ethics Engineering drawing (CAD).

Recommended Reading: Gordon, J.E. (2003). Structures: or why things don't fall down, Da Capo Press, Cambridge, Mass., 395 pp.

Salvadori, M. (1980). Why buildings stand up: the strength of architecture, Norton, New York, 323 pp.

School of Civil and Environmental Engineering

CivEnvEng-02 Engineering in Development – Water for a Cambodian Village



More than ever, engineers are turning their attention to areas in the world where the need is greatest. This project will allow you to learn from those who have taken their engineering skills to developing regions, and to try your hand at designing for a Cambodian context.

Design Task

Your task will be to work as a member of a small team to design a new community that is to be established in the Kampong Speu region of Cambodia – about 2 hours drive from Phnom Penh. Its purpose will be to provide a new life for approximately 100 families who are living in Phnom Penh under impoverished conditions, and provide them with the basics needed to start a new and better life back in rural Cambodia. An emphasis will be placed on ensuring this a sustainable village.

Design Objectives

You will design a complete system for the community that will provide:

- clean and reliable supplies of water throughout the year;
- appropriate methods of dealing with the wastewater from the community;
- adequate sanitation (toilet facilities) for the new village.

Designing such a project for Cambodia is very different from designing it for Australia. The Cambodian school must be able to sustain and maintain its own water system. Other local villages should be able to replicate and rebuild each design. Effort should be made to use locally available materials. Low dependence on village electricity and water supply systems is desirable.

Further Information

Further details on the structure of the CVEN projects, the objectives and the assessable tasks are given at <http://www.civeng.unsw.edu.au/currentstudents/courses/engg1000/>



School of Civil and Environmental Engineering

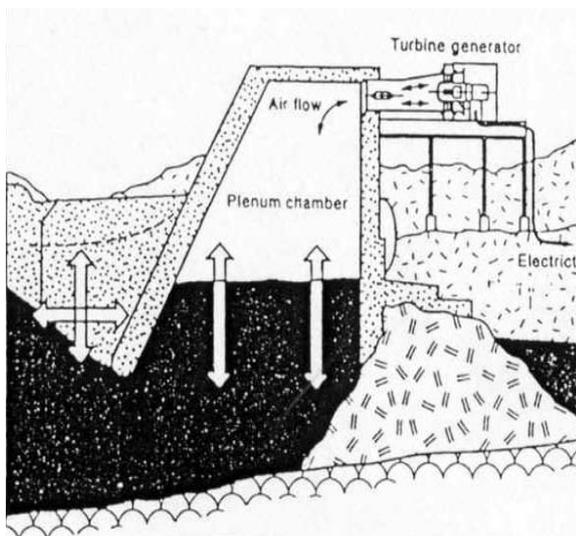
CivEnvEng-03: Civil-Environmental Infrastructure – Wave Energy from the Oceans

Design Task

Your task is to work within a small team to design a device to extract wave energy from the ocean. You will test your model in a wave flume under controlled laboratory conditions. Both civil and environmental design aspects will be central to the design process. The natural variability of environmental conditions will be a key consideration in the design and testing of your wave power device.

Design Objectives

Design, construct and test a scaled physical model of a wave energy device. Working in groups, you will design, construct and test the performance of a wave energy device. Powered by waves, the device is to be designed to harness the power of sea waves to generate power. Limitations on the construction materials will be in place and designs will be tested in a wave basin in the Hydraulics Laboratory in the Civil and Environmental Engineering Building.



The design report will include sections on:

- the design philosophy – why did you choose this design?
- difficulties encountered and if and how you overcame them,
- test conditions and their selection,
- measurements undertaken on the model
- some calculations on the power generated in the model
- a CAD drawing of the structure, and
- an appraisal of the performance of the device, including a calculation of the power available from the waves.

(Source: <http://www.irishscientist.ie/p186a.htm>)

Further Information

Further details on the structure of the CVEN projects, the objectives and the assessable tasks are available from <http://www.civeng.unsw.edu.au/currentstudents/courses/engg1000/>

School of Electrical Engineering and Telecommunications

Even Smarter Cars

Have you ever got a speeding ticket? Ever been fined for breaking a red-light?



Could you imagine having a car that detects the speed limit, and adjusts its speed to suit, or at least warns you of the danger? How about a car that detects whether it needs to stop at a red-light or slow down for a school zone? Are such vehicles that far off in the future?

http://www.msnbc.msn.com/id/15321899/ns/technology_and_science-innovation/

<http://www.autoblog.com/2010/06/03/audi-travolution-project-has-cars-and-traffic-signals-talking/>

The Design Project

Your mission is to build a car which can drive and understand basic traffic rules by itself. It will need to be able to stop for traffic lights and slow down for school zones along a set track. The aim is to make it through the course as fast as possible, however you'll receive time penalties for running a red light and breaking the speed limit in school zones. There's no penalty for going through an intersection on yellow – the challenging is being able to judge whether or not you're going to make it!

Sound too easy? Well what if you're designing an ambulance that can't afford to wait at an intersection? Every system is 'hack-able' and our traffic light system is no different. Each traffic light has an override-code. If you're up for the challenge, then forcing a red light to go green could make your journey even faster...

How will the project work? Your team, of at most 6, will be assigned a mentor from the academic staff, with whom you will meet for 1 hour each week. You'll also have weekly laboratory sessions where you'll be looked after by enthusiastic, highly capable demonstrators, most of whom are students who excelled in EE&T design courses. To sign up, please visit the course's Moodle page and follow the EE&T project instructions.

What if I don't know anything about Electrical Engineering? The project assumes no prior knowledge of electronics or electrical engineering. To make your learning experience as fruitful and focused as possible, the School of EE&T will provide a series of targeted lectures covering electronic circuit design principles, with many relevant examples. The material in these lectures is valuable also to students taking other degree programs, since an elementary understanding of electrical circuits is required in many disciplines.



¹ Photo sources: <https://wiki-land.wikispaces.com/Smart+cars;>
<http://stage.macarthur-chronicle->



School of Biomedical Engineering

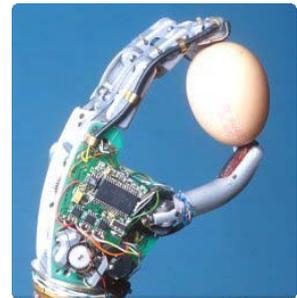
BioMedEng: Bionic Hand

Design task

Hands are pretty, well, *handy*. It can be argued that hands were the major driving force behind the evolution of the human brain. Our upright posture freed our hands so that they could start *manipulating* things. Our brain then evolved in new directions because of the greater scope for doing. No dispute. Hands are useful.



The task is to design and build a mechanical hand prosthesis, a device that will replace the function of one hand. The intended client might be an amputee or a quadriplegic. The prosthesis is to be fixed to the forearm. The method used to activate the hand is open. Some possibilities are:



Direct muscle activation

- Any muscle can be used directly to activate the Bionic Hand, as long as that muscle is not associated with the hand whose function is being replaced.

Indirect muscle activation

- Muscle movement can be converted to an electrical signal which in turn is converted to a mechanical force that activates the Bionic Hand.
- Muscle electrical (myoelectric) activity might be converted to a mechanical force.

The hand may be built from materials bought in a supermarket, hardware, hobby or toy shop for less than \$100 total. Junk is free. Special components that might be useful will be made available by the School (perhaps for a virtual fee). Teams may consult with "experts" on specific fabrication or design problems. There may be a (virtual) charge for these services.

Design Objectives

The Bionic Hand should be designed to carry out the following tasks:

1. Pour water from a bottle into a soft plastic cup and drink the contents without spilling. The elapsed time will be measured and judges will assess the degree of spillage.
2. Stack a set of plywood boxes as high and fast as you can.
3. An unrehearsed object pick-up. Pick up 10 objects of various sizes and place them in a basket.

Teams will be ranked in order of performance on each task. An overall rank will be calculated as the mean rank.

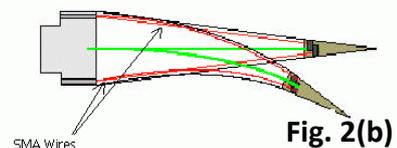
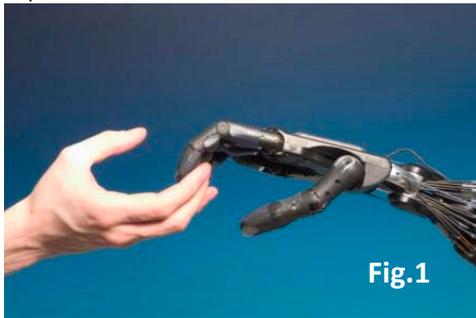


School of Materials Science and Engineering

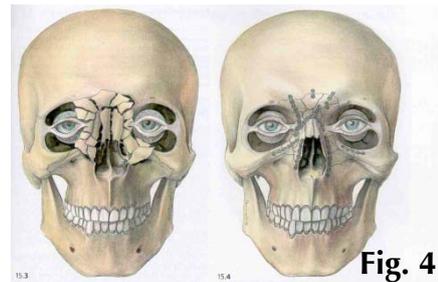
Materials: Advanced Application of Shape Memory Effects

Design Task

Shape memory effect is a process of restoring the original shape of a plastically deformed sample by heating it. Some alloys called Shape Memory Alloys (SMA), such as NiTi, CuZnAl, and CuAlNi etc. possess this effect. The extraordinary properties of SMA are being applied to a wide variety of applications in a number of different fields and have become the bases of advanced technologies. For example, biomedical and mechanical engineers can't make an advanced "robot hand" without the artificial muscles made with SMA (Fig. 1). SMA is also the unique material used to fabricate a huge antenna with hemispherical shape in satellites. SMA has been widely used in aerospace (Fig. 2) and robot industries.



SMA exhibits a number of remarkable properties, which open new possibilities in engineering and more specifically in biomedical engineering. For example, the dental braces were developed to exert a constant pressure on the teeth with SMA (Fig. 3). The excellent biocompatibility of SMA makes it an ideal biological engineering material, especially in orthopaedic surgery (Fig. 4) and cardiovascular stents.



Design Objectives

There are many possible applications for SMAs. Future applications are envisioned to include engines in cars and airplanes and electrical generators utilizing the mechanical energy resulting from the shape transformations. In this project, we will use the shape memory alloys to build an engine which can be driven by the wasted heat. How to design a high performance heat engine with SMA is a great challenge. In this project, the students are required to:

- (1) understand the principle of shape memory effects associated with the materials,
- (2) design a high performance heat engine, and
- (3) build a prototype of the engine.

The performance of engine will be evaluated by determining the rotating speed of the engine.

School of Mechanical and Manufacturing Engineering

MechEng: Project FUBaR

Background

For more than 20 years, students from universities across Australia have been participating in the annual Weir Warman Student Design-and-Build Competition. Students in the MMAN stream will compete in the Competition as part of MMAN 2100 in their second year. As well as being a vehicle by which you will achieve the learning objectives of ENGG 1000, our project this Session will give you a taste of what to expect and prime you for a competitive run in second year. For more information about “The Warman” (including the perpetual trophy and cash prize!), start here: <http://www.ncedaust.org/index.php?select=151>.

Design Task

The project is set on the mythical planet Gondwana which has only recently been civilised. For support during the early stages of the development of their planet's infrastructure, the Gondwanans are heavily dependent on visitors from Earth. A rich seam of Unobtanium has recently been discovered in the vicinity of existing infrastructure. This discovery will, in the long term, prove to be a great boon to Gondwana's economy but in the short term has created headaches with regard to materials handling. Owing to the unstable nature of freshly-mined Unobtanium, an unmanned, autonomous system must be devised to transport the fresh ore to the processing facility. To prevent issues with critical mass, the ore must be handled and transported in discrete packets – thus making traditional conveyor systems unsuitable.

The Challenge

The challenge is to design a prototype system to meet the needs of the Gondwanan industry. You will work in groups of five or six to design a system which moves stocks of a valuable and sensitive material. Resources on Gondwana are limited, so the machine presented as part of the winning tender will be constructed from commonly-available materials using simple processes which may be performed by unskilled workers. Your team's objective will be to optimise the overall performance within the criteria listed below:

- Use one vehicle to carry out safe, reliable delivery of the load.
- Compliance with rules regarding size, movement and positions of vehicles during transfer.
- Working within time constraints to complete the transfer and delivery of the load.
- Demonstration of innovation, styling and simplicity.

The Gondwanans have named the assignment Project Grab and Stash. The Engineers from Australia have dubbed their tender Project FUBaR - *Find Unobtanium, Bundle and Relocate*.



Impressing the Judges – 2010



Warman Competition National Final - 1994

School of Mining Engineering

Mining: Student Developed Project

Introduction

In a departure from the usual approach to this design project where we decide the project title and ask you to design, build and test it, this year we want you to come up with the topic of the design project and then manage it and present a final product for evaluation.

The initial challenge for you is with limited background experience in mining to come up with a simple but achievable task that represents a specific aspect of mining. You could consider the rationale behind this is for you to design and build a model to be shown to say senior High School students and be able to explain its operation.

Design Task

You will work closely with your mentor in the selection of a suitable and achievable project and as many of your group members will be undertaking MINE1010 in conjunction with this course, they will provide much of the technical input into the design.

The final outcome of the project will be the production of a short documentary to be uploaded to YouTube for all to see. A number of the 2009 submissions will be available on Moodle to give you some ideas.

Design Objectives

In broad terms the design must be representative of an aspect of mining, simplicity of operation is preferred, the rationale behind the design must be clearly linked to the outcome of the design process. It is meant to be a serious design project – software including AutoCAD will be made available to you as will tuition on report writing, formal presentation techniques etc.

The aims of this project are consistent with the aims of the course in general, and are to:

1. Introduce you to the principles and methods of engineering design.
2. Involve you in hands-on design and engineering projects.
3. Help you gain skills in written expression.
4. Introduce you to the way a professional engineer works.
5. Provide a team-based environment so you can experience and learn collaborative skills.
6. Help you learn the professional use of new information resources.

I am sure you will find this a challenging and enjoyable project.

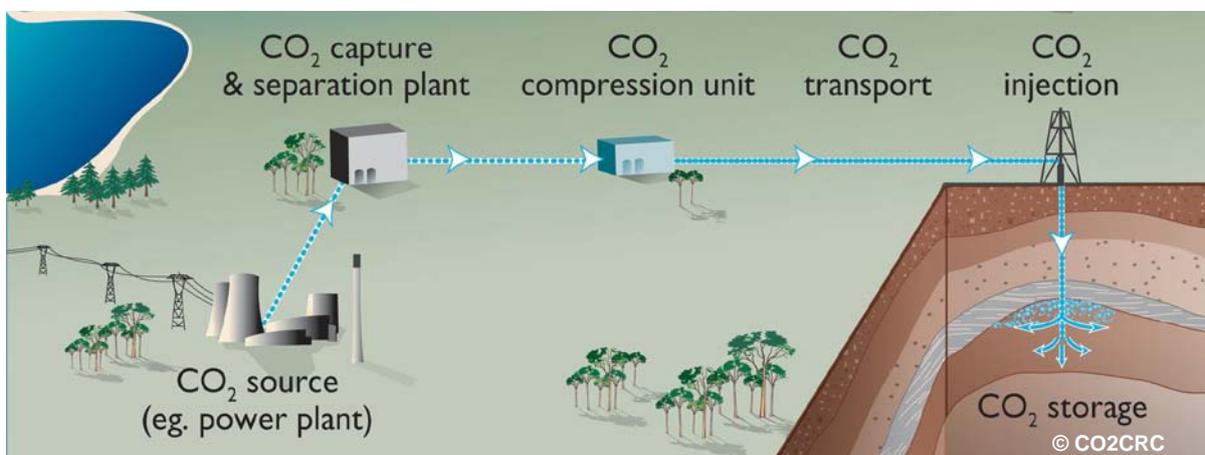
School of Petroleum Engineering

Petroleum: Geological storage of greenhouse gases

Putting carbon back where it came from

One of the main greenhouse gases causing climate change is carbon dioxide (CO_2). It is estimated that 7 billion tonnes a year of CO_2 emissions come from human activity. According to International Energy Agency, the current estimation of greenhouse gases per capita is about 3.9 tonnes per annum, which is slightly above the estimated sustainable limit (3.5 tonnes per annum).

As awareness of the threat from climate change has grown, research has turned to carbon capture and storage (CCS). CCS is one of a suite of methods proposed to reduce carbon emissions into the atmosphere. CCS can be applied to stationary sources of CO_2 like oil and gas fields, power stations steel works, aluminium refineries, and cement plants. In a CCS process CO_2 is captured from the source, transported to a storage site and injected into deep geological structures. The main types of geological storage structures are oil and gas reservoirs, saline aquifers and unmineable coal seams.



Design Task: Your task is to design and build a device that will take CO_2 (represented by coloured water) from a holding tank and inject it into a model saline aquifer. The model aquifer will be supplied by the school and consists of a rectangular plexiglass reservoir packed with unconsolidated sands and saturated with salty water.

Design Objective: To maximize the amount of ' CO_2 ' effectively stored in one minute in a model saline aquifer while also minimising the cost per unit of ' CO_2 ' avoided. The amount of ' CO_2 ' stored is the difference between the water injected into the model aquifer from the volume of the water discharged. The amount of the ' CO_2 ' stored depends on the design of the pump and how efficiently the water is displaced from the sand. A simple economic model will be used in order to calculate the cost per litre of ' CO_2 ' stored.

Design Constraints: The pump must be operated manually and should be constructed from simple materials which can be purchased from any hardware store. The total cost for the device shall not exceed an amount specified by the School in Week 2. Therefore using surplus or waste materials is recommended as a simple way to minimize costs. The initial volume of water in the model aquifer will be 2 litres. The pump shall be secured to a platform (20cmx50cm) mounted on top of the model aquifer supplied by the school.

School of Photovoltaic & Renewable Energy Engineering

Project PHOT01: Space Elevator

Design task

Find a cheaper and safer way into space, powered with renewable energy! Using solar-electric panels and motor provided, plus any other materials of “no commercial value”, design a “Space Elevator” that can climb to the top of a 7-metre “Space Tether” and return back down, safely. Your group will design, construct and test an elevator, and then compete in a contest to determine the best performing design in several categories.

Your elevator must climb on the 2.5-cm-wide nylon strap (the Space Tether) that will be suspended from 7 meters to the ground. Gears, bands, belts, pulleys, balsa, plastic, glue, spit, tape – basically any materials of no commercial value – can be used in the construction. The more recycled materials, the better! However, the only allowed source of energy is the solar panels provided – no batteries, wind up devices or other forms of energy storage are allowed. Your elevator must also be completely self contained and have some way that allows it to make a controlled return to the ground safely (falling doesn’t count). The elevator must also carry a “Space Tourist^{*}” to the top and back again safely.



Check out NASA’s Space Elevator Contest: <http://www.spaceelevatorgames.org/>

* The Space Tourist is a small figurine provided by the group.

Design Objectives

Your team’s objective is to design, test and build a Space Elevator that will (1) meet the design constraints (to be provided), (2) be constructed from no commercially valuable materials and (3) climb to the top of the Space Tether and return in a controlled manner back to the ground in minimum time. Space Elevator designs will also be recognised for:

- Highest climb, fastest climb to the top and fastest round trip
- Coolest looking design (usually very competitive)
- Most innovative feature
- Best construction
- Best use of recycled materials
- And more...