School of Mining Engineering
Engineering Design and Innovation

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ENGG1000
Engineering Design and Innovation
Mining Component
Course Outline

SESSION 1, 2014

STAFF INVOLVED IN THE COURSE AND THEIR CONTACT DETAILS

The following staff members have been allocated to this module. For any assistance or queries outside your allocated tutorial times, please arrange via email.

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INFORMATION ABOUT THE COURSE

What this course is about

Engineers solve problems! These problems can range from rather simple problems such as how to keep a door from blowing open on a windy day, to highly complex problems, such as how to land an unmanned spacecraft on the surface of a distant planet. You might ask what could these two vastly different types of problems have in common? The answer is simple: Design! However, design is anything but simple and can take an entire lifetime to master. Design is the act of creating solutions to problems. While often we are asked to design an improvement to an existing solution, where that solution can be somewhat predictable, (for instance next year's line of new Holden Commodores), we must strive to look at each problem with a view to innovation. What new technologies, material, techniques and imaginative ideas can we bring to bear on the problem? And how can we do this and still ensure that we can deliver our solution within very real cost and time constraints?

In this course we will focus on the skills, concepts and methods needed to design innovative solutions to Engineering problems. We will look at Design as a multi-faceted activity which requires considerable creativity, sound decision making and problem solving skills, as well as excellent interpersonal and communication skills. The problem solving and project management skills that you learn will be invaluable for later courses in your degree.

You will get the opportunity to demonstrate your competency at these skills by experiencing first hand what is required to design, build and test your solution to an interesting design problem in the same way that professional engineers all over the world are doing right at this moment.

For the work in this course, everyone will be assigned to a group for the duration of the course. Most of the activities and assessments in this course will be conducted through the group although individual performance will be monitored and assessed as it would be in industry. Make use of the wide range of experience within your group - you are all well-educated and capable, and there is much you can learn from one another.

In this course we will be concerned with the design of a mechanical engineering device. There are two main ideas to be explored:

- Engineering activity usually results in the creation of a tangible artifact, produced to satisfy human needs. This artifact comes into being through a systematic process of decision making and activities called the engineering design process.
- If the artifact is complex (think of an aircraft) knowledge and skills from many diverse engineering disciplines will be needed by designers to make the design successful.

A study of these diverse areas in engineering science will occupy much of your time in later years. To do this you will need some basic introductory knowledge of engineering design concepts, which are the focus of the lectures.

A large part of engineering design involves synthesising basic engineering components to form new products. To do this well you need to be familiar with some basic engineering science, including materials, manufacturing/workshop processes and testing methods which are the focus of the labs.

The objectives of the course are to:

- Introduce you to the principles and methods of engineering design.
- Involve you in a number of hands on design and engineering activities.
- Provide a team-based environment so you can experience and learn collaborative skills.
- Help you improve your skills in written, verbal and graphical communication.
- Familiarise you with the roles and responsibilities of a professional engineer.

The teaching strategies that will be used and their rationale

The teaching strategies that will be used include:

- Presentation of the material in weekly **Lectures** so that you gain an understanding of the underlying concepts that will be needed to perform your assignments and develop your major design project.
- Provision of experienced design **Mentors** who will provide face to face feedback and advice on your progress through the course and your understanding of engineering design, project management and team development skills.
- Provision of a **Major Design Project** where you can practice your design skills and demonstrate your understanding of the fundamental concepts of design, teamwork and project management.
- Provision of **Assignments** that will give you the opportunity to demonstrate your understanding of the lecture topics and obtain feedback on your comprehension and communication skills.
- Provision of a **Moodle** based online learning environment where you can collaborate in discussion groups and acquire the necessary information to complete your assignments through interaction with lecturers, mentors and your peers.

Suggested approaches to learning in the course

- Regular attendance and participation in lectures.
- Diligence in working through the assignments and major project activities.
- Effectively utilising mentors.
- Reading the assigned textbook as well as additional reading, on and about the material presented in lectures to broaden your understanding.
- Working effectively with the other students in your design team.
- Maximising the use of Moodle.
- Making regular use of your team's Wiki to record your progress.

Expected learning outcomes; their association with the teaching strategies and with the suggested approaches to learning

On completion of the course, it is expected that the student will:

- Be familiar with the process of engineering design and the use of design methods for defining an open-ended design problem, generating alternative and innovative conceptual solutions and evaluating these solutions.
- Understand the dynamics of collaborative teams and how to work effectively within a team to accomplish tasks within given deadlines.
- Understand the basic elements of managing a design project and be able to plan and schedule work activities in accordance with standard practice.
- Be able to organise, conduct and record engineering meetings.
- Be able to effectively convey his/her thoughts and ideas in an engineering design report and in formal presentations and critiques.
- Understand the roles and responsibilities of a professional engineer and the importance and relevance of ethical and professional behaviour in that role .
- Be able to understand the issues of quality, safety, diversity and equal opportunity as it applies to university and professional life.

Student-centred and self-directed learning (expectations of the students)

This course involves typically 3 hours per week of face-to-face contact in the form of lectures and mentor meetings. It is suggested that the student put in, on average, an additional 6 – 8 hours per week of his/her own time (including stuvac and exams periods). This time should be spent in revising the lecture material, studying the assigned text, further reading, and working with your group to complete the major project and set assignments.

For class schedule please refer to the single page in the Moodle Mining Project folder. Check back regularly for updates as there are liable to be some at least minor changes as semester proceeds.

There are two projects being offered by the School on of 80 places and one of 40 places. Each team of 8 will have an assigned Mentor.

ASSESSMENT IN THE COURSE **Due dates to be confirmed – please see timetable in Moodle. Week 7 submissions will be incorporated into 1 submission.**

Assessment in this course consists of a mixture of individual and group assessments. The assessments will follow the scheme given in the following table.

Activity	Weight	Contribution	Task	Due Date
Impromptu Design Activity	0%	Group	T1	Week 1
Impromptu Design Reflection	5%	Individual	F1	Monday Week 2
Learning Portfolio	20%	Individual	T2, T3, T4	See project plan
Gantt Chart and Minutes	5%	Individual	T5	Week 7
Prelim Peer Review	0%	Group	*SPARK*	Week 7
Preliminary Design Performance	5%	Group	T6	Week 7
Risk Assessment	5%	Individual	T8	Week 7
Client Presentation	10%	Group	T7	Week 9
Demonstration Day	30%	Group		Week 11
Video	10%	Group	T9	Week 12
Final Report	10%	Group	T10	Week 12
Final Peer Review	See Below	Individual	T11	Week 12

Where appropriate specific date and times will be displayed in Moodle together with Submission Boxes.

As can be seen, the the total course marks consists of **35% individual** and **65% group** marks. To ensure that all students participate equitably in group assessments there will be a **Peer Review** process whereby each student will be evaluated by every member of their group. The results of this Peer Review will determine your final group mark. The Peer Review component will constitute a maximum of 30% off of your group mark. That is, you stand to lose up to 30 x 0.65 = 19.5 marks off of your total group marks for non-participation in group assessment activities. Group work is an important part of the assessment, and we expect each member to play their part in making your group into a successful team. **If you are unlucky and are in one of the few groups each year which develop problems, tell your mentor or Chris Daly early so they can do something about it in time.**

Individual Task Details

T1 [Impromtu Design Activity]
The Impromptu Design Activity will be held on Thursday of Week 1 and does not count toward the final mark, but will be the basis for Reflective Assessment F1 in Week 2.

F1 [Impromptu Design Reflection]
This is a Faculty written assessment.

T2, T3 and T4 [Learning Portfolio]
The first part (A) requires a short essay style written assignment covering the three Phases of the Design Process. The second part (B) requires a critical analysis of the written work of your peers. Please refer to the Learning Module on Moodle.

T5 [Minutes and Gantt Chart]
You will be expected to submit formal minutes of your group meetings along with a Gantt Chart depicting your groups planning and scheduling to achieve the successful delivery of a prototype on the evaluation day.

T6 [Preliminary Design Performance]
This is a practical exercise requiring you to estimate through measurement and calculation, how your prototype will perform in the final competition. We will need to see something built to illustrate all or a component of your final design.

T7 [Design Proposal]
This task involves a formal verbal presentation on your design. It could be thought of as a presentation to a prospective client who has to choose one of the 8 designs for investment in.

T8 [Risk Assessment] This consists of a brief Risk Assessment to be undertaken on the final design if it were to be used in a mining environment. It is an individual submission.

T9 [Final Design Performance]
This is your opportunity to demonstrate the operation of your model to an audience. The assessment criteria is available separately.

T10 [Final Test Report]
The proposal will be in the form of a professionally formatted engineering report that summarises the first three design phases with a project plan, budget estimate, test results. This is a sufficient design description package that could be handed over to a client if required.

T11 [Peer Review]
To ensure that all students participate equitably in group assessments there will be a **Peer Review via SPARK** whereby each student will be evaluated by every member of their group. The results of this Peer Review will determine your final group mark.

Peer Assessment:

Group performance is a key component of the assessment for this course. The sole measure of performance of team work is by peer review. Teams which are having problems with unproductive or non-cooperative members are encouraged to seek the intervention of the course coordinator as early as possible. Do not leave these problems to the last minute. SPARK will be used as peer assessment tool and a link to the Student Starter Guide can be found on Moodle. The PEER REVIEW is required for all group assessments. SPARK is an online tool that will be used to collect Self and Peer Assessment data. These data will be used to provide feedback to, and receive feedback from, your group members regarding contributions to the project.

Based on a series of answers from each group member SPARK automatically produces two weighting factors. The SPA or Self and Peer Assessment factor is a measure of how the group overall viewed the contribution of each member of the group. This factor will be used to adjust the group mark for the project into an individual mark.

Individual mark = Group mark x Individual's SPA

For example; a student who receives an SPA factor of 0.9 for their project contributions, reflecting a lower than average team contribution as perceived by a combination of themselves and their peers, would receive an individual mark of 72% if their group project mark was 80%.

The second factor calculated is the SAPA factor. This is the ratio of a student's own self assessment rating compared to the average rating of their contribution by their peers. It provides students with feedback about how the rest of the group perceives their contribution. For example, a SAPA factor greater than 1 means that a student has rated their own performance higher than they were rated by their peers. Conversely, a SAPA factor less than 1 means that a student has rated their own performance lower than they were rated by their peers.

Important: Students who do not complete and submit the required peer review tasks on SPARK on time will lose 20% of the group's assessment mark and their peer review mark will be calculated based on the other group members' submission.

Both factors for each student will be released to all group members.

The idea of using SPARK is not only to make group work fairer and provide feedback on your performance but to encourage the development of your professional skills. These skills include giving and receiving both positive and negative feedback, conflict resolution, collaboration, the ability to assess both your work and the work of your peers and developing your professional judgement. If you successfully achieve these learning outcomes your group experience should be productive. Teams that contain students who do not adequately participate in group activities and/or develop their teamwork skills typically have friction between group members.

Objections: The initial SPA and SAPA factors will be preliminary, and only become official after any protests are considered. Any students believing their SPARK assessments were unfair may lodge an objection. Any objection to yourself and peer assessment ratings must be made in writing to the lecturer in charge of the course. Each objection must be a maximum of 500 words (12 point Times New Roman font) clearly outlining why you believe your rating is unfair. Your protest will be discussed

with the other members of your group. Objections must be lodged within 3 days from the date that the SPARK assessments are released.

An objection usually indicates that at least one member of a group has not achieved the teamwork learning objectives. Marks are only awarded for successfully achieving learning outcomes. The lodgement of an objection will be considered as a request for reassessment of the entire group. Hence if a student lodges an objection the marks for the entire group will be reassessed and released after the objection has been considered. In considering any objection the log books and or meeting minutes for a group will be reviewed.

Students must put up a bond of 5% of the assessment result to lodge an objection. If the objection is found to be unwarranted then the student who lodged the objection will lose the 5% bond. If the objection is found to be warranted the saboteur or saboteurs will lose 5% and the groups SPA's will be altered accordingly.

The course coordinator reserves the final right to review and alter the SPA factor.

School of Mining Engineering

Mining Engineering Project: MINE01

Open Cut Coal and/or overburden removal system

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Background

An open cut coal mining company has announced that it is seeking expressions of interest in designing and presenting an overburden or coal removal system for their mining operation in the Hunter Valley of NSW. Historically draglines have commonly been used in open-cut coal mining operations to remove overburden material, uncovering and providing access to the coal seam beneath. Once the coal seam has been exposed coal can be extracted by such techniques as a bucket wheel excavators or by truck and shovel methods. Draglines are high-capital-cost/low-operating-cost systems typically costing between $50 and $100 million AUD. They are very large, heavy and highly productive pieces of machinery comprised of a bucket that is suspended from a boom (typically 45-100m) by two cables known as the 'hoist rope' and 'drag rope'.

A Bucket wheel excavator costs approximately the same as a dragline but is used to load coal rather than overburden material. The coal is cut and transported to a conveyor using buckets on an endless belt.

The third common approach to overburden and coal removal is via a truck and shovel operation. In this operation the shovel can perform a dual purpose of loading coal or overburden for road transport to a dump or crusher.

Your Task

The aim of this project is for your team to investigate the 3 existing methods of surface mining with the aim of redesigning one approach to improve its efficiency. However you could also design a completely new and innovative approach to materials handling if you wish. It is up to you but at the end of week 12 we need to see an operating model of your design which will be evaluated on basically the efficiency, innovation, creativity and functionality.

Full specifications will be provided by week 3. We will provide you with small motors, gear boxes etc as well as a moderate budget to assist you in building the model. All power must come from dry batteries. Workshop facilities and basic hand tools will be available for your use during the semester. Interaction with mining staff will be available during the semester. Representatives from the mining industry will be present during the final presentation of your model.

School of Mining Engineering

Mining Engineering Project: MINE02

Off World Mining Project

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Background

This is a cross discipline ENGG1000 project resulting from from the Off Earth Mining Forum held last year at UNSW and organised by ACSER, The Australian Centre for Space Engineering Research.

http://www.acser.unsw.edu.au/

Why this Project?

'As history has repeatedly shown, where there are valuable minerals to be unearthed, adventurous humans will arrive in droves - even if it means battling extreme conditions and risking life and limb. So what will happen when the next great "gold rush" in our history is quite literally out of this world? And what kind of technology would be needed for the mining?

Business analysts may poke fun at the "impossibly" expensive cost of mining nearby celestial bodies such as asteroids, or even the moon, but these pursuits are not beyond the realm of possibility. Returning to the moon for the purposes of mining will require new technologies and new ways of thinking, and this extends to the conventional business model. We cannot write these pursuits off based on high cost alone, especially given the hidden treasures to be found. Demand for "rare-earth" minerals (which are used in a range of technologies) is rising sharply, but their supply is extremely limited.

http://www.acser.unsw.edu.au/oemf/presentations.html

Your Task

In conjunction with your Mentor you are required to design and construct an item of mining machinery to operate on the moon or in space. You can mine the moon or you can mine an asteroid. I will provide you with specifications for an asteroid 'miner' but as this course is all about Design and Innovation all design initiatives are welcome to be discussed with your mentor. It is meant to be an innovative but feasible cross disciplinary project hence your team should have not only miners but have representatives from other disciplines to provide specialised input.

There is a considerable amount of information on this topic and there will be guest lectures from specialists in this field. Places are limited to 40 students.

Full specifications will be provided by week 3. We will provide you with small motors, gear boxes etc. All power must come from dry batteries. Workshop facilities and basic hand tools will be available during the semester. Interaction with mining staff will be available during the semester. Representatives from the mining industry will be present during the final presentation of your model.

Marking and Submission of Assessments

All assessment activities (except for T6 and T10) will be administered and submitted electronically through Moodle and are typically due Friday at 5pm in the week indicated in the course schedule above with additional details provided in Moodle.

All written assignments will be assessed on your ability to adhere to the recommended formats for submission and on the quality of your discussion in relation to the content. Whilst it is appreciated that for some students, English is a second language, this course will require you to submit written work that is of a reasonable standard for a first year engineering student. If you feel that this may be a problem for you, please contact the Learning Centre for additional assistance: www.lc.unsw.edu.au

There will be no provision for late submissions – **no submission means zero marks**. If you encounter difficulties with deadlines please discuss with Chris Daly asap.

Construction Area

A limited construction area, and by negotiation with me will be provided for you to build your prototype and to conduct any experiments and tests that you think are needed to validate your design concepts. I can also provide some assistance with the video production. I am assuming you will use your own camera to produce the video and basic editing software should be freely available to help you. Any questions please ask.

Safety in Laboratories

The University observes strict safety precautions in laboratories for the safety of us all.

- Students are not permitted to work unsupervised in the laboratories.
- Thongs, open-toed sandals or bare feet expose the feet to the risk of injury and are not permitted in laboratories. Footwear must completely cover the feet, including toes, or you will be required to leave the laboratories

Long hair and loose items of clothing, such as unbuttoned long sleeves and neckties are a safety hazard and have caused many serious injuries. You will not be using rotating machinery in this course, but please get into the habit of wearing safe clothing in laboratories and workshops.

Mentor Meetings

Wisdom is gained most effectively by attempting to avoid the (often painful) mistakes of those who have come before you. Your design team will be assigned a mentor who will be able to provide you with the advice, feedback and encouragement you will need to learn how to perform effectively as an engineering designer. Make full use of these experienced people but do so in a professional manner. **Your mentors are busy people like yourselves. Please make specific arrangements with them if contact is required outside of the allocated meeting times for your group.**

Adverse Performance – Special Consideration

In cases of illness or other extenuating circumstances that may adversely impact on performance in a course, it is recommended a student apply to Student Central for *Special Consideration*.

For further information, see the Policy section on the School webpage at
www.mining.unsw.edu.au/information-about/our-school/policies-procedures-guidelines

RELEVANT RESOURCES FOR STUDENTS ENROLLED IN THIS COURSE

Required Texts
Your assessments will require that you obtain a copy of the following text:

Dym, Clive L. and Little, Patrick. Engineering Design, 3rd Edition

There are a number of copies in the library reserved section. You might also consider having your group purchase one copy- new or 2nd hand - to save time and costs.

Recommended Reading
"Tools and Tactics of Design", Peter G. Dominick, John T. Demel et al. John Wiley and Sons.

Internet Sites
Course notes, structured exercises and other information needed for this course are available on Moodle at: http://moodle.telt.unsw.edu.au/

ADMINISTRATIVE MATTERS

Information about each of the following matters is available in the Faculty Course Outline for ENGG1000. It is esssential that you obtain a copy, read it carefully and become familiar with the information, as it applies to this course and to each of the other courses in which you are enrolled.

Expectations of students (including attendance at lectures and tutorials; computer usage.)

The staff will do all they can to make this course run smoothly and it is up to each of you to make a success of it for yourself. I suggest that you:

- Read this course information package carefully and keep it for reference - you won't meet the course requirements if you don't know what they are.
- Contact me as soon as you can if you have timetable problems, or any other problems.
- Watch for changes to the program - listen in class, check the Moodle site.
- Report any major problems with your group promptly - most groups work well and are enjoyable, but a few struggle and need help.
- Make sure you contact me if you are ill, or have other reasons for concessions, or have other assessment problems.

Academic honesty (including misconduct, plagiarism)

The University has certain expectations in terms of academic behaviour related to study and research. This is expressed in the University Policy on Academic Misconduct. Students should be aware of and understand this Policy. Links to this and other University and School Policies can be found at:
www.mining.unsw.edu.au/information-about/our-school/policies-procedures-guidelines

Plagiarism is one form of Academic Misconduct. It is the presentation of the thoughts or work of another as one's own[1]. Examples include:

- direct duplication of the thoughts or work of another, including by copying work, or knowingly permitting it to be copied. This includes 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[2].

Submitting an assessment item that has already been submitted for academic credit elsewhere may also be considered plagiarism.

The inclusion of the thoughts or work of another with attribution appropriate to the academic discipline does not amount to plagiarism.

Students are reminded of their Rights and Responsibilities in respect of plagiarism, as set out in the University Undergraduate and Postgraduate Handbooks, and are encouraged to seek advice from academic staff whenever necessary to ensure they avoid plagiarism in all its forms.

The Learning Centre website is the central University on-line resource for staff and student information on plagiarism and academic honesty. It can be viewed at http://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.

Dr Chris Daly
1st March 2014

[1] Based on that proposed to the University of Newcastle by the St James Ethics Centre. Used with kind permission from the University of Newcastle.

[2] Adapted with kind permission from the University of Melbourne.