THE UNIVERSITY OF ADELAIDE
AUSTRALIA

SUB CRUCE LUMEN

School of Mechanical Engineering

Aerospace Program

Student Information Manual

2005

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GENERAL ADVICE

Welcome

If this is your first year with us at The University of Adelaide, welcome to the School of Mechanical Engineering. If this is your second or subsequent year, welcome back and congratulations on your success in getting this far.

The courses that you study in each semester will include lectures, tutorials and practical work and some will include films, videos and site visits. Lectures provide a great opportunity to acquire understanding as well as information and tutorials provide an opportunity to further develop your understanding and test it. As early as possible, you should develop the habit of learning new material, doing assignments, practicals, and the required reading when the work is presented. Hopefully this year you will continue to develop good time management skills, which will serve you well throughout your career. Don't leave all your revision until swot vac – ask your lecturers to clarify points you don't understand as soon as you can.

Attitude

A major difference between the level of enjoyment and success you obtain from the program will be your 'attitude'. Choose to be involved and enjoy the program; turn it into a journey of discovery and give it everything you have.

Seeking help

If you have a problem which is interfering with your studies **seek advice/help as early as possible**. If the problem concerns a particular course it may be best to see the lecturer in charge. If, however, the problem is of a more general nature talk to one of the year coordinators. If you cannot resolve your problem in this way you may see the Head of School or make an appointment with the student counselling service, if the problem is non-academic in nature.

It is usually easier to correct problems as they arise - act sooner rather than later.

Terminology

You are enrolled in a "**Program**" ie BE.(Aero) is called a Program. The individual components that make up the program are called "**Courses**" i.e. Design Practice, Dynamics and Control 1, Thermo-Fluids 1, etc are all called Courses.

Attendance at lectures

Attendance at lectures is highly recommended although not compulsory. Unruly behaviour (including talking) can be grounds for being excluded from the remaining lectures for a particular course. We believe that you as students can benefit greatly from material presented in lectures and it is highly recommended that you attend.

Study Hints

Problems can arise if you fail to attend lectures on a regular basis. It is important that you keep up to date with your studies; it is hard to catch up once you fall behind. Problems can also arise if you do not have the right approach to your studies. In the earlier stages of your program, you should transition from the high school way of doing things to the university way of studying. At high school, the teacher takes a lot of responsibility for your learning and "spoon feeds" you to a large extent. At university, you are responsible for your learning and we try to avoid too much "spoon feeding". At high school, much of your learning may be described as "surface learning" where you try to pick out what is important in a course, then memorise it and regurgitate it in an exam after which you forget it. This type of learning is not adequate for university study where you need to develop problem solving skills and you need to be able to reach a personal understanding of material so you can examine the validity of concepts rather than just accept them. You need to actively involve yourself in the material you are learning, ask questions in class, keep up to date with assignments (do not leave everything until the last minute), read beyond the course notes and make links between the material in one course and that in others. It is important that you do all the assignments either by yourself or as part of a group, but not by copying someone else's work. Copying someone else's work and handing it up as your own is not only unethical, it is very short sighted and damaging to your own personal development.

To be successful as an engineer, you need to use the program as a means of teaching yourself how to learn, how to find information and grasp its meaning quickly and accurately and then use it to solve problems. If you do not develop these skills at university, then you will most likely be an ineffective engineer at best. It is important to realise that your future employers will value your ability to solve problems and be innovative as much as or more than they value your degree certificate. You need to realise that it is crucial to use your time at university to develop in this area by practising these skills at every opportunity (for example, when given sample problems to try or assignments to hand up).

Student Feedback and Mentoring Opportunities

A student staff committee consisting of one representative from each year level, year coordinators, the international student coordinator, the Head of School and the Deputy Head of School meets several times per year and is your opportunity to provide feedback to the staff about your program with the idea of improving our programs and our service to you. If you perceive any problems at all, please make sure your year coordinator or student representative is informed.

In 2005, we will be introducing student focus groups for students enrolled in the aerospace and automotive engineering programs. Dr Kestell will lead the Automotive Engineering group and Dr Schneider will lead the Aerospace Engineering group. All students enrolled in these programs are invited to attend.

All students in their first year in any one of the programs in the School of Mechanical Engineering will be assigned a member of the Academic Staff as a personal mentor. Your mentor will arrange a meeting in the first semester of your first year and we strongly urge you to attend. After that first meeting, we hope that you will feel comfortable in contacting your mentor for advice about anything or to discuss anything that you feel unsure about. Your mentor will remain available to you throughout your entire time as a student in the School of Mechanical Engineering.

Free membership to IE Aust

IE Aust offers free membership to all undergraduate students. For more information please phone the South Australian Branch on (08) 8267 1783.

GENERAL STUDENT ENQUIRES

Enquires about the operation of the School may be directed to the appropriate person on the list below. In an emergency, dial 0000.

POSITION	STAFF MEMBER	ROOM*	PHONE NUMBER
Head of School	Professor Colin Hansen	S116a	8303 5698
Deputy Head	Dr Bassam Dally	S120	8303 5397
Business Manager	Ms Rae Tyler	S119	8303 4125 (Part time)
Business Manager	Ms Lynette Kelly	S118	8303 3658 (Part time)
Office Staff	Ms Wendy Brown Ms Yvette Knapp Ms Vicky Samra	S116 S116 S116	8303 5460 8303 5460 8303 4124
Postgraduate Co-ordinator	Dr Anthony Zander	S308	8303 5469
Laboratory Organisation	Mr Alan Mittler	SM04	8303 3151
Senior Technical Officers	Mr Ron Jager *(Mechanical Workshop)*	SG22	8303 5870
	Mr Alan Mittler *(Laboratories)*	SM04	8303 3151
	Mr Silvio De Ieso *(Electronics)*	SG05	8303 5443
	Mr George Osborne *(Instrumentation)*	SG05	8303 5443
Computing Support	Mr Billy Constantine	S215	8303 3092
CATS (Engineering)	Mr Johnathan May Ms Vera Mellisaratos	S315b S329	8303 5873 8303 3149
School Safety Officer	Dr Colin Kestell	S230	8303 5946
Career and Course Advice Centre	Wills Building, Level 4		8303 4204

- Room numbers: prefix S = Engineering South Building

PROGRAM OBJECTIVES AND GRADUATE ATTRIBUTES

The main objective of the Aerospace Engineering program is to develop in you the necessary skills, knowledge and problem solving ability that will allow you to work effectively as an Aerospace Engineer. You will also have sufficient background and technical knowledge to take on many of the roles traditionally undertaken by Mechanical Engineers. In order for you to function effectively in any of the traditional Aerospace Engineering roles after graduation, you will need to ensure, with our help, that you have developed the following attributes, which we believe capture the qualities that all competent engineers should possess.

The graduate attributes to be developed as a result of undertaking one of the above programs are specified by our accrediting body, Engineers Australia and are listed below.

- ability to apply knowledge of basic science and engineering fundamentals;
- ability to communicate effectively, not only with engineers but also with the community at large;
- in-depth technical competence in Mechanical Engineering;
- ability to undertake problem identification, formulation and solution;
- ability to utilise a systems approach to design and operational performance;
- ability to function effectively as an individual and in multi-disciplinary and multi-cultural teams, with the capacity to be a leader or manager as well as an effective team member;
- understanding of the social, cultural, global and environmental responsibilities of the professional engineer, and the need for sustainable development;
- understanding of the principles of sustainable design and development;
- understanding of the professional and ethical responsibilities and commitment to them; and
- expectation of the need to undertake lifelong learning, and the capacity to do so.

The above graduate attributes map into the University of Adelaide generic graduate attributes as follows. The University of Adelaide attribute is shown first and the Engineers Australia attribute or attributes that map to it are shown in italics immediately underneath.

1. Knowledge and understanding of the content and techniques of a chosen discipline at advanced levels that are internationally recognised.
   Ability to apply knowledge of basic science and engineering fundamentals.
   In-depth technical competence in the specific discipline (Aerospace Engineering).

2. The ability to locate, analyse, evaluate and synthesise information from a wide variety of sources in a planned and timely manner.
   Ability to apply knowledge of basic science and engineering fundamentals.
   Ability to undertake problem identification, formulation and solution.
   Ability to utilise a systems approach to design and operational performance.

3. An ability to apply effective, creative and innovative solutions, both independently and cooperatively, to current and future problems.
   Ability to undertake problem identification, formulation and solution.
   Ability to utilise a systems approach to design and operational performance.

4. Skills of a high order in interpersonal understanding, teamwork and communication.
   Ability to communicate effectively, not only with engineers but also with the community at large.

5. A proficiency in the appropriate use of contemporary technologies.

In-depth technical competence in the specific discipline (Aerospace Engineering).

6. A commitment to continuous learning and the capacity to maintain intellectual curiosity throughout life.
   Expectation of the need to undertake lifelong learning, and the capacity to do so.

7. A commitment to the highest standards of professional endeavour and the ability to take a leadership role in the community.
   Ability to function effectively as an individual and in multi-disciplinary and multi-cultural teams, with the capacity to be a leader or manager as well as an effective team member.

8. An awareness of ethical, social and cultural issues and their importance in the exercise of professional skills and responsibilities.
   Understanding of the social, cultural, global and environmental responsibilities of the professional engineer, and the need for sustainable development.
   Understanding of the principles of sustainable design and development.
   Understanding of the professional and ethical responsibilities and commitment to them.

HONOURS CRITERIA

How do we work out what class of degree you will get when you graduate??

For the award of honours it is necessary to achieve a prescribed level in the weighted average mark for levels II, III and IV courses. The weightings are 2, 3 and 5 respectively for levels II, II and IV courses.

All courses are weighted by their number of units, except for the level IV project, which is only weighted as a 4 unit course rather than eight unit course.

- For First Class Honours, the weighted average mark must be 75% or above.
- For Second Class Honours, Division A, the weighted average mark must be between 70% and 75%.
- For Second Class Honours, Division B, the weighted average mark must be between 65% and 70%.

For students granted status in one or more courses due to work undertaken at another institution, only those courses undertaken at University of Adelaide will be used to assess their honours grade.

For the purpose of honours calculations, repeated courses will be allowed a maximum mark of 50%, even if a higher mark is actually gained when the course is repeated.

Grading Scheme

The grading scheme used for all courses in the School is:

High Distinction:	85-100%
Distinction:	75-84%
Credit:	65-74%
Pass:	50-64%
Conceded Pass:	45-49%
Fail	0-44%

Details of the level of achievement corresponding to each grade are listed below.

	High Distinction	Distinction	Credit	Pass	Conceded Pass*	Fail
General description	Outstanding or exceptional work in terms of understanding, interpretation and presentation	A very high standard of work which demonstrates originality and insight	Demonstrates a high level of understanding and presentation and a degree of originality and insight	Satisfies the minimum requirements	Just fails to satisfy the minimum requirements	Fails to satisfy the minimum requirements
Reading	Strong evidence of independent reading beyond core texts and materials	Evidence of reading beyond core texts and materials	Thorough understanding of core texts and materials	Evidence of having read core texts and materials	Some evidence of having read core texts and materials	Very little evidence of having read any of the core texts and materials
Knowledge of topic	Demonstrates insight, awareness and understanding of deeper and more subtle aspects of the topic. Ability to consider topic in the broader context of the discipline	Evidence of an awareness and understanding of deeper and more subtle aspects of the topic	Sound knowledge of principles and concepts	Knowledge of principles and concepts at least adequate to communicate intelligently in the topic and to serve as a basis for further study	Some knowledge of principles and concepts but insufficient to communicate intelligently in the topic or to serve as a basis for further study	Scant knowledge of principles and concepts
Articulation of argument	Demonstrates imagination or flair. Demonstrates originality and independent thought	Evidence of imagination or flair. Evidence of originality and independent thought	Well-reasoned argument based on broad evidence	Sound argument based on evidence	Some ability to argue coherently	Very little evidence of ability to construct coherent argument
Analytical and evaluative skills	Highly developed analytical and evaluative skills	Clear evidence of analytical and evaluative skills	Evidence of analytical and evaluative skills	Some evidence of analytical and evaluative skills	Little evidence of analytical and evaluative skills	Very little evidence of analytical and evaluative skills
Problem solving	Ability to solve very challenging problems	Ability to solve non-routine problems	Ability to use and apply fundamental concepts and skills	Adequate problem-solving skills	Some evidence of problem-solving skills but skills inadequate	Very little evidence of problem-solving skills
Expression and presentation appropriate to the discipline	Highly developed skills in expression and presentation.	Well developed skills in expression and presentation.	Good skills in expression and presentation. Accurate and consistent acknowledgement of sources.	Adequate skills in expression and presentation	Some skills in expression and presentation Inaccurate or inconsistent acknowledgement of sources.	Rudimentary skills in expression and presentation Inaccurate and inconsistent acknowledgement of sources.

Student Prizes

Esso/Mobil week 1, Design and build competition, 1st Prize, \$1000, 2nd prize \$250, Innovation Prize, \$250.

Level 2

Weir-Warman and Engineers Australia Design and Build Competition (National Competition). Winners of our event receive a, expenses paid trip to Sydney to compete in the national event.

Level 3

Esso/Mobil Engineering Communication and Management Award for the best performance in the communications component of the Level 3 course, Design and Communication, \$500.

School of Mechanical Engineering Award for the best Level 3 project, \$200.

Level 4

Esso/Mobil Academic Excellence Award for the best performance in the level 4 project, \$500
The Cooperative Research Centre (CRC) for Welded Structures Award for the best performance in a level 4 project of relevance to welded structures, \$500.

The R.J. Jennings Memorial Award for Mechanical Engineering Design for the person who most distinguishes him or herself in the Level 4 project, $500.

The Society of Automotive Engineers (Australasia) Award for the highest achieving student who completed a project on vehicle transport (land, sea or air), $150 worth of publications (books, papers etc) from the SAE publications office.

The IMechE (UK) project prize (Australian region) for the best performance in a final year project in the preceding year, £100.

The IMechE (UK) Frederick Barnes Waldron Prize (Australian region) for academic excellence in the preceding year, £100.

Level 4 Project Exhibition Prizes

Schefenacker Award for the best Level 4 project as judged by the judging panel at the Level 4 project exhibition, $500.

Schefenacker Award for the second best Level 4 project as judged by the judging panel at the Level 4 project exhibition, $300.

Vipac Award for the best Level 4 acoustics – vibration related project as judged by the judging panel at the Level 4 project exhibition, $500.

ASC Innovation in Engineering Award for the most innovative Level 4 project as judged by the judging panel at the Level 4 project exhibition, $500.

ASC Encouragement Award for the Level 4 project which is the second most innovative as judged by the judging panel at the Level 4 project exhibition, $250.

Vipac Prize for the best Level 4 acoustics – vibration related project as judged by the judging panel at the Level 4 project exhibition, $500.

The Cooperative Research Centre (CRC) for Welded Structures Award for the best welding related project, as judged by the judging panel at the Level 4 project exhibition, $500.

Sir Ross and Sir Keith Smith Fund Award for the best aerospace related project, as judged by the judging panel at the Level 4 project exhibition, $500.

Amdel Award for the best materials related project, as judged by the judging panel at the Level 4 project exhibition, $500.

MechTest Award for the project with the best commercial potential as judged by the judging panel at the Level 4 project exhibition, $500.

Tenix Innovation in Engineering Award for the most innovative project in an area of interest to Tenix, $500.

Holden Award for the best mechatronics related project, as judged by the judging panel at the Level 4 project exhibition, $500.

Schefenacker student poster prize for the best project poster as judged by the judging panel at the Level 4 project exhibition, $200.

English as a Second Language (ESL) and International Students

ESL is compulsory in the first semester of study for all international students. Students articulating from another institution with prescribed status are not eligible for any additional status in lieu of ESL. Students in single degree programs may be excused from one final year elective to compensate for doing ESL. Students in double degree programs must do ESL as an overload.

Laboratory Classes

Most courses include laboratory classes. Students should attend only the lab sessions for the courses in which they are enrolled (labs and corresponding courses are listed in the timetables included in Laboratory book and they are posted on the School's Undergraduate Notice Board).

Laboratory classes are compulsory (if you are enrolled in a corresponding course). If unable to attend any specific lab class, permission must be sought from a lab demonstrator to attend the next available lab session. If a class is missed or a lab report not handed in, then that is grounds for failure of the entire course.

Unless specified otherwise by a course supervisor, the laboratories account for a total of 10% of the course assessment, irrespective of how many labs are included in the course.

Coursework and Reports – Submission and Penalties

Work required for assessment for each course will be one of three general forms:

<u>Coursework</u>
Weekly problems, tutorials etc handed in at the lecture (to the lecturer) will be classed as coursework.

For coursework, the lecturer will be responsible for setting, collection and marking, and if applicable penalties for late submission (outlined below) will apply.

<u>Assignments</u>
Work requiring longer preparation time (eg due in two weeks) such as essays, laboratory reports, set assignments etc will be regarded as assignments.
Those marking your assignments will endeavour to return them to you within 2 weeks after the due date. Laboratory reports will not be handed back until all students in the class have completed that particular lab class. This could be the end of the semester for most classes. However, within 2 weeks of the report deadline, marks will be posted on the notice board. These should be checked by students for possible errors or omissions.

For assignments and reports a **School Submission Sheet** must be attached to the front of the work and completed in full. These submission sheets are available at the window of the School Office. The assignments and reports MUST be submitted into the appropriate submission box near the School Office or other arrangements as notified. The boxes will be emptied each day at **4:30pm** and the work stamped with the current date.

The submission dates for assignments and reports will be strictly adhered to for each course. For work that is not submitted on time the following penalties will apply.

10% per day late – coursework (or applied by lecturer)
10% per day late – assignments and reports (or applied by lecturer)

Thus if the assignment is 1 day (or part thereof) late and it is worth 20 marks, 2 marks will be deducted from the mark that you would otherwise have received.

Reports
Work lasting for a full semester, such as project reports will be regarded as reports.

The percentage that assignments and coursework contribute to the overall result for a course is usually about 30%, but it does vary depending on the particular course.

Exclusion from the examination

We regard assignments as a very important part of the assessment process.
Students may be precluded from sitting the examination in a particular course if the total mark received for their coursework and assignments is less than 50%. If this is the case, students so affected will be required to repeat the course when it is next offered.

Students who did not do Specialist Maths at Year 12

If you are a Level 1 student and did not do Specialist Maths at Year 12 and are doing Maths 1MA and Maths 1MB in 2005, you must do Maths IIM in Summer Semester to be eligible to do level 2 mathematics courses in 2006.

Your rights

If you believe that you have been awarded an incorrect mark for any work, you must see the lecturer in charge of the course in the first instance. In the case of an examination, you have a right to see your exam paper but you cannot remove it from the lecturer's office without his/her consent. If you are still unsatisfied with the response of the lecturer, you may write a letter to the Head of the School requesting that your paper be remarked by another staff member. In this case the new mark will apply, whether it be lower or higher than the original.

Note that if you pass a course, you are not permitted to repeat it to obtain a better grade, unless you have been awarded a conceded pass. If you undertake more than the specified number of elective courses in your final year, we will use only the specified number and use the best ones in our calculation of your Honours grade.

Failures

If a student fails 33% or more of the units in which he/she is enrolled, he/she will be required to attend a counselling session with a senior member of the Academic staff. If 33% or more of the units in which a student is enrolled is failed a second time, the student's enrolment will be restricted. In some cases, the student may be precluded from the program altogether. If 33% or more of the units in which a student is enrolled is failed a third time, it is highly likely that the student will be precluded from the program permanently.

Policy on Supplementary Examinations for Courses taught by Schools in the Faculty of Engineering, Computer & Mathematical Sciences (please note, the policy for courses taught by other Faculties may differ from this).

Medical Supplementary Examinations

Applications must be lodged within seven (7) days of the illness.

It will be to your advantage to see a doctor on the day of the illness, so an accurate assessment of your condition can be made. Retrospective certificates are not accepted.
The category of "unfit to sit an examination" is reserved for major illness that prevents attendance at the examinations. As a general rule, minor ailments, such as colds and mild respiratory infections, are not considered sufficient grounds for being certified unfit to sit an exam.

There is no restriction on the maximum grade awarded for a Medical Supplementary.

Any student applying for and sitting a medical supplementary examination will have the existing primary examination mark cancelled and replaced by the supplementary examination mark whether it is higher or lower than the primary mark. Note, attendance at a supplementary examination granted on medical grounds constitutes acceptance of the offer of the supplementary examination.

Compassionate Supplementary Examinations

Supplementary examinations may be awarded where special circumstances beyond the student's control significantly affect their preparation for, or performance in, an exam. Applications must be lodged prior to the exam or within seven (7) days after the exam. All students applying for compassionate supplementary examinations are required to see the Executive Dean or his nominee in the Faculty Office. There is no restriction on the maximum grade awarded for a Compassionate Supplementary.

Any student applying for and sitting a compassionate supplementary examination will have the existing primary examination mark cancelled and replaced by the supplementary examination mark whether it is higher or lower than the primary mark. Note, attendance at a supplementary examination granted on compassionate grounds constitutes acceptance of the offer of the supplementary examination.

Academic Supplementary Examinations

Supplementary examinations on academic grounds are normally offered to students obtaining a mark of 40-49 (provided they meet all other requirements of the course) and to students in their final year of study who have completed all the requirements for the degree with the exception of up to four units.

Students do not apply for academic supplementary examinations. The maximum final grade that can be awarded for a course in which students have an Academic Supplementary is 50 Pass, except where a higher division pass (55 P1) is required to proceed to the next level of the course.

Students granted a Medical or Compassionate Supplementary Examination who are also eligible for an Academic Supplementary Examination

For courses taught by Schools in the Faculty of Engineering, Computer & Mathematical Sciences, students granted a medical or compassionate supplementary examination who are also eligible for an academic supplementary examination should consider their options and before sitting the examination, advise the Faculty Student Office (email: schooloff@eng.adelaide.edu.au) whether they wish to accept the medical/compassionate supplementary examination or whether they wish to take the academic supplementary examination. If no notification is received it will be assumed that the student wishes to take the academic supplementary examination and thus allow the possibility of retaining the primary examination mark.

Applications and Acknowledgement of supplementary exams

All applications for a medical or compassionate supplementary examination from students enrolled in program offered by Engineering, Computer & Mathematical Sciences should be submitted to the Faculty Student Office Room S134 Engineering South Building. Students will be given a copy of their application, date stamped as a receipt.

Notification of Supplementary Examinations Granted

To find out if they have been granted a supplementary examination, students will need to check Access Adelaide in the week beginning 2 weeks after the end of the examination period. Some Schools also place examination results on School Notice Boards or email students. Note, it is not possible in the time between the primary examinations and the supplementary examinations for all students to be notified personally. It is the student's responsibility to check if they have been awarded a supplementary examination and to check the Examinations Website for the official supplementary examinations timetable.

For any queries please contact the Faculty Student Office Room S134 Engineering South (Phone: 8303 4148)

Conceded Pass

A candidate may present for the degree, courses for which a conceded pass (CP) grade has been awarded, with the following limits:

- You are allowed to present 4 units of Level I courses.
- You are allowed to present CPs for courses at Level II or above with an aggregate units value not exceeding 6 units, and no more than 4 units at Level IV.

Plagiarism and Related forms of Cheating

From time to time work which is not original is presented by students as part of their coursework. This represents a lack of professional attitude and lack of ethics. It will not be tolerated by the School of Mechanical Engineering (or within the wider University community in general). Your attention is drawn to the section on *plagiarism and related forms of cheating,* in the student information manual (which you received when you enrolled) and to chapters XVII and XII in the statutes of the University.

Grievance Procedures

If you have an academic problem with one of the courses you are taking, you should first consult the lecturer teaching the component that you are having trouble with. If that doesn't satisfy you, then you should consult with the co-ordinator for that course (if different to the lecturer). If you are still not satisfied, you should then consult your year coordinator (Names can be found at the Mechanical Engineering School Office), and/or your student feedback group coordinator. Your final option is to make an appointment with the Head of School, Professor Hansen.

If you have a general problem with your course or need course advice, please consult your year coordinator. If, after following the above procedure, you still need help, then you may make an appointment to see the Head of School at the School Office.

If you have a conflict with one of your lecturers or another student, then your first port of call is your year co-ordinator. Depending on the nature of the problem, he/she may resolve it for you, he may ask that you see the Head of the School or he may suggest that you see a student counsellor who may be able to help you with further action..

If you wish to consult with a student counsellors initially they can be found at:

Counselling Centre, Ground Floor, Horace Lamb Building, North Terrace Campus
Telephone: +61 8 8303 5663

Professional counsellors are available to assist and help you explore options towards resolving your difficulties. The service is free and confidential.

If you have any other type of personal problem, it is best to make an appointment with the student counselling service. Academic Staff are not qualified to offer help in this area.

Practical Work Experience

Practical Work Experience is an aspect of the program which the School of Engineering rates very highly. It enables your to appreciate the nature of the work environment and the view of a range of employees – their attitudes towards work and working conditions, unions, engineers and management. You will be able to learn about company structure and operation, to appreciate the responsibilities of engineers at various levels, and be exposed to a far greater diversity and scale of plant and equipment than we can provide at the University.

As set out in the University Handbook, students MUST complete 12 weeks of approved experience. Several categories of work experience have been identified and it is important that you gain the most that you can from each area. In order to obtain acceptance, the work must be full-time and extend over a minimum continuous period of three weeks. Up to six weeks of general work may be included.

The Institution of Engineers Australia produces a booklet annually containing suggestions relating to practical work experience (this booklet is available free to student members of the IEAust). Students must apply for and obtain practical work for themselves. Twelve weeks is a minimum requirement and you should attempt to gain more if possible. A suggested program follows: In your first period of employment, when you are still relatively unskilled in engineering at the end of first year, look for general process or labouring work, with the aim of acquainting yourself with basic labour relations. At the end of the second year, familiarisation with general trade or construction activities, eg as a tradesperson's assistant, would be appropriate. Prior to entering final year you should attempt to obtain work corresponding to a technical or engineering assistant level, eg assembly, manufacture, maintenance, testing of equipment or simple design work.

The School of Mechanical Engineering has contacted a large number of local engineering companies and obtained commitments from many of them to take on work experience students. The contact details for these companies are available from our data base which is accessible from the School of Mechanical Engineering's web site, http://www.mecheng.adelaide.edu.au/courses/undergrad/workexp.

Engineering Work
This work must be undertaken in an engineering environment, under the supervision of an engineer, and may comprise activities such as:
analysis; design; drafting; construction; manufacture; installation; operation; maintenance; testing or repair of engineering works; facilities; equipment or software.

General Work Experience
The following areas of work are not appropriate for engineering experience, but may be used for general work experience: shop assistant with supervisory role; process worker on an assembly line; installation of garden watering systems; non-engineering computer software development; tradesperson's assistant (eg plumber's, electrician's, mechanic's mate); youth camp leader; data processing.

Unsuitable Work Experience
The following areas of work are not generally appropriate for either engineering or general work experience: shop assistant (non supervisory); bar, hotel or restaurant work; fruit picking or general gardening; part-time work; shelf stacker in a supermarket; delivery person/courier; painting and decorating.

Reports
Reports submitted to the School of Engineering for acceptance of work experience must be typed or written neatly in an acceptable form of English prose. Forms claiming engineering work experience approval should be certified by a **qualified engineer**, NOT a personnel manager or accountant, etc, as they may not be accepted. The name and qualifications of the engineer must also be legibly written on the application.

Insurance
<u>Unpaid Work Experience</u>
If work experience is to be unpaid, information letters for employers are available from the School Office. In such cases, the student represents the University of Adelaide and as such is covered for worker's compensation and public liability by the University insurer. The work experience must be approved by the Head of School or School Work Experience Coordinator before the work experience commences.

<u>Paid Work Experience</u>
When the student is doing paid work experience, he/she is covered by the employer's insurer. The employer is advised to remind their insurer that a student is working on the premises.

School of Mechanical Engineering Work Experience Coordinator
Dr Colin Kestell
Room S227
Phone: 8303 5946

Further Information
Claims for recognition of work experience must be lodged with the School Office by 31 March each year, or if anticipating participation in the December graduation, four weeks before the commemoration ceremony is scheduled.

For further information, students may consult the University Handbook, see the School Office staff, or consult the website www.mecheng.adelaide.edu.au/courses/workexp/ to obtain work experience forms.

MyUni (Blackboard 6)

USERNAME

Your username is in the format "axxxxxxx" where xxxxxxx is the 7 digits that form your student number.

MyUni has been established to provide a framework for online education at the University of Adelaide. MyUni is jointly managed by the Learning and Teaching Development Unit and Information Technology Services.

The key features of the MyUni service are:

- A web-based software platform that holds an entry for every academic course in addition to other staff development initiatives and provides personalised access for all students and staff at the University of Adelaide.
- Support services that include an Online Education Helpdesk and an integrated support site for MyUni instructors and students
- An educational and quality program that includes training for instructors and students

As a student at Adelaide, you will have access to quick links into all of your courses, see University announcements, personal tools such as a calendar and address book, and links to important institutional services from the one webpage. A student-friendly helpdesk is only a phone call or email away to sort out any problems you might be having in accessing material online.

You can connect through any computer with:

an internet connection Windows 95 or higher, or an Apple Macintosh running Mac OS 8.6 or higher

a web browser (Netscape Navigator or Microsoft Internet Explorer, version 4.0 or higher, Java script enabled)

Need help? Contact the Help Desk at 8303 3335 or send an e-mail to myuni.help@adelaide.edu.au

All courses taught by the School of Mechanical Engineering rely on MyUni for posting notices to students and for providing general course information. In some cases online assessment and discussion boards are used. It is assumed that students access MyUni and read notices on a regular basis so please make an effort to log on regularly.

Purchasing of Lecture Notes

Lecture notes are available for sale from the Mechanical Engineering School Office during orientation week and the first two weeks of each semester from 9am until 4pm. After this they will only be available on Wednesday between the hours of 1pm and 4pm. Notes are sold to students at cost which is well below what it would cost you to print or photocopy them.

School Office Hours

The Mechanical Engineering School office hours are 10am to 4pm Monday to Friday.

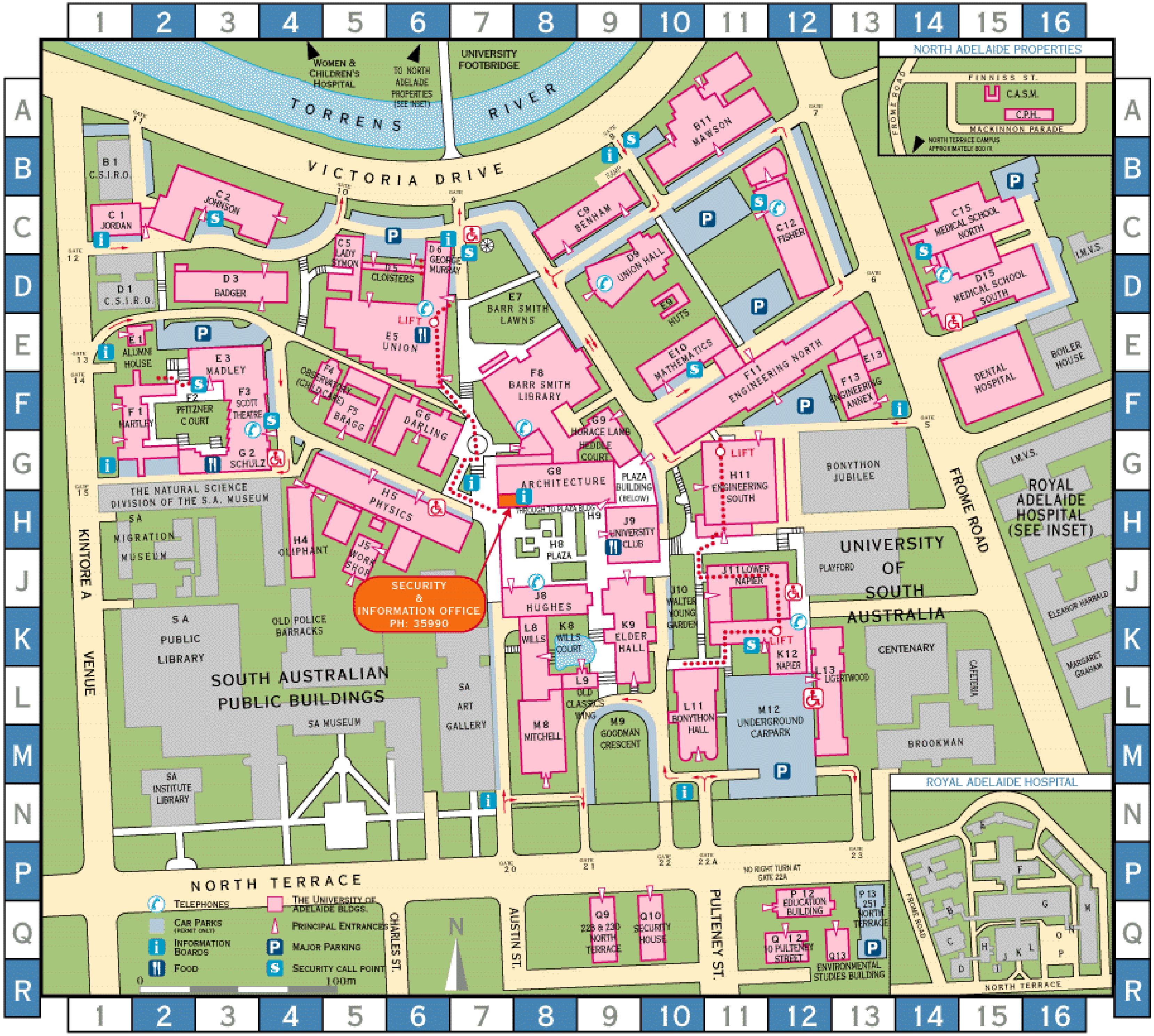
Timetable

You can obtain your personal timetable from the Access Adelaide website

www.access.adelaide.edu.au

You should check this site regularly to ensure you have the most up to date information regarding your class times and locations.

North Terrace Campus



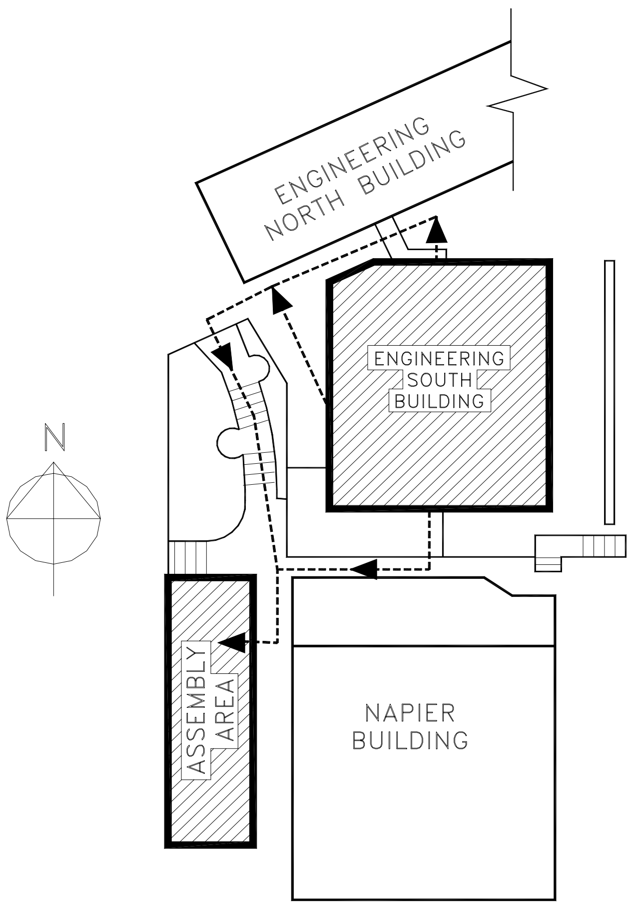
Thebarton Campus

1) **SOUND ALARM**. If the situation is out of control, notify a FLOOR WARDEN or activate a BREAKGLASS ALARM located in the corridors. The alarm activates the EMERGENCY WARNING SYSTEM and notifies the Fire Brigade.
ALERT TONE (Beep - Beep) sound:- This means standby – await further instructions. It is not a signal to evacuate.

2) EVACUATE TONE (Whoop – Whoop) sound:- This means evacuate the building immediately.
TELEPHONE SECURITY :- **Dial 35444**. Explain the nature of the emergency.
After hours a telephone is available by the western ground floor entrance, on the second floor near the lift and in the CATS suite.

3) **EVACUATE** :- When the Whoop – Whoop alarm sounds all occupants of the building must evacuate by the nearest exit or follow the directions of the Floor Wardens (Red Hats). Leave doors unlocked and lights on. Take personal valuables with you. Mobility impaired occupants should proceed to the most convenient exit point and seek the assistance of a floor warden. **DO NOT USE THE LIFTS. DO NOT RE- ENTER THE BUILDING.**
Proceed to the ASSEMBLY AREA **on the lawns outside the Napier Building. (see map below)**

4) Wait for the all clear from the Chief Warden.



Persons who fail to comply with these procedures will not be permitted to undertake the assigned tasks.

These procedures have been developed from information supplied by the SA Department of Labour, the University OH&S Unit and the Standards Association of Australia.

The University of Adelaide recognizes its obligations to take all reasonable precautions to safeguard the Health, Safety and Welfare of its staff and students while they are working in the environs of the University.

General Safety Rules:

Eating, drinking or application of cosmetics are not permitted in laboratories.
Working under the influence of drugs or alcohol is prohibited.
Horseplay or running are not tolerated.

Personal:

Suitable clothing which provides adequate protection must be worn. Button loose clothing, tie back long hair, remove jewellery if the possibility exists for it to get caught in moving parts.
Close toe shoes must be worn in the laboratories, workshops and on all site visits.
Approved safety equipment is provided and must be used whenever indicated.
Never undertake any work unless the known and possible hazards of the operation are known as precisely as possible and the appropriate safety precautions adopted.
Approved safety glasses must be worn when working with any type of equipment that could cause material to become airborne.
Approved safety glasses must be worn when working with any chemicals, including solvents and epoxy resins.
Only use equipment when authorised to do so and after you have familiarised yourself with its correct operating procedures.
Avoid lifting heavy objects – use mechanical aids whenever possible.

Chemical:

Chemical waste must not be disposed of via sinks, drains or stormwater channels.
Before using any chemical know of its hazards and dangers (if in doubt!)
All spills to be cleaned up immediately.

Housekeeping:

All bench surfaces are to be kept clean and tidy and free of chemicals and apparatus that is not being used.

When operating equipment or carrying out an experiment in the laboratory ensure that the area is safe for any personnel who may enter.

Observe safety signs at all times.

Walkways must be kept clean and accessible at all times.

Extension leads, air lines etc are not to be placed across designated walkways or when finished with, left lying on the ground.

In areas where there is a risk of water spillage, no electrical cords may be placed on or near the floor.

Electrical:

All hand held electrical devices and extension leads must be protected with earth leakage devices.

Switch off all electrical equipment when not in use.

Fire:

Fire escape routes are to be kept clear at all times.

Be familiar with FIRE AND EVACUATION PROCEDURES within your working area.

Know where the fire extinguishers and fire alarm buttons are located for the area in which you are working and know how to use them.

After hours:

Work outside of core hours 8:00am – 6:00pm, or on weekends is regarded as after hours.

Personnel of school who wish to work outside normal hours are required to fill in the after hours book outside the School office.

Work by undergraduate students can only be performed when supervised by an academic staff member (or nominee) during or outside core hours.

PROGRAM SUMMARY

LEVEL 1					
COURSE CODE	**COURSE NAME**	**SEMESTER**	**UNITS**	**LECTURER**	**ROOM**
MECH ENG 1001	Design Graphics	2	2	Dr Colin Kestell	S227
MECH ENG 1000	Dynamics	2	2	Mr Gareth Bridges	S317
ELEC ENG 1008	Electrical Engineering IM	1	2	Dr Bruce Davis	EM306
MECH ENG 3006	Engineering Communication ESL	1 & 2	2	Ms Kristin Munday Ms Karen Adams Ms Dorothy Missingham	S237c N107 S237a
CHEM ENG 1002	Engineering Computing I	1	2	Dr Zeyad Alwahabi	N113b
MECH ENG 1005	Engineering Planning, Design & Communication M	1	3	Ms Elizabeth Yong Ms Dorothy Missingham	S237a S237a
CHEM ENG 1003	Materials I	2	2	Mr Ian Brown Dr Yung Ngothai	S106 N212B
MATHS 1007	Mathematics IA & IB	1 & 2	6	Dr David Parrott	Maths 105a
PHYSICS 1003	Physics IHE	2	3	Dr Rod Crewther	Physics 108
C&ENV ENG 1001	Statics	1	2	Dr Rudi Seracino	N141

PROGRAM SUMMARY

LEVEL 2					
COURSE CODE	**COURSE NAME**	**SEMESTER**	**UNITS**	**LECTURER**	**ROOM**
MECH ENG 2018	Design Practice	1	4	Mr Antoni Blazewicz	S310
APP MTH 2000	Differential Equations and Fourier Series	1	2	Dr Jim Denier	EM123
MECH ENG 2019	Dynamics and Control I	2	3	Dr Anthony Zander Dr Ley Chen	S209 S308
MECH ENG 3006	Engineering Communication ESL	1 & 2	2	Ms Kristin Munday Ms Karen Adams Ms Dorothy Missingham	S237c N107 S237a
MECH ENG 2020	Materials and Manufacturing	1	3	Mr Ian Brown	S106
MECH ENG 2011	Mechatronics IM	2	2	Dr Ley Chen	S308
APP MTH 2009	Numerical Analysis and Probability and Statistics	2	2	Dr Stephen Cox Dr Andrew Metcalfe	MTHS 224 MTHS 223
MECH ENG 2002	Stress Analysis and Design	2	3	Dr Andrei Kotousov	S207
MECH ENG 2021	Thermo-Fluids I	1	3	Mr Gareth Bridges Mr Antoni Blazewicz	S317 S310
APP MTH 2002	Vector Analysis and Probability and Statistics	1	2	Dr Peter Gill	MTHS 106

PROGRAM SUMMARY

LEVEL 3					
COURSE CODE	**COURSE NAME**	**SEMESTER**	**UNITS**	**LECTURER**	**ROOM**
MECH ENG 3016	Aeronautical Engineering I	2	2	Dr Gerald Schneider A/Prof Richard Kelso	S205 S227A
MECH ENG 3026	Aerospace Materials and Structures	1	3	Professor Valerie Linton Dr Andrei Kotousov	S104 S207
MECH ENG 3027	Design and Communication	2	3	Dr Colin Kestell Ms Elizabeth Yong Ms Dorothy Missingham	S227 S237b S237b
MECH ENG 3028	Dynamics and Control II	2	3	Dr Anthony Zander Dr Ben Cazzolato	S209 S229
MECH ENG 3017	Engineering and the Environment	1	2	Professor Colin Hansen A/Prof Graham Nathan	S116 S305
MECH ENG 3006	Engineering Communication ESL	1 & 2	2	Ms Kristin Munday Ms Karen Adams Ms Dorothy Missingham	S237c N107 S237a
MECH ENG 3020	Heat Transfer	1	2	Dr Bassam Dally	S120
PHYSICS 2010	Space Science and Astrophysics	2	4	A/Prof Roger Clay	Oliphant 406
MECH ENG 3025	Space Vehicle Design	1	2	Dr Gerald Schneider	S205
MECH ENG 3031	Thermo-Fluids II	1	3	Dr Gerald Schneider A/Prof Richard Kelso	S205 S227A

LEVEL 4					
COURSE CODE	COURSE NAME	SEMESTER	UNITS	LECTURER	ROOM
MECH ENG 4034	Aerospace Navigation & Guidance	2	2	Mr M Evans	DSTO
MECH ENG 4036	Aerospace Propulsion 1	1	2	A/Prof Sook-Ying Ho	DSTO
PHYSICS 3014	Atmospheric and Environmental Physics III	2	2	Professor Bob Vincent Dr Charles James	Oliphant 313 Ol. 312
MECH ENG 3006	Engineering Communication ESL	1 & 2	2	Ms Kristin Munday Ms Karen Adams Ms Dorothy Missingham	S237c N107 S237a
MECH ENG 4038	Engineering Management & Professional Practice	1	2	Mr Jim Dunlop Ms Krystyna Sawon Mr Roger Inverarity Dr John Brydon	External
MECH ENG 4035 A/B	Aerospace Project (level IV)	1 & 2	8 in total	Dr Ben Cazzolato	S227

PROGRAM SUMMARY

LEVEL 4 ELECTIVES	3 OF THE 4 REQUIRED ELECTIVES MUST BE AEROSPACE COURSES - **.				
COURSE CODE	COURSE NAME	SEMESTER	UNITS	LECTURER	ROOM
MECH ENG 4011	**Advanced Automatic Control	1	2	Dr Ben Cazzolato	S229
MECH ENG 4023	**Advanced Topics in Fluid Mechanics	2	2	A/Prof Richard Kelso	S227A
MECH ENG 4020	**Advanced Vibrations	1	2	Dr Anthony Zander	S209
APP MTH 4003	**Aerodynamics	2	2	Dr Steve Cox	MATHS 224
MECH ENG 4037	**Aerospace Propulsion 2	2	2	A/Prof Sook-Ying Ho	DSTO
MECH ENG 4013	Air Conditioning	2	2	Mr Antoni Blazewicz	S310
PHYSICS 3013	**Astrophysics III	1	2	A/Prof Roger Clay Dr Ray Protheroe	OL. 406 OL. 404
MECH ENG 4002	**Combustion Technology and Emissions Control	1	2	A/Prof Graham Nathan	S305
APP MTH 4007	Computational Fluid Dynamics	1	2	Dr Michael Teubner	MATHS 214
MECH ENG 4046	**Computational Techniques for Engineering Applications	2	2	Dr Bassam Dally	S120
MECH ENG 4004	Engineering Acoustics	1	2	Professor Colin Hansen	S116
MECH ENG 4026	Environmental and Architectural Acoustics	2	2	Mr Byron Martin	S105
MECH ENG 4039	Finance for Engineers	2	2	Ms Jean Canil	Security House 224
MECH ENG 4003	Fracture Mechanics	2	2	Dr Andrei Kotousov	S207

MECH ENG 4000	Fundamentals of Non-Linear Computational Mechanics	2	2	Professor Carlo Sansour	External
MECH ENG 4040	**Hypersonic Flow	1	2	A/Prof Richard Kelso	S227A
PHYSICS 3007	**Introduction to Physics Research III	2	2	Dr Ray Protheroe	Oliphant 414
MECH ENG 4024	Materials Selection and Failure Analysis	Not offered 2005	2	Professor Valerie Linton	S104
MECH ENG 4033	Mechanical Signature Analysis	1	2	Mr Byron Martin	S105
MECH ENG 4027	Robotics M	1	2	Dr Tien-Fu Lu	S208
MECH ENG 4025	Topics in Welded Structures	1	2	Professor Valerie Linton	S104
APP MTH 4043	Transform Methods and Signal Processing	2	2	Dr Matt Roughan	MATHS G18

Double and Combined Degree Program Summaries

For these programs, some courses have been omitted from the single degree program and have been replaced with courses from the Combined or Double degree programs. The omitted courses are listed below together with the additional courses that must be taken to satisfy the requirements of the Combined or Double degree programs.

Combined or Double degree program	Length of prog. (years)	Courses omitted from single degree program	Units	Courses added in addition to single degree program	Units
BE/BA (Double)	5	Engineering Planning, Design and Communication M	3	12 units Level 1 Arts courses 8 units Level 2 Arts courses 12 units Level 3 Arts courses	12 8 12
BE/BEc (Comb.)	5	Engineering Planning, Design and Communication M Engineering Management & Professional Practice 2 Elective courses	3 2 4	Principles of Microeconomics 1 Principles of Macroeconomics 1 Macroeconomics: Theory Policy II Consumers, Firms & Markets II Organisational Behaviour II Economic & Financial Data Analysis II 16 units of Level III B Economics courses	3 3 4 4 4 4 16
BE/B Ma & Comp Sci (Computer Sci focus) (Comb.)	5	Engineering Computing 1	2	Computer Science 1 Data Structures & Algorithms Computer Systems 20 units Lv 3 Maths /Comp. Sci.	6 2 2 16
BE/B Ma & Comp Sci (Maths focus) (Comb.)	5	None		24 units Lv 3 Maths /Comp. Sci.	24
BE/BSc (Astrophysics) (Comb.)	5	Engineering Planning, Design and Communication M Physics 1HE Electrical Engineering 1M	3 3 2	Physics 1 Chemistry 1 Physics II 20 units level III Physics courses	6 6 8 20

LEVEL 1

COURSE OUTLINES

Design Graphics

Course Code: MECH ENG 1001

Course Type: Core

Credit: 2 Units

Offered in Semester: Two

Pre-requisites / Assumed Knowledge: None

Teaching Method: 12 hours lectures and 27 hours practical classes in the design suite

Assessment: Course work 40%, final exam 60%

Course Objectives: In this course students shall be shown how to:

- Interpret Engineering drawings,
- Effectively communicate through drawing,
- Visualise 3D objects from 2D images,
- Acquire a basic freehand drawing skill,
- Acquire a skill in using drawing instruments,
- Learn the basics of a CAD package,
- Prepare drawings suitable for manufacture and documentation and will be introduced to the design process

Graduate Attributes to be Developed:

- ability to apply knowledge of basic science and engineering fundamentals;
- ability to communicate effectively, not only with engineers but also with the community at large;
- in-depth technical competence in at least one engineering discipline;
- ability to undertake problem identification, formulation and solution;
- ability to utilise a systems approach to design and operational performance;
- understanding of the principles of sustainable design and development; and
- understanding of the professional and ethical responsibilities and commitment to them.

Course Synopsis: Design methods and the influence of design and computers in manufacturing; the language of drawing including sketching; instrument drawing; orthogonal and axonometric projection; visualisation; dimensioning; tolerancing; manufacturing methods and an introduction to CAD.

Content:

- Introduction 2%
- Orthographic projection 6%
- Line type application 2%
- Freehand drawing 5%
- Pictorial projection 5%
- Auxiliary projection 5%
- Dimensioning 5%
- Tolerancing - size and form 5%
- Abbreviations & symbols 5%
- Working drawings 5%
- The design process 5%
- Computer Aided Design 50%

Text book: Litchfield, 1998, *The technical drawing handbook*, 2nd Edition, Flinders Press; *Design Graphics course notes*, available from the Mech. Eng. Office; Basic Engineering Drawing Equipment. This is best purchased as a package from the Student Union Book Store.

Recommended Reading: The afore mentioned text

Experiments: None

Dynamics

Course Code: MECH ENG 1000

Course Type: Core

Credit: 2 Units

Offered in Semester: Two

Pre-requisites / Assumed Knowledge: SACE Stage 2 Mathematics 1 and 2, Physics

Teaching Method: 36 hours lectures and tutorials

Assessment: Assignments 10%, mid-semester exam 25%, final exam 65%

Course Objectives:
- Be able to adequately describe planar motion in a range of appropriate co-ordinate systems.
- Know and understand the physical laws that underpin the dynamics of bodies in motion. These include Newton’s Laws of Motion, the Work-Energy principle and impulse-momentum relation. Classical physics only is employed at this level.
- Draw free body diagrams for bodies in dynamical systems.
- Solve problems – determine various physical quantities employing the range of analytical techniques taught in this course.

Graduate Attributes to be Developed:
- Confidence to apply mathematical concepts (vector representations, integral and differential calculus) to engineering problems;
- Able to define problems in appropriate form and develop strategies to determine solutions;
- Know fundamental physics governing mechanical systems;
- Able to apply a range of techniques to solve dynamics problems, and determine which are the most suitable;
- Be able to communicate problem solving strategies effectively, in written form;
- Possess problem solving skills with broader applicability; and
- Have some appreciation of the value of Dynamics in a broader engineering context.

Course Synopsis: Kinematics of particles and rigid bodies; rectilinear, and curvilinear motion; motion relative to moving axis. Kinetics of particles and rigid bodies: application of Newton's Laws, and the principles of work, energy, power, and momentum in mechanical systems. Conservation of energy and momentum.

Content:

RECTILINEAR MOTION (2 lectures)
a) Relationships between displacement, velocity and acceleration.
b) Relative motion in one dimension.

COUPLED/DEPENDENT MOTION (2 lectures)
a) Pulley systems and constrained motion

CURVILINEAR MOTION (4 lectures)
a) Definition of parameters describing general motion in a plane.
b) Relative motion in two dimensions.
c) Cartesian co-ordinate system.
d) Polar co-ordinate system.
e) Tangential-normal co-ordinate system.
f) Central force motion

NEWTON'S LAWS OF MOTION (4 lectures)
a) Newton's Laws of Motion.
b) Free-body diagrams and Newton's 2nd Law.
c) Friction force

WORK and ENERGY (4 lectures)
a) Work-Energy principle.
b) Conservative forces.
c) Potential Energy functions for conservative forces.
d) Efficiency
e) Power

IMPULSE and MOMENTUM (4 lectures)
a) Impulse-Momentum relationship.
b) Impulsive forces.
c) Conservation of momentum
d) Coefficient of Restitution

RIGID BODY KINEMATICS (4 lectures)

a) Description of general motion of a rigid body.
b) Use of relative motion formulae in rigid body problems.

Text book: Extensive notes are provided to students.

Recommended Reading: Beer and Johnston, *Dynamics*, 3rd metric SI Edition.

Experiments: None

Electrical Engineering IM

Course Code: ELEC ENG 1008

Course Type: Core

Credit: 2 Units

Offered in Semester: One

Pre-requisites / Assumed Knowledge: A knowledge of mathematical techniques and physical and electrical phenomena such as can be obtained by studying SACE Stage 2 Mathematics 1 and 2 and Physics will be assumed.

Teaching Method: 36 hours lectures and 6 tutorials, plus interactive learning

Assessment: Assignments 10%, Examination (2 hours) 90%.

Course Objectives: After successfully completing this course students will understand basic electrical quantities and be able to model the behaviour of simple electrical circuit elements. They will be able to perform steady state analysis of networks of resistors, independent sources and dependent sources with direct current excitation. They will also be able to analyse circuits consisting of resistors, inductors, capacitors, independent sources and dependent sources with steady state sinusoidal excitation. They will have an appreciation of the usefulness of linear models in analysing circuits containing non-linear devices. They will be able to analyse simple electronic circuits including diode circuits and basic amplifier circuits. They will have an appreciation of some of the design criteria for such circuits. Students should also be able to perform analysis and synthesis of simple digital logic circuits, and be familiar with binary numbers and operations on these numbers.

Graduate Attributes to be Developed:

- ability to apply knowledge of basic science and engineering fundamentals;
- ability to communicate effectively, not only with engineers but also with the community at large;
- in-depth technical competence in at least one engineering discipline;
- ability to undertake problem identification, formulation and solution;
- ability to utilise a systems approach to design and operational performance;
- ability to function effectively as an individual and in multi-disciplinary and multi-cultural teams, with the capacity to be a leader or manager as well as an effective team member;
- understanding of the social, cultural, global and environmental responsibilities of the professional engineer, and the need for sustainable development;
- understanding of the principles of sustainable design and development;
- understanding of the professional and ethical responsibilities and commitment to them; and
- expectation of the need to undertake lifelong learning, and the capacity to do so.

Course Synopsis:
Circuit analysis: Electrical circuit concepts: definitions, basic quantities and units. Models for simple circuit elements. Network topology and simple methods of analysis. Steady state alternating current circuits and phasor methods. Analog electronics: Principles of electronic circuits. Models for diodes and field effect transistors. Rectifier circuits, the zener diode. Simple amplifier circuits. Operational amplifiers. Digital electronics: Boolean variables and Boolean algebra. Combinational logic circuits and minimization techniques. Number representation and arithmetic operations. Introduction to the principles underlying the operation of DC and AC motors and generators.

Content:

This course introduces basic electrical circuit elements and quantities and methods for analysing and modelling analog and digital electrical and electronic circuits. There is also a brief introduction to electrical machines. The following topics will be addressed:

Electric Circuits (17%)
- Definitions, basic quantities and units
- Models for simple electrical circuit elements
- Capacitors & Inductors
- Kirchhoff's Laws
- Superposition
- Power

Introduction to Electronics (15%)
- Semiconductor devices
- Diodes
- Rectifier circuits
- Field Effect Transistor models
- Simple amplifier circuits
- Operational amplifier circuits

Steady State Sinusoidal Analysis (20%)
- Representation of sinusoidal signals by phasors
- Impedance and admittance
- Complex numbers and graphical representations (review)
- Phasors and phasor diagrams
- Power in AC circuits

Digital Electronics (25%)
- Binary numbers
- Boolean algebra
- Combinational logic circuits

Introduction to Electrical Machines (23%)
- DC Motors & Generators
- Ideal Transformers
- AC Motors & Generators

Text book: Course notes are provided – textbook purchase is not required

Recommended Reading:

- A.R. Hambley: *Electrical Engineering - Principles and Applications*, 2nd Edition, (Prentice Hall, 2000).
- Giorgio Rizzoni: *Principles and Applications of Electrical Engineering*, 3rd Edition (McGraw-Hill, 2000).
- J.R. Cogdell: *Foundations of Electrical Engineering*, 2nd Edition, (Prentice Hall, 1996).
- Gajski, Daniel *D: Principles of Digital Design*, Prentice Hall (Highly recommended).
- Katz, *Contemporary Logic Design*, Benjamin/Cummins (Reference)

Experiments: There are no laboratory sessions in this course.

Engineering Communication (ESL)

Course Code: MECH ENG 3006

Course Type: Available to students whose native language is not English, may be presented in lieu of one elective at Level IV. Compulsory for international students from language backgrounds other than English, who presented an English language score for admission or who entered via a Foundation Studies Program.

Note: *Students are expected to undertake this course during the first six months of your study at this university. Th course may be taken at any level during your degree so students arriving in their second, third or fourth year of their program may undertake the course. The course need only be passed once.*

Credit: 2 Units

Offered in Semester: One and Two

Pre-requisites / Assumed Knowledge: English language levels accepted for entrance to the University of Adelaide.

Teaching Method: : 24 hours lecture-workshops

Assessment: Assignments 90%, attendance 10%. Pass mark 50%. No supplementary exams or assessments are given for this course.

Assignments:

- Grammar, (online modules) 10%
- Oral, 5%
- Written 20%
- Oral, 25%
- Written, 30% ,
- Attendance, 10%

Course Objectives: On completion of the course, students should:

- grasp some of the ways in which social context shapes language features and communicat
- develop and present evidence based propositions
- identify and begin to apply the language features of academic writing and speaking
- locate appropriate sources of information toward your assignments
- critically read and interpret information in the development of your own point of view
- write appropriate texts which communicate the logical development of proposition(s) and analysis of issues
- present your understanding and analysis of issues in a formal seminar presentation
- participate in class and group discussions, and present decisions made to class colleagues in informal presentations.
- increase your awareness of social, cultural and ethical issues and be able to discuss these in relation to professional and social responsibilities.

Graduate Attributes to be Developed:
The University of Adelaide provides an environment where students are encouraged to take responsibility for developing the following attributes:

- the ability to communicate effectively in formal and informal situations, in writing and speaking as is assessed in written and oral assignments
- the ability to communicate effectively with engineers, other professionals and the community general as is emphasised throughout the course and indirectly assessed through assignments
- independent and critical thinking: the ability to locate, analyse, critically evaluate and synthesise information from a wide variety of sources in a planned and timely manner, as must be demonstrated students and oral assessments
- skills of a high order in interpersonal understanding, teamwork and communication as is emphasised throughout the course and must be demonstrated through interactive class tasks
- proficiency in the appropriate use of contemporary technologies as is assured through student interaction with the MyUni environment, database and catalogue searching, email and use of Turniti
- a commitment to continuous learning and the capacity to maintain intellectual curiosity throughout life is emphasised throughout the course
- an awareness of ethical, social and cultural issues and their importance in the exercise of profession skills and responsibilities as is assessed through assignment topics which explore these issues.

Course Synopsis: This course provides language development in English as a second language for the purposes of oral and written communication in the context of the study of Engineering. It introduces linguistic principles as tools to assist communication in English as a second language and in cross-cultural settings. Class work is designed to develop the capacity of students for communication (in speaking, listening, writing and reading) and critical thinking relevant to their current studies and intended careers in the fields of engineering and computing. Language development is task-based. Tasks and assignments are focussed on academic writing, research and preparing evidence-based papers, reading, informal academic discussion and formal oral presentation.

Content:
The lecture-workshops are interactive to assist students to develop skills in discussion, research skills, practice writing texts, develop their oral presentation skills and analyse and discuss their ideas about issues in Engineering.

Register (2L)
concept of register
identification of different registers language features of academic communication

Paragraphs - basic overview of features, structure and functions (2L)
topic sentences(s)/proposition/outline
evidence, examples, citing sources closing statement

Using evidence (1L)
evaluating evidence & reliability
strategies for

Discussion session (1L)
critical examination of evidence for topic
oral discussion oral presentation of propositions

Plagiarism & Referencing (2L)
university policy
referencing guide, in-text citations,& language features

Self-editing of paragraphs (1L)
strategies
Oral Presentations Intro. (1L)
identifying features of good academic seminars /practice

Oral Presentations 3 mins Assessment (2T)

Library orientation, (2L)
referencing database searching

Propositions, claims & facts. (1L)
definitions, examples, tasks
General to specific movement (1L)
functions of as support for proposition

Logical cohesion (2L)
concepts
language features
strategies for analysis & increasing cohesion
recognizing cohesion, lack of cohesion

Interpretation, analysis & summary (2L)
concepts
identifying the differences
Structure of a short discussion paper (discourse organization/sequencing)
identifying and applying language features appropriate in a short paper

Passive & Active voice (2L)
concepts, functions, identifying and swapping voice
Oral Presentations strategies (4T)
guidelines
analysis of features of model student presentations (video)
practice applying features

Text book: A detailed description of the course and course notes, will be distributed to the students at the first lecture.

Recommended Reading: None

Experiments: None

Engineering Computing I

Course Code: CHEM ENG 1002

Course Type: Core

Credit: 2 Units

Offered in Semester: One

Pre-requisites / Assumed Knowledge: SACE Stage 2 Mathematics 1 and 2, Physics

Teaching Method: 32 hours lectures and practical/tutorial classes

Assessment: Assignments 40%, final exam 60%

Course Objectives: In this course students shall be shown how to:
- Understand the role of an operating system in managing computer resources;
- Understand the way data is stored inside a computer;
- Develop algorithms to solve engineering-related problems;
- Implement algorithms using the C++ programming language;
- Design and implement simple object oriented programs; and
- Understand how a graphical user interface functions.

Graduate Attributes to be Developed:
Capability to apply knowledge of basic computing and engineering fundamentals through written examination and programming assignments.

Course Synopsis: Introductory computing: Introductory Programming (ANSI'C); introduction to engineering applications-oriented software.

Content:

Part 1 – Procedural Programming (40%)
Computer basics (history etc); getting data in and out of programs; decision making in programs; repeating a series of instructions; packaging up actions to perform a specific task; grouping information.

Part 2 – Write moderate sized programs in the ANSI "C" computer language (60%)
- Variables, expressions and assignments. (9%)
- Introduction to initialisation, data input, data output, and the pre-processor. (9%)
- Introduction to flow control, data input and ASCII character streams. (10%)
- Assignment. (6%)
- Blocks and compound statements. (5%)
- General flow and loop control. (10%)
- Functions and structured programming. (10%)

- The fundamental data types (sizes and ranges), arithmetic conversions and pointers. (6%)
- Functions and call-by-reference, scope rules and storage classes. (8%)
- pointers. (7%)
- Two dimensional arrays. (7%)
- Character processing, strings and pointers. (7%)
- Standard library string functions. (6%)

Text book: Kelley, A. and Pohl, I., *'C' by Dissection: The Essentials of 'C' Programming*, Benjamin/Cummings: 4th Edition

Recommended Reading:

O'Leary, T. and O'Leary, L., Computing Essentials: Complete Edition 2000 – 2001, McGraw-Hill

Experiments: None

Engineering Planning, Design and Communication M

Course Code: MECH ENG 1005

Course Type: Core

Credit: 3 Units

Offered in Semester: One

Pre-requisites / Assumed Knowledge: None

Teaching Method: 24 hours lectures, 18 hours seminars/workshops and 20 hours project work

Assessment: Planning & Design 67%, Communication 33%.
Within the Planning & Design component assessment comprises project 50%, exam 40%, coursework 10%. Within the Communication component, assessment comprises participation 20%, written assignments 50%, oral presentations 30%.

Course Objectives:

- introduce students to the field of engineering
- introduce the planning and design process
- develop some skills for solving engineering problems
- develop effective written and oral communication skills

Graduate Attributes to be Developed:

- ability to apply knowledge of basic science and engineering fundamentals;
- ability to communicate effectively, not only with engineers but also with the community at large;
- ability to undertake problem identification, formulation and solution;
- ability to utilise a systems approach to design and operational performance;
- ability to locate, analyse evaluate and synthesize information from a wide variety of sources in a planned and timely manner;
- ability to function effectively as an individual and in multi-disciplinary and multi-cultural teams, with the capacity to be a leader or manager as well as an effective team member;
- understanding of the social, cultural, global and environmental responsibilities of the professional engineer, and the need for sustainable development;
- understanding of the principles of sustainable design and development;
- understanding of the professional and ethical responsibilities and commitment to them;
- expectation of the need to undertake lifelong learning, and the capacity to do so.

Course Synopsis: The course combines aspects of engineering planning and design, as well as aspects of communication. Students are introduced to the field of engineering, and provided with some tools for tackling real engineering problems – especially those centred on the preliminary stages of the planning and design process. Effective written and oral communication skills are an integral part of the course.

Content:
Within the Communication component (33% of the total), content comprises

- Features of Academic and Professional Language 24.5% - active and passive voice, foregrounding information, function and language structure of an Introduction, function and language structure of Discussion paragraphs, function and language structure of Conclusions,
- Language Styles 8.5% - language register, descriptive, synoptic, analytical styles
- Logical Cohesion 8.5% - linking information in and between sentences, paragraphs and entire documents through repetition, related and referred meaning, and structuring
- Integrating Evidence and Referencing 8.5% - expositional writing, critical thinking, supporting academic arguments
- The Function of a Report 17% - research and analysis, applying academic writing techniques to report writing
- Presenting a Seminar 33% - structure of an oral presentation, oral presentation techniques, delivery style

Within the Planning and Design component (67% of total), content comprises a number of topics selected from the following:

- Engineers and Engineering as a Profession 10% - engineers and their work, engineering education, engineering problems
- The Design Process 10% - problem formulation, feasiblity study, preliminary and detailed planning and design, implementation
- Creativity 10% - processing and storing information in the brain, types of thinking, stages of and methods to enhance creativity
- Economic Concepts 10% - time value of money, cost benefit analysis, criteria for economic evaluation of engineering projects
- Decision Theory 10%
- Environmental Assessment 10%
- Project Scheduling 10% - project planning, researching, design and evaluation, effective meetings
- Environmental Economics 10%
- Working in Groups 10% - group development, roles, managing conflict and diversity
- Engineering Report Writing 10% - formatting and structuring reports

Text book: Manual and notes are provided – no textbook needed

Recommended Reading:

- Dandy, G C & Warner, R F 2000, *Planning and Design of Engineering Systems*, E & FN Spon, London.
- Lovell, David 2001, *Student Writer's Friend*, The Macquarie Library, Macquarie University, Australia.
- Winckel, A & Hart, B 2002, *Report writing style guide for Engineering students*, 4th edn.,

rev. M Behrend, University of South Australia, <http://www.unisanet.unisa.edu.au/learningconnection/students/Lguides/report-writing-engineering.pdf>

Experiments: None

Materials I

Course Code: MECH ENG 1003

Course Type: Core

Credit: 2 Units

Offered in Semester: Two

Pre-requisites / Assumed Knowledge: SACE Stage 2 Mathematics 1 and 2, Physics

Teaching Method: 20 hours lectures and 10 hours tutorials

Assessment: Written exam 70%, assignments and tutorials 30%

Course Objectives: At the end of the course the students should have gained a basic understanding of:

- The relationship between the structures and the properties of materials.
- The test methods used for determining the mechanical properties of materials.
- The effect of chemical composition and processing on the properties of materials.
- The process of materials selection.

Graduate Attributes to be Developed:

- ability to apply knowledge of basic science and engineering fundamentals;
- in-depth technical competence in at least one engineering discipline;
- ability to undertake problem identification, formulation and solution;
- understanding of the principles of sustainable design and development; and
- expectation of the need to undertake lifelong learning, and the capacity to do so.

Course Synopsis: The mechanical properties of materials, the distinction between elastic and plastic deformation of crystalline solids, the theoretical strength of crystalline solids, effect of dislocations and types of failure mechanisms. Rheological properties of materials, models of viscoelastic behaviour. The formation of crystalline solids. Direct observation of the microstructure of materials. The failure of materials in engineering service. Polymers and composites.

Content:

SYLLABUS PART A (50%)

STRUCTURES AND PROPERTIES OF METALS

- Introduction: Classification of materials by structure, by properties, effect of structure and processing on properties.(1 lecture)
- Atomic Bonding: Periodic table, electronegativity, ionic, covalent, metallic and secondary bonding, relationship between properties and bonding. (1 lecture/1 tutorial)
- Atomic Structure: Energy and packing, crystal structures, structure-property relationships. (1 lecture)
- Imperfections in Solids: Types of imperfections, effect of defects on properties. (1 lecture/1 tutorial)
- Diffusion in Solids: Types of diffusion, processing using diffusion, Fick's first and second laws, structure and diffusion. (1 lecture)
- Mechanical Properties: Principles of elastic and plastic deformation, states of stress and strain, test methods for determining mechanical properties. (1 lecture/1 tutorial)
- Dislocations and Strengthening: Movement of dislocations, strategies for strengthening – grain size, work hardening, solid solution and precipitation hardening. (2 lectures/1 tutorial)
- Fracture Ductile versus brittle failure modes, introduction to fracture mechanics, effect of temperature, strain rate and cyclic stress on failure. (2 lectures/1 tutorial)

SYLLABUS PART B (50%)

STRUCTURES AND PROPERTIES OF CERAMICS (3 lectures, 2 tutorials)

- Crystal structures: Ceramic crystal structures, Density computations, Silicate Ceramics, Carbon;
- Point defects: Point defects in ceramics, Impurities in ceramics;
- Mechanical properties: Flexural strength, Elastic behaviour, Hardness;
- Deformation mechanisms for ceramic materials: Crystalline ceramics, Noncrystalline ceramics;
- Failure: Brittle fracture of ceramics; Creep in ceramic materials;
- Type of ceramics: Glasses, Glass-ceramics, Clay products, refractories, abrasives and cements;

STRUCTURE AND PROPERTIES OF POLYMER (4 lectures/2 tutorial)

- Polymer structures: Hydrocarbon molecules, Polymer molecules, Molecular weight, Molecular shape, Molecular structure, Thermoplastic and thermosetting polymers, Copolymer, Polymer crystallinity, Polymer crystals;
- Point defects: Point defects in polymers;
- Mechanical properties: Stress-strain behaviour, Macroscopic deformation, Tear strength and Hardness of polymers;
- Mechanisms of deformation and for strengthening of polymers: Deformation of semicrystalline polymers, Factors that influence the mechanical properties of semicrystalline polymers, Deformation of elastomers;
- Failure: Fracture of polymers, Fatigue in polymeric materials, Creep in polymeric materials;
- Type of polymers: Plastics, Elastomers, Fibers;

- Synthesis and fabrication of polymers: Polymerization and polymer additives;

COMPOSITES (3 lectures/1 tutorials)

- Particles-reinforced composites: Large-particle composites, Dispersion-strengthened composites;
- Fibre-reinforced composites: Influence of fiber length, Influence of fiber orientation and concentration, The fiber phase, The matrix phase, Polymer-Matrix composites, Metal-matrix composites, Ceramic-matrix composites, Carbon-carbon composites, Hybrid composites, processing of fiber-reinforced composites;
- Structural composites: Laminar composites, Sandwich Panels

Text book: Callister, W.D., *Materials Science and Engineering an Introduction*, 6th Edition, Wiley.

In addition, students may obtain copies of the course materials (such as overhead notes, tutorial answers) from the University of Adelaide's INTRANET home page at http://www.adelaide.edu.au/myuni/

Recommended Reading: None

Experiments: None

Mathematics IA & Mathematics IB

Course Code: MATHS 1007

Course Type: Core

Credit: 6 Units

Offered in Semester: One and two

The Mathematics I course is held over two semesters - students must enrol in both MATHS IA & IB to complete course requirements

Pre-requisites / Assumed Knowledge: SACE Stage 2 Mathematical Studies & Specialist Mathematics. Students must obtain a Division 1 pass (P1) in MATHS 1011 Mathematics IA in order to proceed to MATHS 1012 Mathematics IB.

Teaching Method: 4 lectures, 1 tutorial each week plus a number of computer practicals using the mathematical package Matlab.

Assessment: Assignments 10%, tests 10%, final exam 80%

Course Objectives: To provide an introduction to the basic concepts and techniques of calculus and linear algebra, emphasising their inter-relationships and applications to engineering, the sciences and financial areas.

To introduce students to the use of computers in mathematics and to develop problem solving skills with both practical and theoretical problems.

To consolidate the mathematics already learned at school and to introduce students to calculus of two variables, Taylor series and their use in approximating functions, the solution of differential equations and the computation and uses of eigenvalues and eigenvectors.

To discuss and explain certain theoretical concepts which underpin the topics introduced in calculus and linear algebra.

Graduate Attributes to be Developed:

- Ability to apply basic mathematical knowledge assured through written examination and assignments;
- Ability to communicate effectively, developed through tutorial participation and submission of assignments, but not assured;
- In-depth technical competence in basic mathematics assured through written examination and assignments;
- Ability to undertake problem definition, formulation and solution assured through written examination and assignments; and
- Expectation of the need to undertake lifelong learning and the capacity to do so assured

through the requirement to undertake additional reading to complete some assignments.

Course Synopsis: The two courses together provide an introduction to the basic concepts and techniques of calculus and linear algebra, emphasising their inter-relationships and applications to engineering, the sciences and financial areas; introduces students to the use of computers in mathematics; and develops problem solving skills with both theoretical and practical problems. Calculus: functions of one and two variables, differentiation and integration. Taylor series and differential equations. Algebra: Linear equations, matrices, the real vector space, determinants, optimisation, eigenvalues and eigenvectors, linear transformations.

Content:

Calculus

Functions (9%)
- Trigonometric functions
- Logarithms and exponential functions

The definite integral (7%)
- Areas under curves
- Fundamental Theorem of Calculus
- Revision of differentiation

Techniques of integration (9%)
- Methods of evaluating indefinite integrals
- Numerical integration.

Differential equations (6%)

The derivative (12%)
- Limits, and continuity
- The Mean Value Theorem
- Applications of the derivative

Taylor Series (7%)

Calculus of two variables (9%)

Algebra

Matrices and linear equations (10%)
- Solution of systems of linear equations
- Inverse matrix
- Determinants

Optimisation problems (4%)
- Optimisation of linear functions subject to linear constraints

The real vector space R^n (11%)
- Subspaces
- Linear independence
- linear combinations of vectors
- bases and orthonormal bases

Eigenvalues (12%)
- Eigenvalues and eigenvectors
- Diagonalization of symmetric matrices
- Applications of eigenvalues

Linear transformations (4%)

Text book: Lay, D., *Linear Algrebra and its applications,* 3rd edition, Addison-Wesley-Longman
Stewart, J., *Calculus,* 5th (or 4th) edition, Brooks-Cole

Recommended Reading: Mathematics 1 student notes

Experiments: None

Physics IHE

Course Code: PHYSICS 1003

Course Type: Core

Credit: 3 Units

Offered in Semester: Two

Pre-requisites / Assumed Knowledge: C&ENVENG 1001 Statics, MATHS 1011 Mathematics IA or MATHS 1013 Mathematics IMA (on application to Head of Discipline)
Corequisite: MATHS 1012 Mathematics IB or MATHS 1014 Mathematics IMB (on application to Head of Discipline)
Restriction: PHYSICS 1000A/B Physics I, PHYSICS 1200 Physics IB

Teaching Method: 3 lectures, 1 tutorial per week, 5 x three-hour practicals

Assessment: Practical work 20%, final exam 80%

Course Objectives:
In this course students shall:

- Develop their understanding of the concepts and laws of physics and the models of the physical world based on them;
- Have experience in making careful observations and measurements of physical phenomena, and interpreting the results;
- Use the ideas of physics to understand and explain common physical phenomena;
- Enhance their skills in critical thinking, problem solving, independent learning and communication.

Graduate Attributes to be Developed:

- Ability to apply knowledge of basic science and engineering fundamentals assured through written examination and tutorials.
- Ability to communicate effectively, not only with engineers but with the community at large developed through tutorial discussion but not assured.
- In-depth technical competence in at least one engineering discipline not assured.
- Ability to undertake problem definition, formulation and solution assured through written examination, practical reports and tutorials.
- Ability to utilise a systems approach to design and operational performance not assured.
- Ability to function effectively as an individual in multi-disciplinary and multi-cultural teams, with the capacity to be a leader or manager as well as an effective team member not assured.
- Understanding of the social, cultural, global and environmental responsibilities of the professional engineer, and the need for sustainable development not assured.
- Understanding of the principles of sustainable design and development not assured.

- Understanding of professional and ethical responsibilities and commitment to them not assured.
- Expectation of the need to undertake lifelong learning and the capacity to do so assured through the requirement to undertake independent reading and preparation for practical work and tutorials.

Course Synopsis: The course consists of an introduction to and discussion of various topics in rigid body mechanics, waves, optics, relativity and quantum mechanics.

Content:

RIGID BODY MECHANICS
Rigid body mechanics: centre of mass, rotational motion, torque, angular momentum, equilibrium, oscillations.

WAVES AND OPTICS
Transverse and longitudinal waves, superposition interference, standing waves, Fourier decomposition, Fermat's principle, geometric optics, physical optics, interference, Michelson interferometers, thin film interference, diffraction, resolution of telescopes.

RELATIVITY & QUANTUM PHYSICS
Kinematics, time dilation, length contraction, Lorentz transformations, transformation of velocities, relativistic momentum and energy, X-rays as waves and photons, photoelectric and Compton effects, pair production, de Broglie waves, uncertainty principle, the quantum mechanical wave function.

Text book: Giancoli, D. C., *Physics for Scientists and Engineers with Modern Physics,* 3rd edition, Prentice Hall

Recommended Reading: Nil

Experiments:
- Measurement
- Diffraction Grating
- Conservation of Energy
- Voltage Divider
- Thin Lenses

Statics

Course Code: C&ENVENG 1001

Course Type: Core

Credit: 2 Units

Offered in Semester: One

Pre-requisites / Assumed Knowledge:
Physics, Mathematical Studies and Specialist Mathematics

Teaching Method:
- 24 total contact hours (minimum) comprising lectures
- 3 x 1 hr per week (weeks 2 – 13 inclusive) statics drop-in centre (voluntary)
- Statics Study Pack and Study Guide Website (included with textbook)

Assessment: 20% on-line quizzes (MyUni), 80% exam

Course Objectives:
- Familiarisation with the general principles of static equilibrium;
- Application of Newton's laws of motion to solve engineering problems;
- Development of ability to use *free-body diagrams* and *self-checking* strategies as a standard part of the engineering problem solving process.

Graduate Attributes to be Developed:
- Competence in engineering fundamentals.
- Competence in using computers and information technology effectively.
- Ability to apply an integrative or systems approach to solving engineering problems.
- Awareness of uncertainty and recognising limitations of engineering approaches and systems.
- Competence in problem identification, formulation and solution.
- Competence in critical and independent thinking.
- Competence in creative and innovative thinking.
- Ability to effectively synthesize information and ideas.
- Competence to adapt to a changing society (lifelong learning skills).
- Ability to act in a professional manner.
- Ability to communicate effectively with others in the engineering profession and the community – written, oral and listening skills.
- Ability to manage effectively the allocation of time in performing tasks.

Course Synopsis:
Development of ability to use free-body diagrams and self-checking strategies to solve static equilibrium engineering problems using Newton's laws of motion. Real-life example problems are taken from the following topics: equilibrium of a particle; force system resultants; equilibrium

of rigid bodies; centre of gravity and centroids; distributed loading; fluid pressure; analysis of structures; internal forces; and friction.

Content:

Introduction (2 hrs)
- General principles
- Force (scalar formulation)

Equilibrium of a Particle 2-D and 3-D (2 hrs)
- Conditions of equilibrium
- Introduction of free body diagrams

Force System Resultants (2 hrs)
- Principle of moments
- Equivalent force systems
- Reduction of force and couple systems

Equilibrium of Rigid Bodies 2-D and 3-D (4 hrs)
- Conditions of equilibrium
- Free body diagrams
- Equations of equilibrium
- Constraints for a rigid body

Centre of Gravity and Centroids (2 hrs)
- Centre of gravity (and mass) for a system of particles
- Centre of gravity (and mass) and centroid for a body
- Composite bodies

Distributed Loading (2 hrs)
- Reduction of a distributed loading
- Fluid pressure

Structural Analysis (4 hrs)
- Simple trusses
- Method of Joints
- Method of Sections
- Frames and Machines

Internal Forces (2 hrs)
- Internal forces developed in members
- Shear and moment equations and diagrams
- Relationships between load, shear and moment

Friction (2 hrs)
- Characteristics of dry friction
- Problems involving dry friction

Review (2hrs)

Text book:
Engineering Mechanics: Statics by R.C. Hibbeler
3rd SI Edition, Prentice Hall Publishers
(includes Statics Study Pack and web access code)

Recommended Reading:
Powerpoint lecture slides provided on-line (MyUni).

Experiments:
None

LEVEL 2

COURSE OUTLINES

Design Practice

Course Code: MECH ENG 2018

Course Type: Core

Credit Points: 4 units

Offered in Semester: One

Pre-requisites / Assumed Knowledge: MATHS 1007 A/B Mathematics I; C&ENVENG 1001 Statics; MECH ENG 1000 Dynamics

Teaching Method: 20 hours lectures, 56 hours tutorials, 6 hours laboratory classes and 40 hours workshop practice

Assessment:		
	Individual assignments	20%
	Group assignments	5%
	Design project	15%
	Laboratories	10%
	Final examination	50%
	Workshop practice	satisfactory attendance

NOTE: Laboratories and Design project all compulsory and need to be passed.

Course Objectives: On the completion of this course students are expected to be able to:
- Systematically approach design problems
- Identify and analyse a number of sub-systems commonly used in mechanical design;
- Design such sub-systems using both first principles and according to standard processes;
- Understand basic workshop practices, including basic machining and the use of hand tools;
- Understand the principles of OH&S in a potentially hazardous environment;
- Interpret design requirements from a manufacturing perspective;
- Understand the limitations that manufacturing methods can impose on design;
- Understand the problems that overtly simplified or complex designs can impose upon manufacturing.
- Work in a team environment
- Prepare a technical report

Graduate Attributes to be developed:
- ability to apply knowledge of basic science and engineering fundamentals;
- ability to communicate effectively, not only with engineers but also with the community at large;
- in-depth technical competence in at least one engineering discipline;
- ability to undertake problem identification, formulation and solution;

- ability to utilise a systems approach to design and operational performance;
- ability to function effectively as an individual and in multi-disciplinary and multi-cultural teams, with the capacity to be a leader or manager as well as an effective team member;
- understanding of the social, cultural, global and environmental responsibilities of the professional engineer, and the need for sustainable development;
- understanding of the professional and ethical responsibilities and commitment to them;
- expectation of the need to undertake lifelong learning, and the capacity to do so.

Course Synopsis: In general the course is an introduction to engineering design. It covers basic stages of the design process and fundamentals of good design practice. It also discusses the design of some specific mechanical sub-systems and introduces students to some basic manufacturing processes. Students also learn effective communication skills by means of individual and group engineering reports. The course is divided into three major components:

In ***Design Project*** students work in teams on a design/build/test competition project (Warman competition tun by Engineers Australia) while completing a number of group assignments. In this part students will learn effective team work practices and project management while going through basic stages of the design process such as conceptual, embodiment and detail design.

In ***Design for Function*** a number of power transmitting sub-systems, commonly used in mechanical design, are discussed. In individual assignments students design such sub-systems using both first principles and according to standard processes. Students learn such fundamental aspects of design as using sources of design information; accuracy of engineering quantities; material selection; fabrication methods, and tolerances and fits.

In the *Workshop Practice* component, organized during the semester break at Panorama TAFE, students become familiar with basic workshop practices, including machining and the use of hand tools.

Content:
Design for Function:

- Design Process and basic calculations – 1 hr lecture + 3 hrs tutorial
  - design calculations - report format precision and rounding of quantities
  - free-body diagrams
  - equations for linear and angular motion.
- Friction Clutch Design – 1 hr lecture + 3 hrs tutorial
  - function, classification
  - plate clutch design - design parameters and equations
  - friction materials.
- Brake Design – 1 hr lecture + 3 hrs tutorial
  - function, classification
  - band brake design - design parameters and equations.
- Flat Belt Drives – 1 hr lecture + 3 hrs tutorial
  - geometry and belt construction
  - design parameters and equations

- V Belt & Chain Drives – 1 hr lecture + 3 hrs tutorial
    - geometry and construction
    - nomenclature
    - design parameters and catalogue selection.
- Gear Drive Systems – 1 hr lecture + 3 hrs tutorial
    - Nomenclature
    - types and construction of gears
    - design parameters and equations
    - shaft loads
- Rubbing Bearings – 1 hr lecture + 3 hrs tutorial
    - operation principles
    - material properties
    - bearing selection
- Oil Film Bearings – 1 hr lecture + 3 hrs tutorial
    - operation principles
    - design criteria and bearing selection
- Rolling Element Bearings – 2 hrs lectures + 2 x 3 hrs tutorial
    - Classification
    - types and characteristics
    - selection procedure
    - lubrication, seals, installation
    - case study of bearing selection

Design Project:
- Design Process – 3 hrs lectures + 3 x 2 hrs tutorial
    - Design specification
    - Conceptual design
    - Function analysis
    - Embodiment design
- Organising a Group Project – 1 hr lecture + 2 hrs tutorial
    - design planning
    - Team Work - how to organise design effort
    - Report writing
- Work on competition project - 21 hrs
    - building and testing
    - school finals
    - preparation of a project report

Text book: Notes are provided
Recommended Reading: *Mechanical Engineering Design* (1st metric edition) by Shigley J.E., McGraw Hill, 1986: *Engineering Design* by Dieter G.E., McGraw Hill 1987
Experiments: MatLab-I – 2 x 2 hrs; Introduction to Measurement – 2 hrs

Differential Equations and Fourier Series

Course Code: APP MTH 2000

Course Type: Core

Credit: 2 Units

Offered in Semester: One

Pre-requisites / Assumed Knowledge: MATHS 1012 Mathematics IB (Pass Div I) or MATHS 2004 Mathematics IIM (Pass Div I) or co-requisite MATHS 2004 Mathematics IIM restriction: may not be presented with APP MTH 2007 Differential Equations II or APP MTH 2010 Differential Equations & Statistical Methods (Civil)

Teaching Method: 30 hours lectures and tutorials

Assessment: Written and computing assignments 15%, final exam 85%.

Course Objectives: The objective of this unit is to equip students with the analytical techniques required to solve a broad range of ordinary differential equations and the classical linear partial differential equations of second order.

Graduate Attributes to be Developed:

- ability to apply knowledge of basic science and engineering fundamentals;
- ability to communicate effectively, not only with engineers but also with the community at large;
- in-depth technical competence in at least one engineering discipline;
- ability to undertake problem identification, formulation and solution;
- ability to utilise a systems approach to design and operational performance;
- ability to function effectively as an individual and in multi-disciplinary and multi-cultural teams, with the capacity to be a leader or manager as well as an effective team member;
- understanding of the social, cultural, global and environmental responsibilities of the professional engineer, and the need for sustainable development;
- understanding of the principles of sustainable design and development;
- understanding of the professional and ethical responsibilities and commitment to them; and expectation of the need to undertake lifelong learning, and the capacity to do so.

Course Synopsis: Ordinary differential equations: First order, second order, series solutions. Fourier series for functions of arbitrary period, half range expansions, even and odd functions, complex form of Fourier series. Partial differential equations: heat equation, separation of variables, wave equation, Laplace's equation. Applications in boundary value problems.

Content:

Ordinary Differential Equations (ODEs) (50%)

- Separable, linear and exact first-order ODEs, reduction of order, Picard iteration
- Second-order linear ODEs and solving and interpreting models of forced and unforced oscillations in physical systems
- Series solutions of second-order variable coefficient linear ODEs, including Legendre's and Bessel's equations

Fourier Analysis (15%)

- Orthogonal functions, generalised Fourier series, odd and even functions, periodic functions, trigonometric series, Euler formulae, convergence of Fourier series, functions of arbitrary period (, half-range expansion, complex form of the Fourier series (3 lectures)

Partial Differential Equations (PDEs) (35%)

- Basic concepts and examples
- The vibrating string – derivation of the wave equation.
- Boundary and initial conditions
- The wave equation – D'Alembert's solution, separation of variables, eigenfunctions.
- Satisfying the initial and boundary conditions – the use of Fourier Series in solving PDEs
- Classical linear PDEs of second order important in applications – the heat equation, the wave equation and Laplace's equation, steady-state 2-D heat flow.

Text book: Kreyszig, E., *Advanced Engineering Mathematics,* 8th edition, Wiley. Extensive lectures notes are made available to students.

Recommended Reading: Nil

Experiments: None

Dynamics and Control 1

Course Code: MECH ENG 2019

Course Type: Core

Credit Points: 3 Units

Offered in Semester: Two

Pre-requisites / Assumed Knowledge: APP MTH 2000 Differential Equations and Fourier Series, MECH ENG 1000 Dynamics, ELEC ENG 1006 Electrical Engineering 1.

Teaching Method: 48 hours lectures and tutorials and 9 hours of laboratory classes

Assessment:
- Assignments, 20%, addressing attributes 1, 2, 3, and 4.
- Laboratory experiments, 10%, addressing attributes 1, 2, 3, and 4.
- Final exam, 70%, addressing attributes 1, 2, and 3.
- Note that the laboratory experiments are compulsory and it is a requirement to pass the laboratory experiments to pass the course.

Course Objectives:
On completion of the course, students should:
- Have a good understanding of the principles of machine dynamics.
- Be able to determine the mobility of planar mechanisms.
- Be able to apply vector analysis to planar mechanisms to quantify the displacement, velocity and acceleration of the mechanism components.
- Understand and be able to apply the concept of velocity and acceleration images.
- Be competent in applying kinematic design fundamentals for cam and follower mechanisms.
- Be competent in the kinematic analysis and design of gears and simple, compound, reverted and epicyclic gear trains.
- Understand the concept of inertia forces and its application to kinematic analysis of mechanisms.
- Understand and be able to apply the principles of static and dynamic balancing for rotating and reciprocating systems.
- Have a good understanding of the feedback control theory.
- Be able to model, analyse, design and simulate automatic control systems in the time domain and the frequency domain.
- Be able to apply the methods of block diagram, root locus, Bode plot, Ruth array, and Nyquist diagram to analyse and design automatic control systems.

Graduate Attributes to be Developed: This course is intended to develop in students the following generic attributes:

1. Ability to apply knowledge of basic science and engineering fundamentals;
2. In-depth technical competence in at least one engineering discipline;
3. Ability to undertake problem identification, formulation and solution;
4. Expectation of the need to undertake lifelong learning, and capacity to do so.

Course Synopsis:
Students will be introduced to various applications of feedback control systems and develop fundamentals associated with modelling, analysis, design and simulation of automatic control systems. This course also aims to introduce the basic concepts of machine dynamics and their engineering applications, and deals with the analysis, design and application of a variety of mechanisms.

Content:

- Velocity and acceleration in mechanisms/linkages (7 lectures + 1.5 tutorials)
- Cam and follower motion (4 lectures + 0.5 tutorial)
- Kinematics and dynamics of gears (2 lectures + 0.5 tutorial)
- Gear trains (2 lectures + 0.5 tutorial)
- Force analysis of plane mechanisms (2 lectures)
- Balancing of rotating masses (2 lectures)
- Balancing of reciprocating masses (2 lectures)
- Modelling in the Frequency Domain (2 lectures)
- Laplace Transform (2 lectures)
- Transfer Function and Block Diagram (2 lectures + 1 tutorial)
- Time Response (2 lectures)
- Time Domain Specifications (2 lectures)
- Feedback Control System Characteristics(1 lecture + 1 tutorial)
- System Stability (2 lectures)
- Root locus Techniques (2 lectures)
- Compensator Design via Root Locus (1 lecture + 1 tutorial)
- Frequency Response Methods (2 lectures)
- Stability in the Frequency Domain (2 lectures + 1 tutorial)

Text book:

- Nise, N., *Control Systems Engineering*, John Wiley; **or**
- Dorf, R.C. and Bishop, R.H., *Modern Control Systems,* Prentice Hall.

Recommended Reading:

1. Mabie, H.H. and Reinholtz, C.F., 1987, *Mechanisms and Dynamics of Machinery*, Fourth Edition, Wiley and Sons.

Experiments: Auto Control (6 hours) and Linkage Analysis (3 hours).

Engineering Communication (ESL)

Course Code: MECH ENG 3006

Course Type: Available to students whose native language is not English and may be presented in lieu of one elective at Level IV. Compulsory for international students from language backgrounds other than English, who presented an English language score for admission or who entered via a Foundation Studies Program.

Note: *Students are expected to undertake this course during the first six months of your study at this university. Th course may be taken at any level during your degree so students arriving in their second, third or fourth year of their program may undertake the course. The course need only be passed once.*

Credit: 2 Units

Offered in Semester: One and Two

Pre-requisites / Assumed Knowledge: English language levels accepted for entrance to the University of Adelaide.

Teaching Method: : 24 hours lecture-workshops

Assessment: Assignments 90%, attendance 10%. Pass mark 50%. No supplementary exams or assessments are given for this course.

Assignments:

- Grammar, (online modules) 10%
- Oral, 5%
- Written 20%
- Oral, 25%
- Written, 30% ,
- Attendance, 10%

Course Objectives: On completion of the course, students should:

- grasp some of the ways in which social context shapes language features and communicat
- develop and present evidence based propositions
- identify and begin to apply the language features of academic writing and speaking
- locate appropriate sources of information toward your assignments
- critically read and interpret information in the development of your own point of view
- write appropriate texts which communicate the logical development of proposition(s) and analysis of issues
- present your understanding and analysis of issues in a formal seminar presentation
- participate in class and group discussions, and present decisions made to class colleagues in informal presentations.
- increase your awareness of social, cultural and ethical issues and be able to discuss these in relation to professional and social responsibilities.

Graduate Attributes to be Developed:
The University of Adelaide provides an environment where students are encouraged to take responsibility for developing the following attributes:

- the ability to communicate effectively in formal and informal situations, in writing and speaking as is assessed in written and oral assignments
- the ability to communicate effectively with engineers, other professionals and the community general as is emphasised throughout the course and indirectly assessed through assignments
- independent and critical thinking: the ability to locate, analyse, critically evaluate and synthesise information from a wide variety of sources in a planned and timely manner, as must be demonstrate students and oral assessments
- skills of a high order in interpersonal understanding, teamwork and communication as is emphasise throughout the course and must be demonstrated through interactive class tasks
- proficiency in the appropriate use of contemporary technologies as is assured through student interaction with the MyUni environment, database and catalogue searching, email and use of Turniti
- a commitment to continuous learning and the capacity to maintain intellectual curiosity throughout lif is emphasised throughout the course
- an awareness of ethical, social and cultural issues and their importance in the exercise of profession skills and responsibilities as is assessed through assignment topics which explore these issues.

Course Synopsis: This course provides language development in English as a second language for the purposes of oral and written communication in the context of the study of Engineering. It introduces linguistic principles as tools to assist communication in English as a second language and in cross-cultural settings. Class work is designed to develop the capacity of students for communication (in speaking, listening, writing and reading) and critical thinking relevant to their current studies and intended careers in the fields of engineering and computing. Language development is task-based. Tasks and assignments are focussed on academic writing, research and preparing evidence-based papers, reading, informal academic discussion and formal oral presentation.

Content:
The lecture-workshops are interactive to assist students to develop skills in discussion, research skills, practice writing texts, develop their oral presentation skills and analyse and discuss their ideas about issues in Engineering.

Register (2L)
concept of register
identification of different registers language features of academic communication

Paragraphs - basic overview of features, structure and functions (2L)
topic sentences(s)/proposition/outline
evidence, examples, citing sources closing statement

Using evidence (1L)
evaluating evidence & reliability
strategies for

Discussion session (1L)
critical examination of evidence for topic
oral discussion oral presentation of propositions

Plagiarism & Referencing (2L)
university policy
referencing guide, in-text citations,& language features

Self-editing of paragraphs (1L)
strategies
Oral Presentations Intro. (1L)
identifying features of good academic seminars /practice

Oral Presentations 3 mins Assessment (2T)

Library orientation, (2L)
referencing database searching

Propositions, claims & facts. (1L)
definitions, examples, tasks
General to specific movement (1L)
functions of as support for proposition

Logical cohesion (2L)
concepts
language features
strategies for analysis & increasing cohesion
recognizing cohesion, lack of cohesion

Interpretation, analysis & summary (2L)
concepts
identifying the differences
Structure of a short discussion paper (discourse organization/sequencing)
identifying and applying language features appropriate in a short paper

Passive & Active voice (2L)
concepts, functions, identifying and swapping voice
Oral Presentations strategies (4T)
guidelines
analysis of features of model student presentations (video)
practice applying features

Text book: A detailed description of the course and course notes, will be distributed to the students at the first lecture.

Recommended Reading: None

Experiments: None

Materials and Manufacturing

Course Code: MECH ENG 2020

Course Type: Core

Credit: 3 Units

Offered in Semester: One

Pre-requisites / Assumed Knowledge: CHEM ENG 1003 Materials 1

Teaching Method: 48 hours lectures and tutorials and 4 hours of laboratory classes

Assessment: Assignments 30%, final exam 70%

Course Objectives:
On completion of the course, students are expected to be able to:
- Demonstrate knowledge of the range of manufacturing processes available;
- Use analytical methods to understand the process variables;
- Select manufacturing processes for particular applications;
- Understand the importance of economic factors when considering the application of a process;
- Extend the fundamental understanding of the elastic and plastic properties of materials introduced in earlier courses;
- Develop a knowledge of specific materials based on fundamental knowledge gained from this and previous courses;
- Develop an understanding of the failure mechanisms of different types of materials;
- Develop an understanding of the environmental factors and their effect on the properties of materials.

Graduate Attributes to be Developed:
- Ability to apply knowledge of materials science and manufacturing to produce engineering solutions;
- Ability to communicate effectively, not only with engineers but also with the community at large;
- Ability to undertake problem identification, formulation and solution;
- Understanding of the social, cultural, global and environmental responsibilities of the professional engineer, and the need for sustainable development;
- Understanding of the principles of sustainable design and development;
- Understanding of the professional and ethical responsibilities and commitment to them;
- Expectation of the need to undertake lifelong learning and the capacity to do so.

Course Synopsis: Introduction to materials selection, structure and properties of ferrous and non-ferrous alloys, polymers, ceramics and composites and their influence on engineering design, failure modes of materials, heat treatment of ferrous and non-ferrous alloys, Manufacturing past, present and future; introduction to the manufacturing function. Introduction to manufacturing processes; economics of machine operations; theory of manufacturing processes. Introduction to design for manufacture.

Content:
MANUFACTURING (24 lectures and tutorials – 50%)
- An overview of manufacturing and general introduction to manufacturing processes (1 lecture)
- Detailed description and analysis of specific processes
  - Casting processes (4 lectures/tutorials)
  - Bulk deformation processes (6 lectures/tutorials)
  - Material forming processes (2 lectures/tutorials)
  - Material removal processes: cutting (2 lectures)
  - Material removal processes: chemical, electrical (2 lectures)
  - Processing of polymers (4 lectures/tutorials)
  - Processing of powder metals (2 lectures)
  - Welding and other joining processes (2 lectures)

Competitive aspects, economics of manufacturing and design considerations are included within each topic.

<u>MATERIALS</u> (24 lectures and tutorials – 50%)
- Elastic and plastic properties of metals; measurement, atomic basis dislocations, defects, strengthening mechanisms, continuum plasticity (6 lectures/ tutorials)
- Heat-treatment processes, introduction to welding, plasticity and fracture at elevated temperatures: creep measurement, thermal activation and diffusion, high temperature materials – selection and applications (3 lectures/ tutorials)
- Elastic and plastic properties of polymers by class (4 lectures/ tutorials)
- Elastic and plastic properties of composites (2 lectures/ tutorials)
- Fracture of materials: measurement of toughness and fracture toughness, fatigue fracture, micro-mechanisms of fracture (3 lectures/ tutorials)
- Surface properties of materials; oxidation, corrosion, friction and wear (4 lectures/ tutorials).
- Introduction to materials selection and applications (2 lectures/ tutorials)

Text books: Callister, W.D., *Fundamentals of Materials Science and Engineering*, (e-text) *Introduction to Manufacturing Processes*, 3rd edition, McGraw Hill: De Garmo, E.P., Black, J.T., Kohser, R.A., *Materials and Processing in Manufacturing*, John Wiley & Sons.

Recommended Reading:
Askeland, D.R., *The Science and Engineering of Materials*, S.I. edition, Van Nostrand Reinhold; Ashby, M.F. and Jones, D.R.H. (Part 1) *Engineering Materials – An Introduction to their Properties and Application*, Pergamon: Schey, J.A., Groover, M.P. *Fundamentals of Modern Manufacturing*, John Wiley & Sons

Experiments
Occupational Health and Safety
Plant visits

Mechatronics 1M

Course Code: MECH ENG 2011

Course Type: Core

Credit Points: 2 Units

Offered in Semester: Two

Pre-requisites / Assumed Knowledge: ELEC ENG 1005 Electrical Systems AM or ELEC ENG 1006 Electrical Engineering, MECH ENG 1000 Dynamics, MECH ENG 2021 Thermo-Fluids 1.

Teaching Method: 36 hours lectures and tutorials and 4 hours of laboratory classes

Assessment:
- Assignments, 20%, addressing attributes 1, 2, 3, and 4.
- Laboratory experiments, 10%, addressing attributes 1, 2, 3, and 4.
- Final exam, 70%, addressing attributes 1, 2, and 3.

Course Objectives:
On completion of the course, students should:
- Have a good understanding of the architecture of mechatronic systems;
- Be able to design some simple measurement systems;
- Have the ability to design basic control systems;
- Demonstrate an understanding of PLC programming;
- Demonstrate an understanding of analogue and digital interfacing.

Graduate Attributes to be Developed:
1. ability to apply knowledge of basic science and engineering fundamentals;
2. ability to undertake problem identification, formulation and solution;
3. ability to utilise a systems approach to design and operational performance; and
4. expectation of the need to undertake lifelong learning, and the capacity to do so.

Course Synopsis:
To provide an introduction to the application of electronic control systems in mechanical and electrical engineering. To give framework of knowledge that allows students to develop an interdisciplinary understanding and integrated approach to mechatronic engineering.

Content:
- Introduction to mechatronic systems (2L)
- Principles of measurement systems (2L)
- Measurement of solid-mechanical quantities (4L+2T)
- Measuring temperature (4L+2T)
- Measuring fluid flow rate (4L+2T)

- Electro-pneumatics (2L+T)
- Stepping motors (4L+2T)
- Analogue and digital interfacing (2L+T)
- Programmable logic controllers (L+T)

Text book:

- Introduction to engineering experimentation (2nd Ed.) Anthony J. Wheeler and Ahmad R. Ganji, Prentice-Hall, 2004.

Recommended Reading:

- *Principles of Measurement Systems,* (3rd edition), Bentley;
- *SIMATC 87 – 2000* Programmable Controller System Manual

Experiments: Electro-Pneumatic Control (2 hours) and PLC (2 hours).

Numerical Analysis and Probability and Statistics

Course Code: APP MTH 2009

Course Type: Core

Credit: 2 Units

Offered in Semester: Two

Pre-requisites/Assumed Knowledge: MATHS 1012 Mathematics IB (Pass Div I) or MATHS 2004 Mathematics IIM (Pass Div I)
Restriction: may not be presented together with STATS 2004 Laplace Transforms and Probability and Statistical Methods, STATS 2001 Statistical Methods (Civil), APP MTH 2004 Numerical Methods in Engineering (Chemical)

Teaching Method: 35 hours lectures and tutorials

Assessment: Written and computing assignments 15%, final exam 85%.

Course Objectives:
At the end of this course, students should be able to:

- find numerical solutions to any ordinary differential equation they meet in their engineering studies;
- develop numerical solutions for a number of simple partial differential equations;
- integrate numerically;
- understand the concept and calculus of probability and probability distributions;
- recognise when and how a simple elementary method is appropriate and when a more sophisticated technique is necessary. As a corollary students should be able to appreciate the structure of a statistical or probabilistic argument and to distinguish cogent from doubtful.

Graduate Attributes to be Developed:

- ability to apply knowledge of basic science and engineering fundamentals;
- ability to communicate effectively, not only with engineers but also with the community at large;
- in-depth technical competence in at least one engineering discipline;
- ability to undertake problem identification, formulation and solution;
- ability to utilise a systems approach to design and operational performance;
- ability to function effectively as an individual and in multi-disciplinary and multi-cultural teams, with the capacity to be a leader or manager as well as an effective team member;
- understanding of the social, cultural, global and environmental responsibilities of the professional engineer, and the need for sustainable development;
- understanding of the principles of sustainable design and development;

- understanding of the professional and ethical responsibilities and commitment to them; and
- expectation of the need to undertake lifelong learning, and the capacity to do so.

Course Synopsis: Numerical analysis: numerical solution of ordinary and partial differential equations. Probability calculus. Statistical methods: estimation of means and variances; inferences on means; simple analysis of variance; simple linear regression; inferences on probabilities; contingency tables.

Content:

Numerical Analysis (43%)
- Numerical solutions of ordinary differential equations (both initial and boundary value problems)
- Numerical solutions of partial differential equations
- Matrix inversion techniques

Probability and Statistical Methods (57%)
- Simple graphical methods: stemplots, histograms and boxplots. Exploratory data analysis and summary statistics for location and spread.
- Principles of experimental design: replication, randomization and control. Sampling and surveys.
- Probability and important distributions for discrete and continuous random variables. Expectation, moments and other properties of distributions. Q-Q plots; linear combinations of random variables.
- Estimation, confidence intervals and hypothesis testing for proportions and means. Linear regression analysis and the method of least squares; model checking and diagnostics.

Text book: Kreyszig, E., *Advanced Engineering Mathematics,* 8th edition, Wiley

Recommended Reading: Nil

Experiments: Computer Laboratory based experiments (through hands-on project work) designed to explore the application of the numerical methods introduced in this course.

Stress Analysis and Design

Course: Stress Analysis and Design

Course Code: MECH ENG 2002

Course Type: Core

Credit: 3 Units

Offered in Semester: Two

Pre-requisites / Assumed Knowledge: MECH ENG 1000 Dynamics, C&ENVENG 1001 Statics

Teaching Method: 24 hours lectures, 30 hours tutorials and 8 hours laboratory classes

Assessment: Assignments 20%, laboratory classes 10%, final exam 70%

Course Objectives: The primary goal of the course is to provide students with the skills required to analyse stress, strain and failure in machine parts and to use simple design procedure to ensure adequate strength of mechanical components subjected to static and dynamic loading.

Graduate Attributes to be Developed:
- ability to apply knowledge of basic science and engineering fundamentals;
- ability to communicate effectively, not only with engineers but also with the community at large;
- in-depth technical competence in at least one engineering discipline;
- ability to undertake problem identification, formulation and solution;
- ability to utilise a systems approach to design and operational performance;
- ability to function effectively as an individual and in multi-disciplinary and multi-cultural teams, with the capacity to be a leader or manager as well as an effective team member;
- understanding of the social, cultural, global and environmental responsibilities of the professional engineer, and the need for sustainable development;
- understanding of the principles of sustainable design and development;
- understanding of the professional and ethical responsibilities and commitment to them; and
- expectation of the need to undertake lifelong learning, and the capacity to do so.

Course Synopsis: Concepts of stress, transformation of stress and strain, theories of elastic failure, stress concentration and fatigue failure, pure bending, deflection of beams, torsion, buckling of columns, springs, shafts, keys, splints, pins, bolted joints and welded joints.

Content:

PART I

INTRODUCTION (1 lecture and tutorial)
(a) Overview of the objectives and methods of Stress Analysis and Design
(b) Review of concepts from introductory static and dynamics courses
(c) Notation for vector components
(d) Free-body diagrams
(e) Static Equilibrium
(f) Course organization and policies

AXIALLY LOADED MEMBERS (1 lecture and 2 tutorials)
(a) Stress
(b) Strain
(c) Material Behavior:
(d) Hooke's Law: Young's Modulus and Poisson's ratio
(e) Nonlinear behaviour
(f) Stress and strain in truss

TORSION OF CYLINDRICAL RODS (1 lecture and tutorial)
(a) Kinematics7
(b) Stress distributions
(c) Typical failure of torsion

MULTIAXIAL STATE OF STRESS (1 lecture and 2 tutorials)
(a) Surface traction vector; tractions acting on planes within a solid
(b) State of stress at a point
(c) Plane stress
(d) Traction-stress relation
(e) Change-of-basis formula
(f) Principal stresses
(g) Mohr's Circle

MULTIAXIAL STATES OF STRAIN (1 lecture and tutorial)
(a) Extensional strain
(b) Shear strain
(c) Volume changes
(d) Change of basis for strains
(e) Principal strains
STRESS-STRAIN RELATIONS; LINEAR ELASTICITY (1 lecture and tutorial)
(a) Overview of general types of material behavior
(b) Overview of elastic materials
(c) Isotropic linear elastic materials

INTERNAL FORCES AND MOMENTS IN BEAMS (1 lecture and 2 tutorials)
(a) Definitions
(b) Shear and moment diagrams
BEAM BENDING (1 lecture and tutorial)

(a) Background and assumptions
(b) Area moment of inertia for beam cross sections
(c) Normal and shear stress distributions
(d) Analysis of beam deflections
(e) Beam buckling

CURVED BEAMS (1 LECTURE AND TUTORIAL)

ENERGY METHODS (1 lecture and tutorial)
(a) Strain energy
(b) Work and energy for a loaded structure
(c) Castigliano's theorem

OTHER ELASTIC STRUCTURES (1 lecture and tutorial)
(a) Pressure vessels
(b) Deflections in trusses
(c) Simple frame analysis

INTRO TO PLASTICITY (2 lecture and 2 tutorials)
(a) Overview
(b) Elastic-plastic truss analysis
(c) Elastic-plastic torsion
(d) Bending of elastic-perfectly plastic beams

PART II

MATERIALS FOR MACHINE PARTS (1 lecture and tutorial)

DESIGN FOR STATIC LOADING (1 lecture and tutorial)
(a) Combined stress
(b) Stress concentration factors
(c) Design and permissible stress
(d) Outline procedure for the design of machine parts for static loading

FATIGUE (1 lecture and 2 tutorials)
(a) Endurance strength and modifying factors
(b) Design for limited life
(c) Intro to fatigue damage function

SHAFT DESIGN (2 lectures and 2 tutorials)
(a) Design criteria (strength, deflection and resonance)
(b) Bearing requirements
(c) Requirements of functional members
(d) Outline design procedure, design guidelines and standards

BUCKLING OF COMPRESSION MEMBERS (1 lecture and tutorial)
(a) Euler and Johnson theories for columns

(b) Effect of eccentric loading

KEYS AND PINS (1 lecture and tutorial)
(a) Types
(b) Design of keys and pins

BOLTED JOINTS (1 lecture and tutorial)
(a) Types of bolted joints
(b) Bolt design stress
(c) Outline design procedure, design guidelines and standards

WELDED JOINTS (2 lectures and 2 tutorials)
(a) Intro to welded joints
(b) Weld types
(c) Stresses in welded joints
(d) Outline design procedure, design guidelines and standards

SPRINGS (1 LECTURE AND TUTORIAL)
(a) Helical spring analysis
(b) Belleville springs
(c) Torsion springs

Text book: Gere, J.M., *Mechanics of Materials,* Fifth SI edition, Nelson Thornes Ltd, 2002

Recommended Reading:
Beer, F.P. and Johnston, F.R., *Mechanics of Materials,* Second SI edition; Samuel, A.., and Weir, J., *Introduction to Engineering Design*, Butterworth-Heinemann, 1999; Gere, J.M., and Timoshenko, S.P., *Mechanics of Materials*, Second SI Edition, Van Nostrand Reinhold, UK; Juvinall, R.C. and Marshek, K.M., *Fundamentals of Machine Component Design*, Second Edition, Wiley, 1991; SAA HB6-1985 *Design Standards for Mechanical Engineering Students*, Standard Association of Australia, Sydney, 1985; Dieter, C.E., *Engineering Design: a materials and processing approach*, First Metric Edition, McGraw-Hill, New York, 1986.

Experiments: FEA – I, Stress Analysis

Thermo-Fluids 1

Course Code: MECH ENG 2021

Course Type: Core

Credit: 3 units

Offered in Semester: One

Pre-requisites / Assumed Knowledge: MATHS 1007A/B Mathematics I, PHYSICS 1003 Physics IHE

Teaching Method: 48 hours lectures and tutorials and 4 hours of laboratory classes

Assessment: Laboratory classes 10%, assignments 20%, final exam 70%

Course Objectives: On the completion of this course students are expected to be able to:

- Be conversant with the concepts and definitions used in fluid mechanics;
- Understand and be able to apply fundamental concepts and equations to practical fluid mechanics problems;
- Have a good understanding of basic thermodynamics and its importance in thermal systems;
- Have a good understanding of basic gas laws and phase change processes;
- Have a deep understanding of the different forms of energy, its transfer and the laws that controls this transfer;
- Have a good understanding of basic ideal thermal cycles and their application to daily life
- Be equipped with the knowledge of environmentally responsible and current best practice for the design of efficient thermal system and cycles;
- Have developed analytical cognitive skills and problem solving skills in thermodynamics and fluid mechanics

Graduate Attributes to be Developed:

- ability to apply knowledge of basic science and engineering fundamentals;
- ability to communicate effectively, not only with engineers but also with the community at large;
- in-depth technical competence in at least one engineering discipline;
- ability to undertake problem identification, formulation and solution;
- understanding of the principles of sustainable design and development; and
- expectation of the need to undertake lifelong learning, and the capacity to do so.

Course Synopsis: An introduction to mechanical engineering ***thermodynamics*** dealing with the application of the first and second laws of thermodynamics to the thermodynamic design and performance analysis of typical thermo-mechanical plant using condensable vapours and gases as the working fluid. Basic ***fluid mechanics*** including: kinematics and dynamics of fluid flows; conservation laws applied to fluid flow; Euler, Bernoulli, Navier-Stokes equations; dimensional analysis; differential and integral flow analysis; flow visualisation.

Content:

Thermodynamics:.

- Introductory Thermodynamic Concepts (2 hrs lectures)
  - Energy Model
  - Definitions
  - Problem Solving Methodology
  - Engineering Design
- Energy (1 hr lectures)
  - Mechanical Concepts of Energy: KE, PE, Work
  - Energy of a System
- Energy Transfer and the First Law of Thermodynamics (1 hrs lectures, 1 hr tutorial)
  - Energy Transfer by Heat
  - Heat Transfer Modes
  - Energy Balance of Closed Systems
  - Energy Analysis of Cycles
- Properties of a Pure, Simple Compressible Substance (3 hrs lectures, 1 hr tutorial)
  - State Principle
  - p-v-T Relation
  - Thermodynamic Property Data
  - p-v-T Relation for Gases
  - Ideal Gas Model
- Control Volume Analysis (2 hrs lectures, 1 hr tutorial)
  - Conservation of Mass for a Control Volume
  - Conservation of Energy for a Control Volume
  - Analysis of Control Volumes at Steady State
  - Examples of Several Important Devices
  - Nozzles and Diffusers
  - Turbines
  - Compressors and Pumps
  - Heat Exchangers
  - Throttling Devices - Throttling Calorimeter
  - Transient Analysis
- Second Law of Thermodynamics (1 hr lectures)
  - Work and Processes
  - Statements of the Second Law
  - Reversible and Irreversible Processes
- Second Law Corollaries for Thermodynamic Cycles (1 hr lectures)
  - Energy Analysis of Thermodynamic Cycles
  - Limitations on Power Cycles
  - Limitations on Refrigeration and Heat Pump Cycles
  - Kelvin Temperature Scale
- Cycle Performance Measures and the Carnot Cycle (1 hr lectures, 1 hr tutorial))
  - Maximum Performance of Power Cycles
  - Maximum Performance of Refrigeration and Heat Pump Cycles

  - The Carnot Cycle
- Entropy (4 hrs lectures, 1 hr tutorial)
  - Clausius Inequality
  - Definition of Entropy Change
  - Entropy of Pure, Simple Substances
  - Entropy Change in Internally Reversible Processes
  - Entropy Balance for Closed Systems
  - Entropy Rate Balance for Control Volumes
  - Isentropic Processes
  - Isentropic Efficiency
  - Heat Transfer and Work in Internally
  - Reversible Steady Flow Processes
- Exergy (Availability) (2 hrs lectures, 1 hr tutorial)
  - Introduction to Exergy
  - Evaluation (Derivation)
  - Exergy Balances for Closed Systems
  - Flow Exergy
  - Exergy Rate Balance for Control Volumes
  - Second Law Efficiency

Fluid Mechanics:

- Introduction & Basics – 1 hr lecture
  - Definitions
  - Fluid Properties
  - Units
  - Problem Solving Methodology
- Hydrostatics – 2 hrs lectures + 1 hr tutorial
  - Introduction and Pascal's Law
  - Pressure - A Scalar Term
  - Pascal's Law for Pressure at a Point
  - Pressure Variation with Depth
  - Gauge Vs Absolute Pressure
  - Manometry
  - Forces on Plane Submerged Surfaces
  - Subjected to Uniform Pressure
  - Forces on Plane Submerged Surfaces
  - Definitions of Centroid & Centre of Pressure
  - Forces on Curved Surfaces
  - Buoyancy
- Kinematics, Continuity & C.V. Analysis – 3 hrs lectures + 1 hr tutorial
  - Flow Regimes: Laminar & Turbulent Flow in Pipes
  - Describing Fluid Flow: Lagrangian Description, Eulerian Description
  - Steady & Unsteady Flow
  - Reference Frame and the Galilean Transformation
  - Flow Lines
  - Streamline Coordinate System
  - Flow Dimensionality and Directionality

- Intensive and Extensive Parameters
- Material (Total/Lagrangian/Substantive) Derivative – Acceleration
- The Helmholtz Theorem
- Rotation, Angular Velocity and Vorticity
- Rate of Shear Deformation
- Rate of Volumetric Strain
- Control Volumes and Systems
- Reynolds Transport Theorem
- Conservation of Mass: Integral & Differential Continuity
- Flow Rate and Average Velocity

- Energy & Bernoulli Equations, Equations of Motion – 3 hrs lecture + 1 hr tutorial
  - The General Energy Equation
  - Average Properties and Velocities
  - The General Energy Equation for a Streamline
  - The Mechanical Energy Equation
  - Bernoulli's Equation
  - Pressure Coefficient or Euler Number
  - Stagnation Pressure
  - Pitot-Static Tubes
  - Yaw Meters
  - Venturi Flow Meters
  - Equations of Motion:• Euler's, Cauchy &Navier-Stokes Equations
- Dimensional Analysis, Similitude & Modelling – 2 hrs lecture + 1 hr tutorial
  - Dimensional Homogeneity
  - Buckingham's Π-Theorem
  - Standard Π- Groups
  - Dimensional Reasoning
  - Dimensional Analysis by Inspection
  - Physical Similarity: Geometric ,Kinematic &Dynamic
  - Complete & Incomplete Physical Similarity
- Linear Momentum, Angular Momentum – 2 hrs lecture + 1 hr tutorial
  - Derivation of the Linear Momentum Equation
  - Terms in the Linear Momentum Equation
  - Problem Solving
  - Moving and Deforming Control Volumes
  - Relative Velocity
  - Derivation of the Angular Momentum Equation
- Turbomachinery and Turbomachine Performance – 2 hrs lecture + 1 hr tutorial
  - Classes of Turbomachines
  - Derivation of Euler's Pump and Turbine Equation
  - Centrifugal Pumps and Fans-Simplifications
  - Axial Flow Fans, Pumps and Turbines
  - Departures from Euler's theory
  - Three-dimensionalities
  - Losses
  - Energy Balance for Turbomachines
  - Performance Curves of Turbomachines

- Performance Characteristics of Turbomachines
- Summary - 1 hr lecture

Text book: Moran, M.J., and Shapiro, H.N., *Fundamentals of Engineering Thermodynamics*, John Wiley and Sons Inc, 5th Edition 2004 Wiley, 1999; Munson, B.R., Young, D.F., Okiishi, T.H., *Fundamentals of Fluid Mechanics*, John Wiley and Sons Inc, 4th Edition 2002

Recommended Reading: The Barr Smith library has many books which are concerned with Thermodynamics and Fluid Mechanics. Students are encouraged to consult these books to enrich their knowledge in both topics.

Experiments: Flow Visualisation – 2 hrs; Engine Disassembly – 2hrs

Vector Analysis & Complex Analysis

Course Code: APP MTH 2002

Course Type: Core

Credit: 2 Units

Offered in Semester: One and two

Pre-requisites / Assumed Knowledge: MATHS 1012 Mathematics IB (Pass Div I) or MATHS 2004 Mathematics IIM (Pass Div I) or co requisite MATHS 2004 Mathematics IIM. Concurrent (or prior) enrolment in APP MTH 2000 Differential Equations and Fourier Series.

Teaching Method: 30 hours lectures and tutorials

Assessment: Written and computing assignments 15%, final exam 85%.

Course Objectives: The objective of this unit is to equip students with a good understanding of multi-variable calculus as applied to physical problems, and sufficient understanding of complex analysis to handle most applications.

On completion of this subject students should be able to:

- Use parametric representations for curves and surfaces in 3D
- Use the vector differential operators grad, div and curl
- Evaluate and transform line, surface and volume integrals
- Understand physical Conservation Laws written in vector notation
- Competently handle operations using basic complex functions
- Understand the significance of Taylor Series of complex functions
- Evaluate complex integrals using residue techniques

Graduate Attributes:

- ability to apply knowledge of basic science and engineering fundamentals; and
- ability to undertake problem identification, formulation and solution.

Course Synopsis: Vector calculus: vector fields, gradient, divergence and curl. Line, surface and volume integrals, integral theorems of Green, Gauss and Stokes, with applications. Orthogonal curvilinear coordinates. Complex analysis: elementary functions of a complex variable, complex analytic functions, complex integrals, Taylor Series, Laurent Series, Residue Theorem.

Content:

Vector Analysis (67%):

- Vector and scalar functions and fields
- Parameterisation of curves and its use for tangents and arc lengths
- Calculus of several variables
- Gradient of a scalar field and the directional derivative
- Divergence of a vector field
- Curl of a vector field
- Line integrals
- Independence of path in line integrals
- Potential and work done
- Double integrals - area, volume, mean and centroid
- Green's theorem in the plane
- Parameterisation of surfaces
- Volume or triple integrals
- Gauss' divergence theorem
- Stokes' theorem
- Introduction to curvilinear (non-Cartesian) coordinates.

Complex Analysis (33%) :

- Complex numbers - polar form, powers and roots
- Curves and regions in the complex plane
- Limits, derivatives, analytic functions
- Cauchy-Riemann equations and Laplace's equation
- Complex exponential, trigonometric and logarithmic functions
- Complex line integrals, Cauchy's Integral Theorem and Formula
- Taylor and Laurent series, poles and singularities
- The Residue Theorem and evaluation of complex integrals

Text book: Kreyszig, E., *Advanced Engineering Mathematics,* 8th Edition, Wiley

Recommended Reading: None

Experiments: None

LEVEL 3

COURSE OUTLINES

Aeronautical Engineering I

Course Code: MECH ENG 3016

Course Type: Core

Credit: 2 units

Offered in Semester: Two

Pre-requisites / Assumed Knowledge: MECH ENG 2021 Thermo-Fluids I

Teaching Method: 36 hours lectures and tutorials

Assessment: Assignments 25%, final exam 75%

Course Objectives:

- to equip students with the necessary knowledge and skills to understand and analyse the design and performance of modern aircraft
- to enable students to develop soundly-based vehicle design and flight systems
- to develop in students a deep understanding of aircraft systems such as engines, V/STOL technology, control systems
- to introduce the students to basic theories in Aeronautical Engineering, such as propeller momentum theory, vortex line theory etc.
- to encourage interaction between students in group tutorials
- to apply problem based learning principles in the tutorials
- to apply the knowledge on a field day to Parafield airport
- to develop a deeper understanding for the area of Aeronautical Engineering
- to ensure students are familiar with current best practice in the area of Aeronautical Engineering
- to appreciate environmental issues associated with the area of Aeronautics, such as energy conservation, pollution etc.
- to develop problem solving skills i.e. identify main issues in aeronautical problems, simplify the problem and solve it using standard tools

Graduate Attributes to be Developed:

- ability to apply knowledge of basic science and engineering fundamentals;
- ability to communicate effectively, not only with engineers but also with the community at large;
- in-depth technical competence in at least one engineering discipline;
- ability to undertake problem identification, formulation and solution;
- ability to utilise a systems approach to design and operational performance;
- ability to function effectively as an individual and in multi-disciplinary and multi-cultural teams, with the capacity to be a leader or manager as well as an effective team member;

- understanding of the social, cultural, global and environmental responsibilities of the professional engineer, and the need for sustainable development;
- understanding of the principles of sustainable design and development;
- understanding of the professional and ethical responsibilities and commitment to them; and
- expectation of the need to undertake lifelong learning, and the capacity to do so.

Course Synopsis: The aim of the course is to equip students with the necessary knowledge and skills to understand and analyse the design and performance of modern aircraft. The course focuses on the fluid mechanical and thermodynamic aspects of aeronautical engineering as follows: it firstly introduces the basics of flight mechanics and aircraft performance as well as aircraft stability and control. This is followed by low and high Mach number aerodynamics where lift and drag mechanisms as well as design principles are and requirements are discussed. Concluding the course are different methods of thrust generation as well as propeller theory and selection, followed by V/STOL flight.

namics (10%)

Lift

Drag

Lift/Drag Ratio

Introduction to Compressible Flow (15%)

Ideal Gases (Review)

Isentropic Processes of Ideal Gases

Stagnation or Total Properties

1-Dimensional Theory

Mach Waves

Shock Waves

Flow in a Variable Duct

Problems

Compression and Expansion Waves

External Flow Patterns

Lift and Drag

Aerofoils in Transonic Flow

Aerofoils in Supersonic Flow

Oblique Shock Waves

Design Considerations

Problems

Thrust (20%)

Combustion Engine (otto cycle): Thermodynamics II

Propeller: Basic Principles

Propeller: Momentum Theory

Gas Turbine Engine – Turbojets

Comparison of Turbojet – Turbofan - Turboprop

V/STOL Flight Vehicles (15%)

Helicopters

V/STOL Concepts and Aircraft

Text book: None

Recommended Reading: Barnes, W., *Aerodynamics, Aeronautics and Flight Mechanics*, 2nd Edition, Mc Cormick; Aerodynamics for engineering students, Houghton and Carpenter; *Aerodynamics for Engineers,* Bertin and Smith, 2nd Edition

Experiments: None

Aerospace Materials and Structures

Course Code: MECH ENG 3026

Course Type: Core

Credit: 3 Units

Offered in Semester: One

Pre-requisites / Assumed Knowledge: CHEM ENG 1003 Materials 1;
APP MTH 2000 Differential equations and Fourier Series; APP MTH 2002 Vector Analysis;
MECH ENG 2002 Stress Analysis and Design

Teaching Method: 48 hours lectures and tutorials

Assessment: Lab classes, 10%; Assignments and Quizzes 10%; FE Project, 10%, three-hour written examination 70%

Course Objectives: MECH ENG 3026 is a senior-level undergraduate course on the use of materials in aerospace structures and the mechanics of deformable solids. The aims of the course are to:

- Provide students with the basic skills and knowledge required to analyse displacement field, stress, strain and failure in deformable solids using analytical techniques and the Finite Element Method,
- Examine in detail the variety of materials available for the design of aerospace structures and factors that affect their performance in service, and
- Provide understanding of how solid mechanics relate to structures specifically found in aerospace structures.

Graduate Attributes to be Developed:

- ability to apply knowledge of basic science and engineering fundamentals;
- ability to communicate effectively, not only with engineers but also with the community at large;
- ability to undertake problem identification, formulation and solution;
- ability to utilise a systems approach to design and operational performance;
- ability to function effectively as an individual and in multi-disciplinary and multi-cultural teams, with the capacity to be a leader or manager as well as an effective team member;
- understanding of the social, cultural, global and environmental responsibilities of the professional engineer, and the need for sustainable development.

Course Synopsis: The course examines the different types of materials used in the aerospace industry, including metals, ceramics and composites. Selection of the appropriate material for a variety of applications will be discussed in terms of the material properties, ease of manufacture and performance in the anticipated service environment. Case studies will be used to demonstrate the design principles used when using each of these materials for aerospace applications.

Content:

- INTRODUCTION AND REVIEW – 3%
  (a) Course organization and policies
  (b) Review of ENG 2002 (Stress Analysis and Design) course
  (c) Index notation

- STRESS TENSOR – 7%
  (a) Stress tensor at a point
  (b) Principal stresses and principal directions
  (c) Equilibrium equations

- STRAIN TENSOR – 10%
  (a) Displacement field
  (b) Small strain tensor at a point and engineering strain
  (c) Compatibility equations
  (d) Strain measurements

- STRESS-STRAIN EQUATIONS – 12%
  (a) Elasticity, Hooke's law and interpretation of elastic constants
  (b) Plasticity
  (c) Visco-elasticity, plasticity and creep

- PLANE PROBLEMS IN THE THEORY OF ELASTISITY – 12%
  (a) Airy function in rectangular and polar coordinates
  (b) Elementary solutions in rectangular coordinates
  (c) Airy function in polar coordinates
  (d) Elementary solutions in polar coordinates

- THEORY OF FINITE ELEMENT METHOD – 7%
  (a) Principles of stationary and minimum potential energy
  (b) Applications of the principle of minimum potential energy
  (a) The finite element concept
  (b) Matrix equations via variational principle
  (c) Applications

- INTRO TO FRACTURE MECHANICS – 7%
  (a) Plastic collapse
  (b) Fatigue
  (c) Mechanics of cracks

- AEROSPACE MATERIALS – 20%
  (a) Metals
  (b) Ceramics
  (c) Composites

(d) Polymers
(e) Special materials
(f) Selection of aerospace materials

- FAILURE OF AEROSPACE MATERIALS – 15%
  (a) Oxidation and corrosion
  (b) Fatigue and creep
  (c) Overload

- SPECIAL CHAPTERS IN AIRCRAFT STRUCTURAL ANALYSIS – 7%
  (a) Box beam stress analysis
  (b) Theory of thin plates and shells
  (c) Intro to composite materials

Text book: None. Extensive lecture notes are provided.

Recommended Reading:

- Saada, A.S. 1974, Elasticity Theory and Applications, Pergamon Press Inc.
- Introduction to the Mechanics of Continuous Media, L.E. Malvern, (recommended for advanced students only).
- Timoshenko, S.P. and Goodier, J.N. 1981, Theory of Elasticity, (Well written, and contains lots of useful solutions to elastic boundary value problems, but the notation is dated and the book does not cover plasticity or finite element analysis).
- Lai, W, Rubin, D. and Krempl, E. 1995, An Introduction to Continuum Mechanics, 3rd Edition, Butterworth-Heinemann.
- Gould, P.L. 1983, Introduction to Linear Elasticity, Springer-Verlag New York Inc.
- Budynas, R. G. 1999, Advanced Strength and Applied Stress Analysis, McGraw-Hill.
- Den Hartog, J.P. 1996, Advanced Strength of Materials, Dover Publishing.
- Barber, J.R. Elasticity, (A modern and well-written introduction to linear elasticity).
- Curtis, H.D. 2003, Fundamentals of Aircraft Structural Analysis, McGraw-Hill.
- Donaldson, B.K., 2002, Analysis of Aircraft Structures: An Introduction, McGraw-Hill.

Experiments: FE II and Thick Cylinder

Design and Communication

Course Code: MECH ENG 3027

Course Type: Core

Credit: 3 units

Offered in Semester: 2

Pre-requisites / Assumed Knowledge: Nil

Teaching Method: 66 hours of design and communication lectures and tutorials.

Assessment: Written and oral assignments and a group project (with individualised marks).

Course Objectives: Students will develop innovative and creative problem solving skills and gain a better understanding of the engineering design process. A project will provide an opportunity for students to improve their team and project management skills. Professional communication is an essential part of the engineering design process. Therefore on completion of the course, students should be able to write appropriate academic and professional engineering texts, as well as demonstrate skills of effective communication in writing and seminar presentations relevant to their Engineering program and professional careers.

Graduate Attributes to be Developed:

- ability to apply knowledge of basic science and engineering fundamentals assured through continuous assessment;
- ability to communicate effectively, not only with engineers but also with the community at large assured through written and oral assessments;
- in-depth technical competence in at least one engineering discipline as must be demonstrated in their design project;
- ability to undertake problem identification, formulation and solution assured through continuous assessment;
- ability to utilise a systems approach to design and operational performance as must be demonstrated in their design project;
- ability to function effectively as an individual and in multi-disciplinary and multi-cultural teams, with the capacity to be a leader or manager as well as an effective team member as must be demonstrated in their design project;
- understanding of the social, cultural, global and environmental responsibilities of the professional engineer, and the need for sustainable development as must be demonstrated in their design project through continuous assessment;
- understanding of the professional and ethical responsibilities and commitment to them emphasised in lectures and assessment;
- expectation of the need to undertake lifelong learning, and the capacity to do so assured through the requirement to undertake additional research and reading to

complete assignments.

Course Synopsis:
The course will cover all of the elements of the design process that are relevant to engineering projects. The various stages of the design process will be discussed including problem identification, concept generation, concept selection and design embodiment. Fundamentals of good design practice will also be covered including aesthetics, ergonomics and safety.

The course also includes effective team work practices and project management. An essential aspect of engineering design is effective communication. Therefore the course provides written and spoken language development in the context of academic and professional engineering.

Class work is designed to develop the capacity of students for effective communication relevant to their current studies and intended professional careers. Areas covered include logical cohesion, writing a research paper, integrating evidence and the effective presentation of individual and group seminars. Particular attention is given to explicit engineering report writing skills.

Content:
Design component 60%
- 12 x 1 hour design lecture per week
- 12 x 2 hour design tutorials per week

Communication component 40%
- 12 x 2 hour communication lecture / workshops
- Plus individual and group consultations

Text book: Course notes are available from Mechanical Engineering for a small fee.

Recommended Reading: Recommended reading will be advised in the lectures.

Experiments: None

Dynamics and Control II

Course Code: MECH ENG 3028

Course Type: Core

Credit: 3 units

Offered in Semester: Two

Pre-requisites / Assumed Knowledge: Level II Applied Mathematics courses with an aggregate value of 6 units, MECH ENG 2003 Automatic Control I and MECH ENG 2005 Machine Dynamics, or MECH ENG 2019 Dynamics and Control I

Teaching Method: 46 hours lectures and tutorials and 6 hours laboratory classes

Assessment: Assignments and tutorials 20%, laboratories 10%, final exam 70%. Note that the laboratory experiments are compulsory and it is a requirement to pass the laboratory experiments to pass the course. Graduate attributes 1, 2, 3 and 4 are addressed in all components of the assessment.

Course Objectives:
On completion of the course, students should:

- Have a good understanding of the principles of vibrations;
- Understand the concepts of vibration modes and natural frequencies;
- Be able to calculate estimates for the lowest natural frequencies for single and multiple degree-of-freedom, continuous, and combined systems for both rectilinear and rotational motion;
- Understand the influence of damping on the motion of vibratory systems;
- Have a good understanding of how to measure the damping of simple vibratory systems;
- Understand the principles controlling the response of forced vibratory systems;
- Understand principles of vibration isolation, and be capable of specifying vibration isolators for a range of applications;
- Be capable of designing single degree-of-freedom tuned vibration absorbers;
- Have an understanding of basic control concepts such as controllability, observability, poles and zeros, stability;
- Be able to construct state space models of a given dynamic system;
- Be able to design a full-state control system;
- Be able to design an optimal control system;
- Have had experience with designing real control systems.

Graduate Attributes to be Developed:

1. Ability to apply knowledge of basic science and engineering fundamentals;
2. In-depth technical competence in at least one engineering discipline;

3. Ability to undertake problem identification, formulation and solution; and
4. Ability to utilise a systems approach to design and operational performance.

Course Synopsis: This course introduces the fundamental concepts of vibrating dynamical systems, from single degree of freedom systems through to continuous and multi-degree of freedom systems. Design of vibration control devices, such as vibration isolators and vibration absorbers, is also considered. This course also introduces the concepts of modern state-space control. This involves time domain descriptions of dynamic systems using state-space system models. The characteristics responsible for the dynamic response (poles, zeros, eigenvalues) are presented. Control laws using state-space are introduced, including specification of controller characteristics, controller design using pole placement and optimal (LQR) control (introduction). State observers are presented, including observer design using both pole placement and optimal (Kalman) observers (introduction). Finally, a computer aided control system design methodology is applied to a MIMO Aerospace platform.

Content:

- Free vibration of single degree-of-freedom systems (2 lectures)
- Forced vibrations (3 lectures)
- Damped vibrations (2 lectures)
- Vibration isolation (3 lectures)
- Multi-degree of freedom systems (4 lectures)
- Vibration of continuous systems (2 lectures)
- Determination of natural frequencies and mode shapes (5 lectures)
- Introduction to State Space (1 lecture)
- States, state vectors (1 lecture)
- Construction of State Space Models (1 lecture)
- Control Canonical, Observer Canonical, Jordan Form (1 lecture)
- Conversion from State Space to Frequency Domain Transfer Functions (1/2 lecture)
- Conversion from Frequency Domain Transfer Functions to State Space models (1/2 lecture)
- Controllability, Observability, Poles, Zeros (1 lecture)
- Stability (1 lecture)
- Full State Feedback Control Design (1 lecture)
- Pole placement, Optimal control (2 lectures)
- Observers (1 lecture)
- Compensator Design (1 lecture)
- Controller + Observer (1 lecture)
- Regulators (1 lecture)
- Robust Tracking using State Augmentation (1 lecture)
- Tutorials using MATLAB (5 Tutorials)

Text book: Extensive notes are provided – no textbook is needed

Recommended Reading:

Inman, D.J., *Engineering Vibration*, Prentice Hall, Second Edition, 2001; or Thompson W.T., 1993, *Theory of Vibration with Applications*, Fourth Edition, Stanley-Thornes.
Dorf and Bishop "Modern Control Systems", Chapter 3; Franklin, Powell and Emami-Naeini

Feedback Control of Dynamic Systems", Chapter 2.2, Chapter 7.1-7.2; Nise "Control Systems Engineering", Chapter 3

Experiments: Balancing Machinery, Vibrating Beam, State Control of a MIMO Aerospace System

Engineering and the Environment

Course Code: MECH ENG 3017

Course Type: Core

Credit: 2 units

Offered in Semester: One

Pre-requisites / Assumed Knowledge: Level 1 Mechanical Engineering

Teaching Method: 36 hours lectures and tutorials

Assessment: Assignments 25%, final exam 75%

Course Objectives: On completion of the course, students should:
- Understand the issues concerning ethical behaviour.
- Assess occupational and environmental noise and vibration problems.
- Understand some basic noise and vibration control design work.
- Assess air and water pollution problems.
- Undertake basic steps to ameliorate air and water pollution problems.
- Understand how to prepare an Environmental Impact Statement.
- Understand issues associated with sustainable development.

Graduate Attributes to be Developed:
- ability to apply knowledge of basic science and engineering fundamentals;
- in-depth technical competence in at least one engineering discipline;
- ability to undertake problem identification, formulation and solution;
- understanding of the social, cultural, global and environmental responsibilities of the professional engineer, and the need for sustainable development;
- understanding of the principles of sustainable design and development;
- understanding of the professional and ethical responsibilities and commitment to them; and
- expectation of the need to undertake lifelong learning, and the capacity to do so.

Course Synopsis: Engineering ethics, noise assessment and control, vibration assessment and control, air pollution assessment and control, water pollution assessment and control, Environmental impact statements, legislative requirements.

Content:
ENGINEERING ETHICS (4 lectures – 12%)

NOISE (7 lectures/tutorials – 20%)
(a) Fundamentals of sound (4 lectures/tutorials)

(b) Noise criteria and instrumentation (1 lecture
(d) Noise and the law (1 lecture
(e) Noise control strategies (1 lectures/tutorials)

VIBRATION (3 lectures/tutorials – 9%)
(a) Fundamentals and measurement
(b) Human body vibration (mobile equipment & buildings)

WATER POLLUTION AND CONTROL (3 lectures, 1 tutorial – 12%)
(a) types of industry and water pollutants
(b) environmental impacts of contaminants
(c) typical treatment approaches

SUSTAINABILITY (3 lectures – 9%)

SUSTAINABLE DESIGN AND MANUFACTURE (5 lectures/tutorials – 14%)

AIR POLLUTION (4 Lectures/tutorials – 12%)
(a) Legislative requirements
(b) Effects on health and property
(c) Principles of measurement of industrial pollution
(d) Basic control equipment
(e) cleaner production/pollution prevention
(f) gaseous and particulate pollution and control

SUSTAINABLE BUILDINGS (2 lectures – 6%)

ENVIRONMENTAL IMPACT STATEMENTS (2 lectures – 6%)

Text book: Extensive notes are provided – no textbook is needed

Recommended Reading: Bies, D.A. and Hansen, C.H., *Engineering Noise Control,* 2nd. edition, Spon Press, London

Experiments: None

Engineering Communication (ESL)

Course Code: MECH ENG 3006

Course Type: Available to students whose native language is not English, may be presented in lieu of one elective at Level IV. Compulsory for international students from language backgrounds other than English, who presented an English language score for admission or who entered via a Foundation Studies Program.

Note: *Students are expected to undertake this course during the first six months of your study at this university. Th course may be taken at any level during your degree so students arriving in their second, third or fourth year of their program may undertake the course. The course need only be passed once.*

Credit: 2 Units

Offered in Semester: One and Two

Pre-requisites / Assumed Knowledge: English language levels accepted for entrance to the University of Adelaide.

Teaching Method: : 24 hours lecture-workshops

Assessment: Assignments 90%, attendance 10%. Pass mark 50%. No supplementary exams or assessments are given for this course.

Assignments:

- Grammar, (online modules) 10%
- Oral, 5%
- Written 20%
- Oral, 25%
- Written, 30% ,
- Attendance, 10%

Course Objectives: On completion of the course, students should:

- grasp some of the ways in which social context shapes language features and communicat
- develop and present evidence based propositions
- identify and begin to apply the language features of academic writing and speaking
- locate appropriate sources of information toward your assignments
- critically read and interpret information in the development of your own point of view
- write appropriate texts which communicate the logical development of proposition(s) and analysis of issues
- present your understanding and analysis of issues in a formal seminar presentation
- participate in class and group discussions, and present decisions made to class colleagues in informal presentations.
- increase your awareness of social, cultural and ethical issues and be able to discuss these in relation to professional and social responsibilities.

Graduate Attributes to be Developed:
The University of Adelaide provides an environment where students are encouraged to take responsibility for developing the following attributes:

- the ability to communicate effectively in formal and informal situations, in writing and speaking as is assessed in written and oral assignments
- the ability to communicate effectively with engineers, other professionals and the community general as is emphasised throughout the course and indirectly assessed through assignments
- independent and critical thinking: the ability to locate, analyse, critically evaluate and synthesise information from a wide variety of sources in a planned and timely manner, as must be demonstrated students and oral assessments
- skills of a high order in interpersonal understanding, teamwork and communication as is emphasised throughout the course and must be demonstrated through interactive class tasks
- proficiency in the appropriate use of contemporary technologies as is assured through student interaction with the MyUni environment, database and catalogue searching, email and use of Turniti
- a commitment to continuous learning and the capacity to maintain intellectual curiosity throughout life is emphasised throughout the course
- an awareness of ethical, social and cultural issues and their importance in the exercise of profession skills and responsibilities as is assessed through assignment topics which explore these issues.

Course Synopsis: This course provides language development in English as a second language for the purposes of oral and written communication in the context of the study of Engineering. It introduces linguistic principles as tools to assist communication in English as a second language and in cross-cultural settings. Class work is designed to develop the capacity of students for communication (in speaking, listening, writing and reading) and critical thinking relevant to their current studies and intended careers in the fields of engineering and computing. Language development is task-based. Tasks and assignments are focussed on academic writing, research and preparing evidence-based papers, reading, informal academic discussion and formal oral presentation.

Content:
The lecture-workshops are interactive to assist students to develop skills in discussion, research skills, practice writing texts, develop their oral presentation skills and analyse and discuss their ideas about issues in Engineering.

Register (2L)
concept of register
identification of different registers language features of academic communication

Paragraphs - basic overview of features, structure and functions (2L)
topic sentences(s)/proposition/outline
evidence, examples, citing sources closing statement

Using evidence (1L)
evaluating evidence & reliability
strategies for

Discussion session (1L)
critical examination of evidence for topic
oral discussion oral presentation of propositions

Plagiarism & Referencing (2L)
university policy
referencing guide, in-text citations,& language features

Self-editing of paragraphs (1L)
strategies
Oral Presentations Intro. (1L)
identifying features of good academic seminars /practice

Oral Presentations 3 mins Assessment (2T)

Library orientation, (2L)
referencing database searching

Propositions, claims & facts. (1L)
definitions, examples, tasks
General to specific movement (1L)
functions of as support for proposition

Logical cohesion (2L)
concepts
language features
strategies for analysis & increasing cohesion
recognizing cohesion, lack of cohesion

Interpretation, analysis & summary (2L)
concepts
identifying the differences
Structure of a short discussion paper (discourse organization/sequencing)
identifying and applying language features appropriate in a short paper

Passive & Active voice (2L)
concepts, functions, identifying and swapping voice
Oral Presentations strategies (4T)
guidelines
analysis of features of model student presentations (video)
practice applying features

Text book: A detailed description of the course and course notes, will be distributed to the students at the first lecture.

Recommended Reading: None

Experiments: None

Heat Transfer

Course Code: MECH ENG 3020

Course Type: Core

Credit: 2 units

Offered in Semester: One

Pre-requisites / Assumed Knowledge: MECH ENG 2001 Thermodynamics I

Teaching Method: 36 hours lectures and tutorials and 2 hours of laboratory classes

Assessment: Assignments 20%, laboratory 10%, final exam 70%

Course Objectives: On completion of the course, students should:
- Have a good understanding of heat transfer, its modes and significance in thermal engineering
- Have a deep understanding of the different controlling parameters that influence each mode of heat transfer, such as material properties, dimensionality and time dependence
- Be equipped with analytical and numerical methods to solve heat transfer problems
- Be equipped with environmentally responsible and current best practice for the design of heat transfer processes including heat exchangers
- Have developed analytical cognitive skills and improved problem solving skills in heat transfer.

Graduate Attributes to be Developed:
1. ability to apply knowledge of basic science and engineering fundamentals;
2. ability to communicate effectively, not only with engineers but also with the community at large;
3. in-depth technical competence in at least one engineering discipline;
4. ability to undertake problem identification, formulation and solution;
5. ability to function effectively as an individual and in multi-disciplinary and multi-cultural teams, with the capacity to be a leader or manager as well as an effective team member;
6. understanding of the principles of sustainable design and development; and
7. expectation of the need to undertake lifelong learning, and the capacity to do so.

Assessment for the Graduate Attributes:
- Individual Assignments addressing attributes: 1, 3, 4, 6 and 7;
- Open Book Exam addressing attributes: 1, 3, 4, 6 and 7;
- Laboratory Report addressing attributes: 2 and 5

Content:

Lecture 1:	Introduction to Heat Transfer
Lecture 2:	Steady One-Dimensional Heat Conduction
Lecture 3:	Fins
Tutorial I:	Steady One-Dimensional Heat Conduction and Fins
Lecture 4:	Multidimensional and Unsteady Conduction- Introduction
Lecture 5:	Unsteady Conduction I
Lecture 6:	Unsteady Conduction II
Lecture 7:	Numerical Solution Methods
Tutorial II:	Unsteady Conduction and Numerical Methods
Lecture 8:	Convection - Introduction
Lecture 9:	Convection II – Natural Convection
Lecture 10:	Convection from Tube Banks and Packed Beds
Tutorial III:	Convection
Lecture 11:	Radiation - Introduction
Lecture 12:	Radiation II – Radiation Exchange between Surfaces
Lecture 13:	Radiation III – Solar Radiation
Lecture 14:	Radiation IV – Spectral Characteristics and Gas Radiation
Tutorial IV:	Radiation
Lecture 15:	Condensation, Evaporation and Boling I
Lecture 16:	Condensation, Evaporation and Boiling II
Lecture 17:	Condensation, Evaporation and Boiling III
Lecture 18:	Condensation, Evaporation and Boiling IV
Tutorial V:	Condensation , Evaporation and Boiling
Lecture 19:	Heat Exchangers - Introduction
Lecture 20:	Heat Exchangers II
Tutorial VI:	Heat Exchangers
Lecture 21:	Practical Application of Heat Transfer (no notes)

Text book: Mills, Anthony F., *Heat Transfer*, Second Edition, Prentice Hall 1999; Lecture Notes will be available from the School Office.

Recommended Reading: The Barr Smith Library has many textbooks, which are concerned with Heat Transfer. Students are encouraged to consult these books to enrich their knowledge in Heat Transfer.

Experiments: BBQ Experiment

Space Science and Astrophysics II

Course Code: PHYSICS 2010

Course Type: Core

Credit: 4 Units

Offered in Semester: Two

Pre-requisites: PHYSICS 1003 Physics IHE and C&ENVENG 1001 Statics and ELEC ENG 1005 Electrical Systems AM, or PHYSICS 1000A/B Physics I or PHYSICS 1100 Physics IA and PHYSICS 1200 Physics IB; and either MATHS 1007A/B Mathematics I (Pass Div I) or MATHS 2004 IIM (Pass Div I) - students without these prerequisites may apply to Head of Discipline for exemption
Corequisite: PHYSICS 2200 Physics IIB
Assumed knowledge: PHYSICS 1002 Astronomy I or PHYSICS 1007 Space Science and Astrophysics I

Teaching Method: 3 lectures per week, 1 tutorial per fortnight, 20 hours experimental work

Assessment: Exam (70%), assignments (10%) and practical work (20%)

Graduate Attributes:
- ability to apply knowledge of basic science and engineering fundamentals;
- ability to communicate effectively, not only with engineers but also with the community at large;
- in-depth technical competence in at least one engineering discipline;
- ability to undertake problem identification, formulation and solution;
- ability to utilise a systems approach to design and operational performance;
- ability to function effectively as an individual and in multi-disciplinary and multi-cultural teams, with the capacity to be a leader or manager as well as an effective team member;
- understanding of the social, cultural, global and environmental responsibilities of the professional engineer, and the need for sustainable development;
- understanding of the principles of sustainable design and development;
- understanding of the professional and ethical responsibilities and commitment to them; and
- expectation of the need to undertake lifelong learning, and the capacity to do so.

Course Synopsis: Protostars and star formation; stellar interiors and atmospheres; planetary systems; planetary atmospheres; introduction to the heliosphere; introduction to the terrestrial ionosphere and magnetosphere, and the local space environment; comets and meteors.

Content:

Overview of the Universe (2 lectures) An introductory discussion of the broad contents of the Universe and their interrelationships

Planetary Physics (6 lectures) An introduction to modern geophysical processes including seismological propagation and signal processing.

Geophysical Fluid Dynamics (6 lectures) An introduction to large scale flows in a rotating Earth.

Atmospheric and Ionospheric Physics (6 lectures) A discussion of atmospheric processes: winds, tides, mass, momentum, and energy transfer.

The Heliosphere. (2 lectures)Processes above our atmosphere as influenced by the Sun. The solar wind, its variability and interactions with spacecraft.

Stellar Evolution from Molecular Clouds to Supernovae. (14 lectures) The evolution of stars with an emphasis on the underlying physics. This includes the energetics and momentum of gravitational collapse, stellar energy sources, the properties of compact objects, supernovae and supernova remnants.

Text book: Zeilik and Gregory. Introductory Astronomy and Astrophysics, Thomson Publishing

Recommended Reading: Reading from the current literature will be identified.

Experiments: Project work associated with telescope construction, calibration and operation. Some solar and stellar observations will be made.

Space Vehicle Design

Course Code: MECH ENG 3025

Course Type: Core

Credit: 2 Units

Offered in Semester: One

Pre-requisites / Assumed Knowledge: MECH ENG 2021 Thermo-Fluids 1; MECH ENG 3031 Thermo-Fluids 2; C&ENVENG 1001 Statics; MECH ENG 1000 Dynamics

Teaching Method: 36 hours lectures and tutorials

Assessment: Assignments 25%, final exam 75%

Course Objectives:
- Introduce students to Space Vehicle Design, its complex issues and significance in Aerospace Engineering.
- Provide the students a deep understanding of the variety of parameters that influence the design of space vehicles, such as propulsion systems, orbital mechanics and optimisation.
- Equip the students with analytical and numerical methods to solve space vehicle problems.
- Equip the students with environmentally responsible and current best practice for the design of space vehicles including alternative fuels.
- Help students develop analytical cognitive skills and improve problem solving skills in space vehicle design.

Course Synopsis: The aim of the course is to introduce the students to the basic theories and design criteria of space vehicles. The first part of the course describes historical developments in space flight and the basic rocket equations, as well as the principles of rocketstaging and its optimisation. This is followed by orbital theory, where two-body motion, manoeuvres and special trajectories are described.

A section about rocket propulsion focuses on performance, propulsion requirements and various propellant systems (monopropellant, bipropellant, solid, cold gas and non-chemical propellant systems). Concluding the course will be a description of space stations and their sub-systems such as life support, energy and orbital control systems.

Content:

Introduction to Space Systems (10%)
- Historical Developments of Space Systems
- Aims of Space Flight

- The Ziolkowski Equation
- Specific Impulse
- Internal and External Efficiencies

Rocket Staging (25%)
- Single Stage Rocket
- Multistage Rocket
- Optimisation of Stages

Orbits (25%)
- Two-Body Motion
- Circular Orbits
- Elliptical Orbits
- Parabolic Orbits
- Huperbolic Orbits
- Orbital Maneuvers
- Special Earth Orbits
- Interplanetary Trajectories
- Lunar Trajectories

Spacecraft Propulsion (20%)
- Thrust
- Converging-Diverging Nozzle Performance
- Assumptions
- Critical Pressure Ratio
- Gas Velocity
- Specific Impulse
- Area Ratio
- Monopropellant Systems
- Bipropellant Systems
- Solid Rocket Systems
- Cold-Gas Systems

Humans in Space (10%)
- Ergonomics
- Physiology
- Psychology

Launch Systems (10%)
- Kistler K-1
- Space Shuttle
- Future Concepts

Text book: None

Recommended Reading: Griffin, M. D. and French, T. R., *Space Vehicle Design,* AIAA Edition Series

Experiments: None

Thermo-Fluids 2

Course Code: MECH ENG 3031

Course Type: Core

Credit: 3 units

Offered in Semester: One

Pre-requisites / Assumed Knowledge: MECH ENG 2013 Fluid Mechanics 1, MECH ENG 2001 Thermodynamics 1, Level II Applied Mathematics courses with an aggregate value of 6 units

Teaching Method: 48 hours lectures and tutorials and 5 hours laboratory classes

Assessment: Laboratory classes 10%, assignments 20%, final exam 70%

Course Objectives: On completion of the course, students should:

1. have a strong understanding of the fundamental laws and principles of thermodynamics and fluid mechanics;
2. be able to apply these principles to real thermo-fluids systems;
3. be familiar with current practice in the area of thermo-fluids;
4. appreciate environmental issues associated with energy conservation, pollution etc.

Graduate Attributes to be Developed:

- ability to apply knowledge of basic science and engineering fundamentals;
- ability to communicate effectively, not only with engineers but also with the community at large;
- in-depth technical competence in at least one engineering discipline;
- ability to undertake problem identification, formulation and solution;
- understanding of the principles of sustainable design and development; and
- expectation of the need to undertake lifelong learning, and the capacity to do so.

Course Synopsis: Flow of inviscid and viscous fluids; laminar and turbulent flow in pipes and boundary layers; forces on bodies, aerofoil theory; incompressible-flow machines. Vapour power cycles; refrigeration cycles; non-reacting mixtures; psychrometry; combustion.

Content:

VAPOR POWER SYSTEMS (12%)

- Ideal / Real Rankine Cycle
- Superheat / Reheat
- Regenerative Vapor Power Cycles

REFRIGERATION AND HEAT PUMP SYSTEMS (10%)
- Vapor Refrigeration Systems
- Refrigerants
- Cascade und Multistage Cycles
- Absorption Refrigeration
- Heat Pumps

GAS POWER SYSTEMS (13%)
- Otto Cycle
- Diesel Cycle
- Dual Cycle
- Gas Turbine Cycles: Brayton Cycle
- Gas Turbine for Aircraft Propulsion
- Combined Cycles
- Ericsson and Stirling Cycle

IDEAL GAS MIXTURES AND PSYCHROMETRICS (8%)
- Mixture Composition
- Amagat and Dalton Model
- Air-Conditioning Systems
- Cooling Towers

REACTING MIXTURES AND COMBUSTION (7%)
- Combustion Equations
- Conservation of Energy in Reacting Systems
- Enthalpy of Formation

Adiabatic Flame Temperature

INTERNAL FLOWS (20%)
- fully developed flow;
- losses and flow behaviour in pipes, ducts, pipe fittings;
- pipe systems and networks;
- flow meters
- calculation of energy loss, flow rates, pipe sizes etc;
- matching of flow systems to turbomachines.

TURBOMACHINES (5%)
- classification of turbomachines;
- selection of turbomachines.

EXTERNAL FLOWS (15%)
- aerodynamic forces on streamlined and bluff bodies;
- flow separation;
- lift and drag on wings, including induced drag;
- drag minimisation;
- theory of lift and circulation;

- vortex shedding;
- automotive aerodynamics.

BOUNDARY LAYERS (10%)

- Behaviour and theory of boundary layers
- Laminar and turbulent boundary layers
- Von-Karman momentum integral equation
- Effect of pressure gradient

Text book: Moran, M.J., and Shapiro, H.N., *Fundamentals of Engineering Thermodynamics* (SI version, 4th Edition), Wiley, 1999; Munson, B.R., Young, D.F., Okiishi, T.H., *Fundamentals of Fluid Mechanics*, John Wiley and Sons Inc, 4th Edition, 1998.

Recommended Reading: The reference body on fluid mechanics in the Barr-Smith Library is catalogued at 532.5 and 621.

Experiments: Ricardo Engine. Aerofoil Lab and Pump Lab.

LEVEL 4

COURSE OUTLINES

Aerospace Navigation and Guidance

Course Code: MECH ENG 4034

Course Type: Core

Credit: 2 Units

Offered in Semester: Two

Pre-requisites / Assumed Knowledge: Level One to Three Aerospace / Mechanical Engineering

Teaching Method: 24 lectures and 12 tutorials

Assessment: 30% Assignments and tutorials, 70% Examination

Course Objectives: On completion of the course, students should:

- Have a good understanding of the principles of inertial navigation
- Be able to select inertial navigation devices for a particular purpose
- Have a good understanding of frames of reference for position, orientation, and motion
- Be able to employ appropriate frames of reference
- Have a good understanding of the principles of radio and satellite navigation
- Be able to assess the utility of radio navigation devices for a various situations
- Have a good understanding of the principles of integrated navigation and how it may be used
- Have a good understanding of the principles of optimal flight path planning
- Understand the need to undertake lifelong learning

Graduate Attributes to be Developed:

- Ability to apply knowledge of basic science and engineering fundamentals;
- In-depth technical competence in at least one engineering discipline;
- Ability to undertake problem identification, formulation and solution;
- Ability to function effectively as an individual and in multi-disciplinary and multi-cultural teams, with the capacity to be a leader or manager as well as an effective team member;
- Understanding of the social, cultural, global and environmental responsibilities of the professional engineer, and the need for sustainable development;
- Understanding of the professional and ethical responsibilities and commitment to them;
- Expectation of the need to undertake lifelong learning, and the capacity to do so.

Course Synopsis: The fundamentals of navigation technology, coordinate frames, navigation principles, inertial navigation technology, radio navigation, satellite navigation, navigation error modelling, integrated navigation and Kalman filtering, aircraft flight planning, optimal launch and flight path planning

Content:

Fundamentals of Inertial Navigation (25%)
- concept of inertial navigation
- inertial navigation technologies

Reference Frames (20%)
- coordinate systems
- position, attitude frames
- motion frames
- orbit description

Fundamentals of Radio Navigation (25%)
- principles of radio navigation
- terrestrially based radio navigation systems
- satellite navigation technologies (GPS, Glonass, Galileo)
- technologies which support astronautic applications

Integrated Navigation (15%)
- integration of sensor outputs
- Kalman filter

Flight Path Planning (15%)
- open loop flight path generation
- optimality

Text book: Notes with be provided

Recommended Reading:
1. Inertial Navigation Systems Analysis, K.R. Britting, John Wiley , New York.
2. Global Positioning Systems, Inertial Navigation and Integration, M.S. Grewal, L.R. Weill, A.P. Andrews, John Wiley, New York(2001).
3. Global Positioning System: Theory and Applications, Vols I, II, Progress in Aeronautics and Astronautics (Vol 163, 164), AIAA (1996).
4. GPS Theory and Practice, 3rd Edition, Springer-Verlag, (1994).
5. Dynamics of Atmospheric Re-Entry, F.J. Regan, S.M. Anandakrishnan, AIAA Education Series (1992)

Experiments: None

Aerospace Propulsion I

Course Code: MECH ENG 4036

Course Type: Core

Credit: 2 units

Offered in Semester: One

Pre-requisites / Assumed Knowledge: Level Three Aerospace Engineering

Teaching Method: 24 lectures and tutorials per semester

Assessment: 30% tutorials and assignments, 70% examination

Course Objectives: On completion of the course, students should:
- Have a good understanding of the basic principles in rocket propulsion;
- Have the necessary knowledge and skills to understand and analyse the design and performance of rocket propulsion systems;
- Have a good understanding of the application of rocket propulsion to aerospace vehicles;
- Be able to interact with other students and apply problem based learning principles in the tutorials;
- Have an appreciation of the current best practice in the area of rocket propulsion;
- Have an appreciation of the environmental issues associated with the area of combustion and propulsion, such as energy conservation, pollution etc.;
- Have practical and computational problem solving skills relevant to aerospace engineering.

Graduate Attributes to be Developed:
- Ability to apply knowledge of basic science and engineering fundamentals;
- In-depth technical competence in at least one engineering discipline;
- Ability to undertake problem identification, formulation and solution;
- Ability to utilise a systems approach to design and operational performance;
- Understanding of the professional and ethical responsibilities and commitment to them;
- Expectation of the need to undertake lifelong learning, and the capacity to do so.

Course Synopsis: Basic principles of rocket propulsion and rocketry, propellant, nozzle theory and their influence on design of rockets, internal and external ballistics, combustion processes and instability. Fundamentals of rocket motor components and design, solid rocket grain structural behaviour, and plume technology.

Content:

Fundamentals of Rocket Propulsion (40%)

- types of propulsion systems and their characteristics
- selection of rocket propulsion systems and their applications
- basic theory and definitions
- general equations for performance analysis (thrust, exhaust velocity, specific impulse)
- nozzle theory and thermodynamics relations

Heat Transfer (2%)

- combustion chamber, aerodynamic heating

Flight Performance (8%)

- performance analysis for flights within atmosphere, earth orbits, earth escape
- influence of propulsion parameters on trajectory analysis
- single and multistage rockets

Chemical Rocket Performance Analysis (10%)

- thermochemical equilibrium calculations
- nozzle expansion process

Solid Propellant Rocket Fundamentals and Motor Design (25%)

- internal ballistics
- basic performance relations
- grain configurations for motor design
- propellant grain stress and strain, including non-linear viscoelastic models
- structural evaluation of solid rocket motors and design approach
- failure modes and analysis
- load definitions (thermal, acceleration, pressurisation)

Solid Propellants (15%)

- combustion mechanisms, combustion instability
- plume technology
- hazards/vulnerability
- propellant ingredients

Text book: Notes will be provided

Recommended Reading: "Rocket Propulsion Elements" by George Sutton, Sixth Edition, Wiley-Interscience Publication

Experiments: None

Atmospheric and Environmental Physics III

Course Code: PHYSICS 3014

Course Type: Core

Credit: 2 Units

Offered in Semester: Two

Pre-requisites / Assumed Knowledge: None

Teaching Method: Two hours of lectures/tutorials per week.

Assessment: Written assignments 70% and assignments 30%

Course Objectives: On completion of the course, students should:

- Have an understanding of the basics of solar-terrestrial relations, including concepts of solar irradiance and the solar constant.
- Understand the concept of radiative temperature of a planet.
- Understand the role of water vapour, including the thermodynamic properties of dry and moist air.
- Have an understanding of the design of thermodynamic diagrams and their use.
- Understand the formation of cloud particles and the formation of precipitation.
- Have an understanding of how the atmosphere absorbs, re-radiates and scatters infra-red radiation, with applications to the remote sensing of the environment from space.
- Understand the processes that lead to the formation and destruction of the ozone layer.
- Have a good understanding of the principles of radiative equilibrium.
- Have an understanding of basic concepts of fluid dynamics, including the equations of heat, mass and momentum in a planetary atmosphere.
- An introduction to the Navier-Stokes equations and scale analysis.
- Understand the effects of planetary rotation, including the principles of planetary vorticity and its influence on large-scale circulations.
- Have experience with the role of the planetary boundary layer, including the Eckman spiral and Eckman pumping in the atmosphere and ocean.
- Understand the principles that determine climate and climate processes, including the greenhouse effect, climate forcing and feedbacks and global change.

Graduate Attributes to be Developed:
This course is intended to develop in students the following generic attributes:

- Ability to apply knowledge of the physical principles that govern the structure and circulation of planetary atmospheres;
- Ability to apply knowledge of the fundamental equations of science to atmospheric processes that occur on a large range of spatial and temporal scales;

- Ability to solve problems in atmospheric thermodynamics, radiative transfer and fluid dynamics.

Course Synopsis: This course aims to introduce the physics of planetary atmospheres with special emphasis on the atmosphere of the Earth. It also aims to provide students with knowledge of the physical processes that govern weather and climate.

Content:
Solar-Planetary Relations (10%)
- introduction to planetary atmospheres
- simple radiative balance

Atmospheric Thermodynamics (27%)
- first law of thermodynamics
- effects of water vapour
- atmospheric stability
- thermodynamic diagrams
- mixing and convection
- formation of cloud droplets
- precipitation

Radiation and Radiative Transfer (27%)
- black-body radiation
- extinction and emission
- absorption in the atmosphere
- radiative transfer equation and solution
- heating rates
- cooling to space
- aerosols: Rayleigh and Mie scattering

The Atmosphere in Motion (27%)
- Eulerian and Lagrangian frames
- momentum equations in a rotating frame of reference
- equation of continuity
- scale analysis
- geostrophic motions
- pressure coordinates
- vorticity
- turbulence, frictional effects and secondary circulations
- atmospheric waves

Climate and Climate Change (9%)
- ozone production and loss
- greenhouse effect and climate feedbacks

Text book: Andrews, D. G. (2000): An Introduction to Atmospheric Physics, CUP.

Recommended Reading:
Wallace, J. M. and P. V. Hobbs (1977): Atmospheric science: An Introductory Survey, Academic Press.
Rogers, R. R. and M. K. Yau (1989): A Short Course in Cloud Physics, 3rd Edition, Pergamon Press.
Holton, J. R. An Introduction to Dynamic Meteorology, Academic Press (any edition).

Experiments: Nil

Engineering Communication (ESL)

Course Code: MECH ENG 3006

Course Type: Available to students whose native language is not English, may be presented in lieu of one elective at Level IV. Compulsory for international students from language backgrounds other than English, who presented an English language score for admission or who entered via a Foundation Studies Program.

Note: *Students are expected to undertake this course during the first six months of your study at this university. Th course may be taken at any level during your degree so students arriving in their second, third or fourth year of their program may undertake the course. The course need only be passed once.*

Credit: 2 Units

Offered in Semester: One and Two

Pre-requisites / Assumed Knowledge: English language levels accepted for entrance to the University of Adelaide.

Teaching Method: : 24 hours lecture-workshops

Assessment: Assignments 90%, attendance 10%. Pass mark 50%. No supplementary exams or assessments are given for this course.

Assignments:

- Grammar, (online modules) 10%
- Oral, 5%
- Written 20%
- Oral, 25%
- Written, 30% ,
- Attendance, 10%

Course Objectives: On completion of the course, students should:

- grasp some of the ways in which social context shapes language features and communicat
- develop and present evidence based propositions
- identify and begin to apply the language features of academic writing and speaking
- locate appropriate sources of information toward your assignments
- critically read and interpret information in the development of your own point of view
- write appropriate texts which communicate the logical development of proposition(s) and analysis of issues
- present your understanding and analysis of issues in a formal seminar presentation
- participate in class and group discussions, and present decisions made to class colleagues in informal presentations.
- increase your awareness of social, cultural and ethical issues and be able to discuss these in relation to professional and social responsibilities.

Graduate Attributes to be Developed:
The University of Adelaide provides an environment where students are encouraged to take responsibility for developing the following attributes:

- the ability to communicate effectively in formal and informal situations, in writing and speaking as is assessed in written and oral assignments
- the ability to communicate effectively with engineers, other professionals and the community general as is emphasised throughout the course and indirectly assessed through assignments
- independent and critical thinking: the ability to locate, analyse, critically evaluate and synthesise information from a wide variety of sources in a planned and timely manner, as must be demonstrated students and oral assessments
- skills of a high order in interpersonal understanding, teamwork and communication as is emphasised throughout the course and must be demonstrated through interactive class tasks
- proficiency in the appropriate use of contemporary technologies as is assured through student interaction with the MyUni environment, database and catalogue searching, email and use of Turniti
- a commitment to continuous learning and the capacity to maintain intellectual curiosity throughout lif is emphasised throughout the course
- an awareness of ethical, social and cultural issues and their importance in the exercise of profession skills and responsibilities as is assessed through assignment topics which explore these issues.

Course Synopsis: This course provides language development in English as a second language for the purposes of oral and written communication in the context of the study of Engineering. It introduces linguistic principles as tools to assist communication in English as a second language and in cross-cultural settings. Class work is designed to develop the capacity of students for communication (in speaking, listening, writing and reading) and critical thinking relevant to their current studies and intended careers in the fields of engineering and computing. Language development is task-based. Tasks and assignments are focussed on academic writing, research and preparing evidence-based papers, reading, informal academic discussion and formal oral presentation.

Content:
The lecture-workshops are interactive to assist students to develop skills in discussion, research skills, practice writing texts, develop their oral presentation skills and analyse and discuss their ideas about issues in Engineering.

Register (2L)
concept of register
identification of different registers language features of academic communication

Paragraphs - basic overview of features, structure and functions (2L)
topic sentences(s)/proposition/outline
evidence, examples, citing sources closing statement

Using evidence (1L)
evaluating evidence & reliability
strategies for

Discussion session (1L)
critical examination of evidence for topic
oral discussion oral presentation of propositions

Plagiarism & Referencing (2L)
university policy
referencing guide, in-text citations,& language features

Self-editing of paragraphs (1L)
strategies
Oral Presentations Intro. (1L)
identifying features of good academic seminars /practice

Oral Presentations 3 mins Assessment (2T)

Library orientation, (2L)
referencing database searching

Propositions, claims & facts. (1L)
definitions, examples, tasks
General to specific movement (1L)
functions of as support for proposition

Logical cohesion (2L)
concepts
language features
strategies for analysis & increasing cohesion
recognizing cohesion, lack of cohesion

Interpretation, analysis & summary (2L)
concepts
identifying the differences
Structure of a short discussion paper (discourse organization/sequencing)
identifying and applying language features appropriate in a short paper

Passive & Active voice (2L)
concepts, functions, identifying and swapping voice
Oral Presentations strategies (4T)
guidelines
analysis of features of model student presentations (video)
practice applying features

Text book: A detailed description of the course and course notes, will be distributed to the students at the first lecture.

Recommended Reading: None

Experiments: None

Engineering Management & Professional Practice

Course Code: MECH ENG 4038

Course Type: Core

Credit: 2 Units

Offered in Semester: One

Pre-requisites / Assumed Knowledge: None.

Teaching Method: 40 hours lectures and tutorials in 2 sessions per week of 2 hours each

Assessment: Assignments 25%, final exam 75%

Course Objectives:

- Demonstrate an understanding of the nature and significance of the human resource management function within organisations.
- Demonstrate an understanding of marketing and business engineering
- Demonstrate an understanding of the management of technical, safety, environmental and financial risk.
- Be able to manage engineering projects and have a good understanding of the software necessary to do so.
- Demonstrate an understanding of the principles of contract law and how it is used to assume legal obligations in a variety of commercial settings.
- Demonstrate an understanding of common law and statutory duties of care and legal consequences of negligence.
- Demonstrate an understanding of the law relating to intellectual property and the forms of legal protection relevant to business and industry.
- Demonstrate an understanding of the principles of employment relationship and procedures for the resolution of industrial disputes.

Course Synopsis: Management of people, management of technical risk, management of safety and environmental risk, management of economic and financial risk, marketing, business engineering, legal issues and responsibilities, ethics and project management.

Content and Lecturing Staff:
5% = 2 hours of lectures

<u>Interpersonal behaviour (5%) (Dr John Brydon)</u>
- types of relationship
- types of personality

Management structures (5%) (Dr John Brydon)
- company values
- company organisation

Management (10%) (Dr John Brydon)
- managing and being managed
- responsibility and authority
- teams and teamwork
- agreement and disagreement
- decision making
- performance measurement

Introduction to risk management (5%) (James Dunlop)
- risk definition
- estimation of probability
- estimation of consequence
- risk management plans and the risk matrix

Safety and environmental risk management (7.5%) (James Dunlop)
- review of catastrophic events
- hazard identification and assessment
- safety and environmental risk management systems

Technical risk management (5%) (James Dunlop
- new and unproven technology
- equipment performance and function
- reliability

Economic and financial risk management (7.5%) (James Dunlop)
- project costing and economic assessment
- case study
- project finance

Marketing (7.5%) (Roger Inverarity)
- basic concepts
- consumers
- competition
- promotion
- patents
- social responsibility

Business engineering (7.5%) (Roger Inverarity)
- entrepreneurship and innovation
- business management
- company structure
- insurance
- suppliers
- union interaction

- impact of government regulations

The Australian legal system (5%) (Krystyna Sawon)

- formation
- interpretation
- discharge of contracts

Criteria for the Tort of negligence and consequences of breach (5%) (Krystyna Sawon)

- part VA Trade Practices Act
- Whistle blowing

Criteria for application of copyright, patent, design and trade marks (5%) (Krystyna Sawon)

Rights and obligations of the employment relationship (5%) (Krystyna Sawon)

Project Management (20%) (Dr John Brydon)

- what is it and why is it important?
- how is it done?
- software tools

Text book: "Getting To Yes" - Roger Fisher, William Ury & Bruce Patton. - Arrow Business Books (Random House) ISBN 0 09 92484 5. Extensive notes are also available.

Recommended Reading: See list provided with the course notes

Experiments: None

Aerospace Project (Level 4)

Course Code: MECH ENG 4035 A & B

Course Type: Core

Credit: 8 Units (4 Units per semester)

Offered in Semester: One and two

Pre-requisites / Assumed Knowledge: Levels 1-3 Mechanical / Mechatronic / Aerospace / Automotive Engineering

Teaching Method: Weekly meeting with supervisors, preparation of oral and written presentations. Workshops throughout the year to assist in the management of the project and its deliverables.

Assessment: Preliminary report, seminar for presentation of results, exhibition, student achievements, project outcomes, workbooks and final report

Course Objectives: On completion of the course, students should have sufficient knowledge to:
- Develop a research or project plan
- Determine appropriate milestones and their associated time frames
- Manage a small group undertaking research or a project
- Orally present their findings to a large group with widely varying degrees of technical knowledge
- Prepare a well written technical report detailing their project.

Graduate Attributes to be Developed:
- ability to apply knowledge of basic science and engineering fundamentals;
- ability to communicate effectively, not only with engineers but also with the community at large;
- in-depth technical competence in at least one engineering discipline;
- ability to undertake problem identification, formulation and solution;
- ability to utilise a systems approach to design and operational performance;
- ability to function effectively as an individual and in multi-disciplinary and multi-cultural teams, with the capacity to be a leader or manager as well as an effective team member;
- understanding of the social, cultural, global and environmental responsibilities of the professional engineer, and the need for sustainable development;
- understanding of the principles of sustainable design and development;
- understanding of the professional and ethical responsibilities and commitment to them; and
- expectation of the need to undertake lifelong learning, and the capacity to do so.

Course Synopsis: The aim of the project is to provide solutions to engineering problems related to industry or to scientific research, with emphasis on project management and effective communication.

Content: Please see the following pages

Text book: None

Recommended Reading: The following book contains useful advice on planning and carrying out a student project:

- The Management of a Student Research Project, Howard, K. & Sharp, J.A. (1983), Aldershot: Gower. (Copies are available in the School Library and in the Barr Smith Library.)
- A guide to report writing is also available to all students on MyUni.

Experiments: None

SCHEDULE OF DELIVERABLES

PHASE	DEADLINE	MARK	✓
Project Preferences	25th Feb	N/A	
Project & Group Allocation	4th March	N/A	
Project Definition & Specification, Project Contract (submitted to Supervisor)*	18th March	N/A	
Attendance of Literature Review Workshop*	Weeks 2-4	N/A	
Preliminary Report (submitted to School Office)	20th May	10%	
Drawings (submitted to appropriate workshop once approved)*	3rd June	N/A	
Student Achievements in semester 1	N/A	5%	
Workbook for semester 1	N/A	2%	
Seminar Abstract (submitted to School Office)*	19th August	N/A	
Seminar Powerpoint Presentation Submission (to School Office)*	9th September	N/A	
Exhibition Abstract Submission (to School Office)*	16th September	N/A	
Seminar Presentation	19th September	10%	
Draft of Final Report (submitted to Supervisor)	14th October	N/A	
Exhibition	21st October	10%	
Final Report (submitted to School Office)	28th October	40%	
Equipment Return Form*	28th October	N/A	
Student Achievements in semester 2	N/A	5%	
Workbook for semester 2	N/A	3%	
Project Outcomes	N/A	15%	

NOTE 1:
The above deadlines will be strictly enforced with the appropriate penalties.

NOTE 2:
All final reports must be handed in **via the School Office** to the Project Co-ordinator. The written documents will incur a 2% penalty for each day late.

NOTE 3:
Items marked with an asterisk will be penalised by 1% if late. No exceptions will be made under any circumstances. Deductions will be made against Student Achievements. If the deadline for submission of the abstract is missed, then your abstract will not appear in the book of abstracts. If you miss the deadline for the submission of the electronic copy of the powerpoint presentation, then your forfeit the chance to use a computer projector during the seminar, in which case you will need to use an OHP or whiteboard.

NOTE 4:
At least **TWO COPIES** of the Final Report must be submitted (one copy for each supervisor and second copy for the School). These only need to be in colour unless the supervisor recommends otherwise.

NOTE 5:
Technical drawings must be supplied to the appropriate technical staff member by this date in order to provide adequate time for construction.

NOTE 6:
Self-Assessment Forms can be used by students to assess their peers and possibly themselves. These forms can be used as guidelines by a supervisor while marking all assessed components except the seminar presentations and the exhibition.

Assessment Criteria

Listed below are some of the factors which will be considered in the assessment

1. Report Presentation

- 1.1 Organisation and structure
- 1.2 Layout
- 1.3 Clarity
- 1.4 Completeness
- 1.5 English expression; grammar; punctuation
- 1.6 Drawings, diagrams and graphs
- 1.7 Errors and proof reading
- 1.8 Reference format
- 1.9 Workbook

2. Approach to Project

- 2.1 Systematic approach
- 2.2 Information search
- 2.3 Identification of problem
- 2.4 Quantification of problem
- 2.5 Attitude to supervision

3. Design Approach (where applicable)

- 3.1 Literature survey
- 3.2 Innovation
- 3.3 Detail design
- 3.4 Design synthesis

4. Research Approach (where applicable)

- 4.1 Literature survey
- 4.2 Theoretical basis
- 4.3 Experiment design
- 4.4 Experimental technique

5. Deductive Ability

- 5.1 Interpretation of results
- 5.2 Correlation with theory
- 5.3 Conclusions
- 5.4 Significance and validity of findings
- 5.5 Suggestions for future work

6. Exhibition

- 6.1 Brochure
- 6.2 Quality of stand
- 6.3 Clarity of information on stand
- 6.4 Clarity of verbal explanations

7. Seminar

- 7.1 Presentation of seminar
- 7.2 Content of presentation
- 7.3 Discussion

Final Year Project Workshops

There will be a series of workshops organised throughout the year to assist the students in managing their project and meeting the deliverables. Topics of the workshops include:

1. Project expectations and organisation
2. Reference search and literature review tutorial (organized by the Library)
3. OH&S
4. Intellectual Property and Good Practice Workbooks
5. Report writing
6. Seminar presentation
7. Organisation of exhibition
8. Poster presentation

Literature Search

An essential part of the Preliminary Report is a critical survey of existing published material relating to your project investigation. This involves locating, reading and analysing the relevant material.

To help you locate such material a **Literature Search Tutorial** will be arranged with the Engineering Course Librarian, Barr Smith Library, at a time and date to be advised. See the Notice Board for session allocations. You will be required to assemble at the Barr Smith Library **Information Desk** at the appointed time.

When writing your reports you need to use a standard and consistent referencing system. You can use the SA Uni guide "Referencing using the Harvard system (author-date system)" which is available online at
http://www.unisanet.unisa.edu.au/learningconnection/students/Lguides/lrngdes.asp#ref

Procedure for Projects With External Clients

1. Meet with client in week one to discuss the project, view the plant/facilities and meet and get to know your contact person.
2. Think about the problem and refine the task specification with the client's and supervisor's help. The specification is extremely important as it clarifies and quantifies what has to be achieved and within what boundaries. Also draw up a schedule of the activities for the project, with deadlines.
3. When you have a clear understanding of the problem use literature search and lateral thinking to formulate a number of possible solutions. Evaluate each solution in terms of pros and cons, remembering function, cost, ease of manufacture, reliability, safety and the environment. These solutions form part of the preliminary report and you will present them, with your recommendations, to the client.

4. After discussion with client and supervisor, one or two solutions are then chosen for more detailed analysis and testing during the remainder of the project. Regular consultations should be arranged with the client.

   In sponsored projects the supply of any hardware is the client's responsibility

Time Management

Design and research always take longer than you first imagine. It cannot be rushed, so don't leave it all until the week before the submission deadlines. What you get out of the project will be directly related to the effort you put into it. Each of you is expected to put in a minimum of 300 (effective) hours on the project, that's over a day/week including holidays; the proportions of time and effort spent on other parts of the course should reflect their relative importance.

Clearly you will need to manage your time efficiently - and will have to learn to juggle several activities simultaneously. Do **not** use projects as an excuse for not getting on with some other parts of the course. If there are serious clashes see your supervisor as soon as possible.

Supervisors

The supervisor's role is to provide advice and guidance, and to ensure that the project proceeds in a fruitful direction. You should not expect your supervisor to do your thinking for you, or to tell you exactly what to do. You are expected to generate your own ideas, to seek out information for yourself, and to make your own decisions about what to do and how to do it. You should make arrangements with your supervisor for **WEEKLY CONSULTATIONS** at which progress may be reported, discussed and assessed. All workshop drawings must be countersigned by your supervisor before submission to the workshop.

Technical Support

During the planning stage of your project you can seek advice on system manufacture or equipment availability from the Senior Technical Officers listed on page 2 of this booklet. They may direct you to other members of the technical staff for more detailed discussion. However your supervisor should be your first port of call for all questions and he/she will direct you to the appropriate source of information.

Once you have submitted your technical drawings, the Department's Workshop Committee will allocate workshop time to your job. Students are encouraged to submit their jobs to the workshop as early as possible. You should address queries about the progress of your job to the Senior Technical Officers.

** PLEASE NOTE: That if you fail to submit the technical drawings by the specified date you may find that there is insufficient time for your rig/apparatus to be made and then commissioned. Should this situation arise, it will impact on your final mark.

Project Software

a. Microsoft Project

You will be required to make use of the project planning software Microsoft Project in the planning stages of your project. Your Preliminary Report must contain at least a Gantt Chart prepared using this software.

b. Cambridge Materials Selector

This program is invaluable in design work for selecting materials which maximise some aspect of a component's performance, for example minimum price for a given strength, minimum mass for a particular stiffness, maximum safety or working temperature, and so on. The selection is done graphically in a Windows environment.

c. Australian Engineering Information Package

This software provides an easy way of searching for the names and addresses of Australian suppliers of particular components, materials and equipment items you may wish to use in your project work.

d. Microsoft Publisher

This package is recommended to prepare your exhibition poster. Details about poster preparation and printing are given on: http://www.cats.adelaide.edu.au/Printing/plotter/

Photocopying

The Department is **UNABLE** to provide photocopying facilities for students. Photocopying may be done in the Barr Smith Library.

FINAL YEAR DESIGN & RESEARCH PROJECT MARKING SCHEME

Marking for Preliminary Report
Assessed By: Supervisor(s)
Total Marks : 10

	1 mark each ✓
Aims and significance of the project	☐
Initial literature review detailing the need of the design and research into the project including Research into the availability of the information/ Library search/technical papers etc	☐
Detail of the several design alternative	☐
Justification of the final chosen design...	☐
Appropriate CAD drawings..	☐
Initial study on the theoretical basis of the project...	☐
Initial numerical / computational work showing feasibility of the project..	☐
Planning of the project showing time framed activities...	☐
Costing of the fabrication / materials	☐
Conclusion from the preliminary research	☐

Assessment Form for Seminar Presentation

Room: ____________ Project Number : ___________________________

Project Title : ____

Name of Assessor: ____

Surname Mark	Marks (Max)	Presenters (Insert Names)			
1. __________ ____/100 2. __________ ____/100 3. __________ ____/100 4. __________ ____/100		1	2	3	4
Structure and Scientific Content of Presentation – Group Mark **Introduction** **5.** Topic was clearly stated • Speaker/s gave brief background to the topic • Speaker/s presented a clear point of view • Speaker/s presented a clear outline of key issues to be discussed	**10**				
Middle of presentation • Speaker/s presented each issue in a logical sequence • Speaker's analysis/interpretation of issues was clear • Speaker/s referred to relevant sources throughout the presentation	**15**				
Conclusion • Speaker/s summarised main points • Presentation was well timed and within required length of time	**5**				
Overhead transparencies (OHT)/Power Point Slides • Format was clear and easy to read • Font on OHTs was 20+ • Figures and drawings were clear and easy to follow • Information was succinct, not too detailed • Grammar and spelling were accurate • Citation of sourced material	**20**				
Sub-Total Group Mark (out of 50) (A)					
Style of presentation – Individual Speaker Mark					
During Presentation Speaker: • Used appropriate semi-formal spoken language (eg speaker avoided use of slang, colloquialisms) • Used appropriate body language • Maintained eye contact with audience (didn't read from notes) • Spoke at reasonable volume, not too soft or too loud • Spoke at reasonable pace, not too rushed or too slow	**40**				
Discussion and handling of questions • Speaker understood the questions and handled them well • Speaker showed deep understanding of the material	**10**				
Sub-Total Individual Marks (out of 50) (Bx)					
Total Individual Mark (out of 100) (A+Bx)					

THE UNIVERSITY OF ADELAIDE
AUSTRALIA

SCHOOL OF MECHANICAL ENGINEERING

ENGINEERING SOUTH
THE UNIVERSITY OF ADELAIDE SA 5005

TELEPHONE: 61 8 8303 5460
FACSIMILE: 61 8 8303 4367

JUDGING CRITERIA FOR LEVEL IV PROJECT EXHIBITION

Please allocate a mark for each of the four criteria listed below:

1. Quality of stand (Visual impact, layout, clarity of material)	/5
2. Poster (Visual impact, layout, clarity)	/5
3. Clarity of problem (Problem, methods, solutions)	/10
4. Degree of difficulty of project	/5
5. Level of initiative	/5
TOTAL	/30

ASSESSED BY: (I) SUPERVISOR, (II) MODERATOR
Decided By: Final Year Coordinator

Please use this form for assessing your Final Year Project and for moderating other people's projects.

PROJECT ASSESSMENT

Project Title ____

____

Students: ____

____

Supervisor / Assessor ____

A. STUDENT PERFORMANCE (Assessed by the Supervisor(s) only)
Principle supervisor must coordinate with second supervisor, if any, for final marks.

1. STUDENT ACHIEVEMENTS (Semester 2 only)	Not relevant	Low	High
Commitment Prepares for meetings, regular attendance, provides agenda for discussion, contributes productively to discussion, makes considered decisions.	_______	_______________________	
Resourcefulness Seeks multiple sources of information, acts on and develops new sources, shows initiative	_______	_______________________	
Enthusiasm Identified and owns the problem	_______	_______________________	
Persistence Prepared to overcome difficulties, shows determination in engaging with problem.	_______	_______________________	
Effort Prepared to work hard over the whole period of the project	_______	_______________________	
		[ ]	/5

	Not relevant	Low	High
2. WORKBOOK (Assessed by Supervisor(s). Semester 2)			
Constructive Self Criticism	______	______________________	
Regular entries, including meeting agendas	______	______________________	
Reviews progress and change	______	______________________	
Record of time spent	______	______________________	
Results of experiments/simulations	______	______________________	
		[ ]	/3

	Not relevant	Low	High
3. PROJECT OUTCOMES (Assessed by Supervisor(s) & Moderators)			
Met all core project goals	______	______________________	
Met "stretch" goals	______	______________________	
		[ ]	/15

B. FINAL REPORT ASSESSMENT (Assessed by Supervisor and Moderator)

	Not relevant	Low	High
1. AIMS AND SIGNIFICANCE			
Exposition of problem What does the student understand to be the objective of the project ? What does the client understand to be the objective of the project?	______	______________________	
Identification of key issues	______	______________________	
Statement of scope and constraints	______	______________________	
Relationship to other work and	______	______________________	

possible applications

Significance of the project, relevance to research and industrial contribution	_______	___________________________
		[ ] /5

2. Approach to Project	Not relevant ___	Low __________________ High
Literature Survey Familiar with latest research on project and general historical background/context of the topic.	_______	___________________________
Systematic Approach Review work, check progress, critical analysis, revise approach where necessary.	_______	___________________________
Theoretical Bases Show understanding of relevant theory and its application to project.	_______	___________________________
Approach to experimentation and/or design experimentation Shows what needs to be measured and/or inferred, uses appropriate procedures, shows awareness of experimental limitations.	_______	___________________________
Design & Innovation Examines a variety of options for problem Solution (divergence, lateral thinking), compares Solution and problem, revises if necessary. Apply existing philosophies in a novel way	_______	___________________________
		[ ] /20

3. Interpretive Abilities	Not relevant	Low High
Interpretation of results	_______	___________________________
Critical Comparison Has result been compared with current theory/practice?	_______	___________________________
Conclusion	_______	___________________________
Assessment of outcome in terms	_______	___________________________

of stated aims

Suggestions for future work	________	______________________________
		[ ] /15

4. PRESENTATION	Not relevant	Low	High
Organisation of report	________	______________________________	
Layout Logical and consistent sub-headings and	________	______________________________	
section headings.	________	______________________________	
Labels/Captions	________	______________________________	
Header/Footer	________	______________________________	
Completeness Provides all information for acceptable Understanding of the problem and its solution.	________	______________________________	
English Expression Clarity and conciseness of expression	________	______________________________	
Drawings, diagrams & graphs Clear and tidy, to conventional (Australian) standards.	________	______________________________	
Errors and proof reading	________	______________________________	
Cross Referencing	________	______________________________	
Citations/Bibliography	________	______________________________	
		[ ] /10	

S U M M A R Y

F I N A L   P R O J E C T   R E P O R T

A. Student Performance

Achievements (Supervisor)		/5
Workbook (Supervisor)		/3
Project Outcomes (Supervisor & Moderator)		/15

B. Report Of Assessment (Assessed by Supervisor and Moderator)

Aims		/5
Approach to Project		/20
Interpretative Ability		/15
Presentation		/10
T O T A L		/50

ELECTIVE

COURSE OUTLINES

Advanced Automatic Control

Course Code: MECH ENG 4011

Course Type: Elective

Credit: 2 Units

Offered in Semester: One

Pre-requisites / Assumed Knowledge: MECH ENG 2003 Automatic Control 1, MECH ENG 3009 Automatic Control II

Teaching Method: 36 hours lectures and tutorials

Assessment: Written Examination 50%; Matlab Examination 20%; Assignments 16%; Tutorials 4%; Practical Project 10%

Course Objectives: On completion of the course, students should:

- Have a good understanding of the principles of automatic control;
- Be able to model a given plant using both time domain and frequency methods;
- Have the skills to tune a PID controller;
- Be able to simulate a given plant and control system;
- Be able to assess a controller for stability and robustness;
- Have the skills to design a stable control system for real plant equipment;
- Have a good understanding of the affect the controller frequency response function has on the plant response;
- Understand the need to undertake lifelong learning.

Graduate Attributes to be Developed:

- Ability to apply knowledge of basic science and engineering fundamentals assured through written examination and assignments
- Ability to communicate effectively, not only with engineers but with the community at large developed through in-class discussion but not assured
- In-depth technical competence in at least one engineering discipline assured through written examination and assignments
- Ability to undertake problem definition, formulation and solution assured through written examination and assignments
- Ability to utilise a systems approach to design and operational performance not assured
- Ability to function effectively as an individual in multi-disciplinary and multi-cultural teams, with the capacity to be a leader or manager as well as an effective team member not assured
- Understanding of professional and ethical responsibilities and commitment to them emphasized in lectures but not assured

- Expectation of the need to undertake lifelong learning and the capacity to do so assured through the requirement to undertake additional reading and literature searches to complete some assignments.

Course Synopsis: Advanced topics in automatic control system design. Emphasis will be placed on techniques used to accommodate uncertainty in practical systems.

Content:

Frequency Domain Analysis (20%)

- Bode Plots : Magnitude & Phase vs Frequency
- Nyquist - Complex Plane for $G(j\omega)H(j\omega)$
- Nichols - |M| versus Phase Angle
- M and N circles

Stability (10%)

- Review including Routh-Hurwitz, Root Locus
- Cauchy Criterion
- Nyquist Stability Criterion
- Gain and phase margins

Plant Modelling (10%)

- Step response methods
- Frequency response methods

PID Control (20%)

- Review of Proportional-Integral-Derivative (PID) control
- Set point weighting
- Actuator saturation and anti-windup Tuning methods (Zeigler-Nichols; Chien, Hrones and Reswick; Cohen-Coon; Pole placement

Sensitivity, Robustness and Controller Design (20%)

- Sensitivity and complementary sensitivity
- Loop shaping
- Bandwidth
- Robustness
- Bode's Integral Theorem
- Design for sensitivity

Matlab / Simulink modeling (20%)

- Design of a control system for a real physical system
- Hands-on implementation using Simulink and dSpace Control Desk

Design of a control system for a real physical system

Text book: Nil

Recommended Reading: Dorf and Bishop, *Modern Control Systems*, Chapters 5, 6, 7, 8, 9, 10, 12; Astrom and Hagglund, *PID Controllers: Theory, Design and Tuning*, Chapters 4 & 5 Maciejowski, *Multivariable Feedback Design*, Chapter 1; Xue, Chen and Atherton, *Analysis and Design of Feedback Control Systems with Matlab*, Chapter 7

Experiments: Hands-on control system implementation using Simulink and dSpace Control Desk

Advanced Topics in Fluid Mechanics

Course Code: MECH ENG 4023

Course Type: Elective

Credit: 2 Units

Offered in Semester: Two

Pre-requisites / Assumed Knowledge: C&ENVENG 1001 Statics, MECH ENG 1000 Dynamics, MECH ENG 2001 Thermodynamics 1, MECH ENG 2013 Fluid Mechanics 1, MECH ENG 3008 Fluid Mechanics 2

Teaching Method: 36 hours lectures, tutorials and project work

Assessment: Laboratory classes 10%, assignments 10%, project 30%, final exam 50%

Course Objectives: On completion of the course, students should:
- Have developed a high level of technical competence in fluid mechanics;
- Be able to understand and analyse the design and performance of practical flow systems;
- Be able to design some simple high performance flow systems;
- Have enhanced their research, thinking and communication skills.

Graduate Attributes to be Developed:
- ability to apply knowledge of basic science and engineering fundamentals;
- ability to communicate effectively, not only with engineers but also with the community at large;
- in-depth technical competence in at least one engineering discipline;
- ability to undertake problem identification, formulation and solution;
- ability to utilise a systems approach to design and operational performance;
- ability to function effectively as an individual and in multi-disciplinary and multi-cultural teams;
- understanding of the principles of sustainable design and development; and
- expectation of the need to undertake lifelong learning, and the capacity to do so.

Synopsis:
The course provides an overview of modern flow measurement and analysis techniques and the methods used to interpret velocity and flow data. The course then introduces the concepts and techniques of flow topology and vortex dynamics, and uses these to describe the flow phenomena associated with fundamental flows, engineering flows and flows in nature. A project is undertaken by each student, involving a literature review, analysis or experiment. Projects are assessed on the basis of a short report and a presentation to the class.

Content:

EXPERIMENTAL METHODS 28%

- Signal Analysis & Resolution
- Flow Facility Design
- Flow Visualization
- Hot-Wire Anemometry
- Laser Doppler Anemometry
- Particle Image Velocimetry 1
- Laser-Induced Fluorescence 1

POTENTIAL FLOW 16%

- Theory
- Sources, sinks, vortices, etc
- Complex flow patterns
- Method of images
- "Potential Flow Machine"

VORTEX DYNAMICS & TOPOLOGY 12%

- Circulation
- Induced Velocity
- Vortex rings and patterns
- Kelvin-Helmholtz instability

FREE SHEAR FLOWS 12%

- Jets
- Wakes
- Boundary Layers

APPLICATIONS 20%

6. Sea-Going Vessels
7. Ground Vehicles
8. Airborne Vehicles
9. Biological Locomotion

PROJECT PRESENTATIONS 12%

Text book: Extensive notes are provided – no textbook needed

Recommended Reading: References will be given during lectures

Experiments: Magnus Effect.

Advanced Vibrations

Course Code: MECH ENG 4020

Course Type: Elective

Credit Points: 2 Units

Offered in Semester: One

Assumed Knowledge: MECH ENG 3012 Vibrations or MECH ENG 3028 Dynamics and Control II

Teaching Method: 36 hours lectures and tutorials, 6 hours laboratory experiments

Assessment: Assignments 20%, laboratory experiments 10%, and final exam 70%. Note that the laboratory experiment is compulsory and it is a requirement to pass the experiment to pass the course.

Course Objectives: This course aims to introduce advanced concepts of vibration and their engineering applications.

On completion of the course, students should:
- Have an in-depth understanding of the principles of vibrations.
- Understand the concepts of vibration modes and natural frequencies and their measurement and estimation for multi-degree-of-freedom systems.
- Have an in-depth understanding of Statistical Energy Analysis and its application to complex vibroacoustic systems.
- Have an understanding of vibration analysis concepts and experimental techniques including mobility, reciprocity, and modal analysis.
- Be familiar with the use of Finite Element Analysis and its application to vibration design.

Graduate Attributes to be Developed: This course is intended to develop in students the following generic attributes:
1. Ability to apply knowledge of advanced vibrations topics to engineering analysis and design for vibration.
2. Expectation of the need to undertake lifelong learning, and capacity to do so.

Graduate Attribute 1 is addressed in all components of the assessment, and Graduate Attribute 2 is the focus of the feasibility study assignment.

Course Synopsis: Students will be introduced to advanced multi-degree of freedom system analysis techniques for vibroacoustic systems, including modal analysis, statistical energy analysis and finite element analysis.

Content:

- modal analysis (5 lectures + 1 tutorial)
- statistical energy analysis (9 lectures + 1 tutorial)
- use of vibration and principles of design of vibration equipment (1 lecture)
- reciprocity (2 lectures)
- finite element analysis (5 lectures)
- a self-directed feasibility study assignment examining application of a technology relating to Advanced Vibrations (equivalent to 12 lectures)

Text book: Extensive notes are provided – no textbook needed

Recommended Reading: Inman, Daniel J., Engineering Vibration, Prentice Hall, Second Edition, 2001.
Lyon, R.H. and DeJong, R.G., Theory and Application of Statistical Energy Analysis, Second Edition, Butterworth-Heinemann, 1995.
Beranek, L.L and Ver, I.L, Noise and Vibration Control Engineering Principles and Applications, Wiley-Interscience, 1992.
Bies, D.A., and Hansen, C.H., Engineering Noise Control, Second Edition, E&FN SPON, 1996.
Ewins, D.J., Modal Testing: Theory, Practice and Application, Second Edition, Research Studies Press, 2000.

Experiments: Modal Analysis

Aerodynamics

Course Code: APP MTH 4003

Course Type: Elective

Credit: 2 Units

Offered in Semester: Two

Pre-requisites / Assumed Knowledge: Hydrodynamics or Fluid Mechanics, and Differential Equations
Restriction: Mathematical Studies in Mechanical Engineering

Teaching Method: 30 hours lectures and tutorials

Assessment: Written and computer assignments 15%, final exam 85%

Course Objectives: A the end of this course the student should have a good understanding of both classical and modern aspects of aerodynamic theory including both incompressible theory and also compressibility effects and the significance of viscous effects.

Graduate Attributes to be Developed:
- ability to apply knowledge of basic science and engineering fundamentals;
- ability to communicate effectively, not only with engineers but also with the community at large;
- in-depth technical competence in at least one engineering discipline; and
- ability to undertake problem identification, formulation and solution.

Course Synopsis: Classical and modern aspects of aerodynamic theory, concentrating on low speed compressible flow, although some effects of compressibility in subsonic and supersonic flow will be discussed. The incompressible material has relevance to hydrodynamics as well as aerodynamics and applications to aerofoils and planing surfaces will be included.

Content:

Fluid mechanics fundamentals - revision (13%)
- material derivative
- pressure, viscosity, Navier-Stokes equation, Reynolds number, Euler equation
- compressibility, Mach number
- vorticity, circulation
- inviscid, irrotational flow, velocity potential
- Laplace's equation for velocity potential
- streamfunction, Cauchy-Riemann equations
- inviscid and viscous boundary conditions

- boundary layers at high Reynolds number
- pressure, lift and drag
- Bernoulli equation for steady, irrotational, inviscid flow
- pressure, lift and drag coefficients

Fundamental 2D, irrotational, incompressible flows (4%)
- principle of superposition
- uniform flow, source/sink, vortex

Two-dimensional flow past aerofoils (13%)
- 2D flow past a circular cylinder - nonuniqueness
- streamlines of flow past circular cylinder
- 2D flow past cylinder-plus-fin; Kutta condition

Complex-variable methods (21%)
- complex potential, complex velocity
- complex potential for flow past a circular cylinder
- conformal mapping, effect on circulation, flow at infinity
- Joukowski transformation
- flow past elliptical cylinder using Joukowski transformation
- angle preservation under conformal mapping
- nonconformal points
- Joukowski aerofoils (sharp trailing edge)
- flow past a Joukowski aerofoil, Kutta condition
- asymmetric Joukowski aerofoils
- Kutta-Joukowski theorem

Boundary layers (13%)
- viscous and inviscid boundary conditions
- boundary layers
- generation of vorticity
- behaviour under favourable and adverse pressure gradients
- reversed flow and separation
- rotational wake
- starting vortex, selection of Kutta circulation

Wings of finite span (4%)
- bound vortex, shed vortices, starting vortex
- horseshoe vortex

Thin wings (32%)
- linearisation of the potential flow problem
- splitting into lifting and nonlifting problems
- components of the flow contributing to lift/drag
- solution of the nonlifting problem
- lifting problem
- aerofoil equation, Hilbert transform, solution of the lifting problem
- Cauchy principal value for singular integrals
- demonstration of Kutta-Joukowski theorem
- lift, optimal camber for lift

Text book: None. Extensive lectures note are available.

Recommended Reading: None

Experiments: None

Aerospace Propulsion II

Course Code: MECH ENG 4037

Course Type: Core

Credit: 2 units

Offered in Semester: One

Pre-requisites / Assumed Knowledge: MECH ENG Aerospace Propulsion I

Teaching Method: 24 lectures and tutorials per semester

Assessment: 30% tutorials and assignments, 70% examination

Course Objectives: On completion of the course, students should:
- Have a good understanding of the fundamentals of advanced rocket and air-breathing propulsion systems (gas turbines, ramjets, ducted rockets, scramjets);
- Have the necessary knowledge and skills to understand and analyse the design and performance of advanced jet propulsion systems;
- Have a good understanding of the application of advanced jet propulsion systems to aerospace vehicles;
- Be able to interact with other students and apply problem based learning principles in the tutorials;
- Have an appreciation of the current best practice in the area of rocket and air-breathing propulsion;
- Have an appreciation of the environmental issues associated with the area of combustion and propulsion, such as energy conservation, pollution etc.;
- Have practical and computational problem solving skills relevant to aerospace engineering.

Graduate Attributes to be Developed:
- Ability to apply knowledge of basic science and engineering fundamentals;
- In-depth technical competence in at least one engineering discipline;
- Ability to undertake problem identification, formulation and solution;
- Ability to utilise a systems approach to design and operational performance.

Course Synopsis: Introduction to advanced rocket and air-breathing (gas turbines, ramjets, ducted rockets, scramjets) jet propulsion systems. Prediction of thrust, combustion reactions, specific fuel consumption and operating performance. Aerothermodynamics of inlets, combustors, nozzles, compressors, turbines.

Content:

Fundamentals of Air-breathing Propulsion (30%)

- overview of the different types of air-breathing propulsion systems (gas turbines, ramjets, ducted rockets, scramjets)
- operational envelopes, standard atmosphere
- air-breathing engine performance (uninstalled and installed thrust, inlet and nozzle loss coefficients, thrust specific fuel consumption)

Aero-thermodynamics and Quasi1-D Flow (30%)

- compressible flow properties and analysis, isentropic flow, Rayleigh flow, normal shock, oblique shock, multiple shocks, stagnation, compression, expansion

Air-breathing engine components (10%)

- inlets (subsonic, supersonic)
- compressors
- turbines
- combustors
- exhaust nozzle

Parametric Cycle Analysis of Ideal Air-breathing Engines (30%)

- Brayton cycle
- application to gas turbines and ideal ramjet
- component performance and non-ideal effects

Text book: Notes will be provided

Recommended Reading: “Aerothermodynamics of Gas Turbine and Rocket Propulsion” by Gordon Oates, Third Edition, AIAA Education Series

Experiments: None

Air Conditioning

Course Code: MECH ENG 4013

Course Type: Elective

Credit: 2 Units

Offered in Semester: Two

Pre-requisites / Assumed Knowledge: MECH ENG 3020 Heat Transfer

Teaching Method: 36 hours lectures and tutorials, 5 hours laboratory

Assessment: Assignments 20%, laboratory 10%, final exam 70%

Course Objectives: On completion of the course, students should:

- Have a good understanding of the principles of air conditioning design, and consideration that influence the design including human comfort, weather and environmental parameters and building structure;
- Be equipped with basic design skills to be able to estimate life-cycle costing and choose the right type of system;
- Have a deep understanding of load estimation and analysis, psychometric analysis of a system and climate data and its use;
- Have a good introduction to plant design, choosing plant components and understanding their characteristics and operating modes;
- Developed a good knowledge of the computational methods used in air conditioning design;
- Have developed analytical cognitive skills and improve problem solving skills in air conditioning.

Graduate Attributes to be Developed:

- ability to apply knowledge of basic science and engineering fundamentals;
- ability to communicate effectively, not only with engineers but also with the community at large;
- in-depth technical competence in at least one engineering discipline;
- ability to undertake problem identification, formulation and solution;
- ability to utilise a systems approach to design and operational performance;
- ability to function effectively as an individual and in multi-disciplinary and multi-cultural teams, with the capacity to be a leader or manager as well as an effective team member;
- understanding of the principles of sustainable design and development; and
- expectation of the need to undertake lifelong learning, and the capacity to do so.

Course Synopsis: Vapour compression cycles; heat transfer in two-phase flow; types, selection and operation of refrigeration plant; psychrometrics; climatic data and its use; load estimation and analysis; constant and variable air volume systems; human comfort and health; cooling and dehumidifying coils; controls; fans and duct systems; system balancing and stimulation; energy efficiency in buildings and system operating costs.

Content: This course consists of combination of lectures and tutorials:

- Introduction to Air-conditioning Systems – 2 hrs
  - definitions
  - complete systems
  - a/c and distribution systems
  - all-air systems
  - air-and-water systems
  - induction systems
  - all-water systems
  - unitary air conditioners
  - heat pumps
  - heat recovery systems
  - thermal storage
- Psychrometrics – 6 hrs
  - psychrometric chart
  - basic processes
- Design Conditions – 4 hrs
  - physiological principles
  - design conditions
- Solar Heat Gain – 2 hrs
  - properties
  - polar angles
  - heat gain through fenestration
  - shading devices
- Heating Load Calculations – 1 hr
  - heat losses
  - general procedure
  - selecting heating design conditions
- Cooling Load Calculations – 3 hrs
  - heat flow rates
  - heat balance fundamentals
  - initial design considerations
  - heat gain calculation concepts
  - heat sources in conditioned spaces
- CAMEL – load calculations software – 4 hrs
  - computer training
- Energy Estimating Methods – 1 hr
  - energy estimating methods
  - overall modelling strategies
  - integration of system models
  - degree-day methods

- Compressors and Expansion Devices – 1 hr
  - reciprocating compressors
  - rotary screw compressors
  - vane compressors
  - centrifugal compressors
  - expansion devices
- Condensers and Evaporators – 2 hrs
  - terminology
  - cooling and dehumidifying coils
  - condensers and evaporators
  - cooling towers
- Funs, Ducts, Pumps and Piping – 6 hrs
  - funs – characteristics, performance, selection and installation
  - ducts – pressure drop, design and optimization
  - pumps
  - piping – water and refrigerant
- Industrial visit – 2 hrs
- Practical aspects of a/c design (guest lecturer) – 2 hrs

Text book: McQuinston, F. C., Parker, J. D., Spilter, J. D., *Heating, Ventilation and Air Conditioning, Analysis and Design,* 5th Edition, USA, John Wiley & Sons Inc, 2000.

Recommended Reading:

- ASHRAE (American Society of Heating, Refrigeration and Air Conditioning) Handbooks: *Fundamentals, Refrigeration, HVAC Systems & Equipment, HVAC Applications*;
- Howell, R. H., Sauer, H. J. (Jr), Coad, W. J*., Principles of Heating Ventilating and Air Conditioning*, USA: ASHRAE, 1998;
- C P Arora, C. P., *Refrigeration and Air Conditioning*, 2nd Edition, Tata McGraw-Hill Publishing Company, New Delhi, 2000;
- Stoecker, W. F., Jones, J. W., *Refrigeration and Air Conditioning*, 2nd Edition, McGraw Hill, 1982;
- Kimura, K. I., *Scientific Basis of Air Conditioning*, Applied Science Publishers, London, 1977;
- Wang, S. K., *Handbook of Air Conditioning and Refrigeration*, McGraw Hill, New York, 1993.

Experiments: Air Conditioning (Thebarton Campus) – 5 hrs

Astrophysics III

Course Code: PHYSICS 3013

Course Type: Elective

Credit: 2 Units

Offered in Semester: One

Pre-requisites / Assumed Knowledge: None

Teaching Method: Three hours of lecturers/tutorials per week

Assessment: 20% Assignments, 20% Tutorials and 60% Written Examination.

Course Objectives: On completion of the course, students should:
- Be able to understand the requirements and limitations of instrumentation for modern astrophysical observations.
- Be able to apply physics principles to the interpretation of a broad range of astrophysical observations.
- Be able to understand the basic issues involved in present day astrophysical investigations.
- Have an understanding of our present picture of the cosmos on a large scale.

Graduate Attributes to be Developed:
This course is intended to develop in students the following generic attributes:
- Ability to apply knowledge of basic science and engineering fundamentals;
- Ability to apply knowledge of the basic physics fundamentals of space and astrophysical processes;
- Ability to identify the physics which is likely to be of importance in the identification, formulation and interpretation of astrophysical observations.

Course Synopsis This course aims to:
- Introduce the basic concepts of non-stellar astrophysics.
- To provide students with a knowledge of modern techniques, theory, and observational results relating to energetic processes in astrophysics, and to cosmology.

Content:
- Photon Emission Processes (Free-free, thermal Bremsstrahlung, synchrotron)
  (2 lectures)
  An introduction to photon emission mechanisms found in astrophysical environments, but rarely in terrestrial situations, apart from some modern electronics devices.
- Stellar binary systems (2 lectures)
  A discussion of the processes found when stars are so close that they share a

gravitational potential.

- Accreting binary systems (2 lectures)
  Processes involving the overflow of material from one star into the potential well of another. This includes processes involved with cataclysmic variables and x-ray emitting systems.
- Observational properties of galaxies (2 lectures)
  A discussion of the processes involved in observing galaxies and then interpreting those data.
- Active Galaxies (4 lectures)
  These galaxies act as our laboratory for the most extreme processes known. They accelerate particles, as well as producing energetic photon emission which gives us a probe into their inner working. These lectures explore the ways in which we try to interpret observational data, on physical grounds, from ill-understood objects.
- Introduction to Cosmology and General Relativity (12 lectures)
  Cosmology is introduced from a physical perspective, including a physical introduction to the most important concepts used to interpret the large-scale properties of our Universe. The presently understood properties of our Universe and its evolution are discussed.

Text book: Introductory Astronomy and Astrophysics Zeilik and Gregory, 4th Edition, Thomson.

Recommended Reading: Reading will be required of current papers in the field. These will normally be from preprint servers dated within 1 month of the course.

Experiments: There are no required experiments for this course.

Combustion Technology and Emissions Control

Course Code: MECH ENG 4002

Course Type: Elective

Credit: 2 Units

Offered in Semester: One

Pre-requisites / Assumed Knowledge: Thermo-fluids I, Thermo-fluids 2, Heat Transfer

Teaching Method: 36 hours lectures and tutorials

Assessment: Laboratory classes 7%, assignments 33%, final exam 60%

Course Objectives: On completion of the course, students should:
- Understand the major environmental issues associated with combustion, and the role of bio-fuels in a sustainable future
- Have a good understanding of the principles of combustion;
- Understand the complexities of combustion and what types of techniques can be used to solve industrial combustion problems;
- Have a basic understanding of the mechanisms of combustion generated air pollution and what techniques can be used to control them;
- Have a basic understanding of the types of measurement techniques that can be used for industrial and laboratory measurements;
- Have a basic understanding of the safety and handling issues associated with combustion;
- Have a good understanding of the modelling techniques which can be used to help solve industrial problems;
- Be aware of the impact of different fuel properties on industrial combustion systems;
- Have a deep understanding of the responsibility of engineers to the community in terms of providing a safe healthy environment;
- Understand the need for lifelong learning.

Graduate Attributes to be Developed:
- ability to apply knowledge of basic science and engineering fundamentals;
- ability to communicate effectively, not only with engineers but also with the community at large;
- in-depth technical competence in at least one engineering discipline;
- ability to undertake problem identification, formulation and solution;
- ability to utilise a systems approach to design and operational performance;
- ability to function effectively as an individual and in multi-disciplinary and multi-cultural teams, with the capacity to be a leader or manager as well as an effective team member;

- understanding of the social, cultural, global and environmental responsibilities of the professional engineer, and the need for sustainable development;
- understanding of the principles of sustainable design and development;
- understanding of the professional and ethical responsibilities and commitment to them; and
- expectation of the need to undertake lifelong learning, and the capacity to do so.

Course Synopsis: Combustion presently provides about 80% of global energy and is expected to be a major energy source for many years. At the same time combustion, particularly of fossil fuels, leads to serious pollution problems and is the primarily source of human-derived greenhouse gas emissions. An important aspect of a transition to a more sustainable future is therefore to reduce the emissions from combustion-based plants, and to utilise alternative fuels, including bio-fuels.
The aim of the course is to equip candidates with the knowledge and skills necessary to understand, analyse and design modern combustion systems for maximising output and minimising air pollution. Combustion involves both mixing of the fuel and oxidant and the subsequent chemical reactions. The course therefore involves consideration of both combustion aerodynamics and fuel properties. It covers fuel selection, alternative and waste fuels, the design principals involved in reducing pollutant emissions, modelling and safety.

Content:
Introduction (10%)
- The role of combustion in existing environmental problems and the transition toward sustainability;
- Applications and industrial systems

Stoichiometry & Thermochemistry (10%)
- Basic chemical reactions, energy release and temperatures;

Premixed Flames (10%)
- Laminar premixed flames; flame speed;
- Stabilisation & quenching; turbulent premixed flames
- Turbulence regimes

Non-premixed Flames (10%)
- Laminar nonpremixed flames; stabilization; theoretical descriptions;
- Flame length; turbulent nonpremixed flames; flame stability;

Scaling & Modelling (5%)
- The need for scaling & examples of the application of modelling to real systems
- Different methods of scaling and their application to industrial combustion systems
- Combustion system modelling methodology

Heterogeneous Combustion (10%)
- An introduction to the properties of coal affecting combustion performance;
- Fuel handling issues for liquid and solids fuels;

Process Efficiency (10%)
- Mass and Energy Balances;
- Fundamentals of design of real combustion systems;

Explosions (10%)
- Characteristics of gas, oil vapour and dust explosions

- Secondary explosions - causes of casualties in explosions
- Dust fires
- Explosion protection

NOx Formation and control & Other Pollutants (15%)
- Major chemical pathways responsible for the formation of combustion-generated pollutants;
- Practical abatement measures for real combustion systems;

Measurement Techniques (10%)
- Introduction; sample probes; thermocouples; optical techniques
- Point measurements: LDA, CARS, Raman scattering;
- Planar imaging: 2D Raman, PLIF, PIV

Text book: S.R. Turns "An Introduction to Combustion", McGraw Hill,
Note: This text is not followed directly, but contains relevant material.

Recommended Reading: Borman, G.L and Raglan, K.W. "Combustion Engineering"

Experiments: A virtual combustion laboratory will be used to measure key properties of flames and analyse them. A tour of a large industrial process (typically glass or cement) will provide insight into the application of combustion in many modern processes.

Computational Fluid Dynamics (Engineering)

Course Code: APP MTH 4007

Course Type: Elective

Credit: 2 Units

Offered in Semester: One

Pre-requisites / Assumed Knowledge: Numerical Analysis or Numerical Methods and Fluid Mechanics

Teaching Method: 30 hours lectures and tutorials

Assessment: Assignments 20%, project 20%, final exam 60%

Course Objectives: On completion of the course, students should:
- Be able to understand the theory behind Computational Fluid Dynamics (CFD).
- Understand the strengths and limitations of CFD packages.
- Have familiarity with at least one commercial CFD package.
- Have limited hands-on experience with one CFD package.
- Be able to write a simple code in Matlab, Fortran, or C to examine aspects of CFD.
- Be able to understand the process of developing and applying a numerical model of an engineering problem.

Graduate Attributes to be Developed:
- ability to apply knowledge of basic science and engineering fundamentals;
- ability to communicate effectively, not only with engineers but also with the community at large;
- in-depth technical competence in at least one engineering discipline;
- ability to undertake problem identification, formulation and solution;
- ability to utilise a systems approach to design and operational performance; and
- expectation of the need to undertake lifelong learning, and the capacity to do so.

Course Synopsis: Review of classical fluid dynamics, the Navier Stokes equations for fluid flow, methods of computational grid generation, solution of systems of equations, modelling of turbulence and the finite volume, finite difference and finite element forms of solutions.

Content:

Classical Fluid Dynamics (21%)
- flow descriptions
- potential flow theory
- material derivative

- nondimensionalisation
- Reynolds, Froude, Prandtl numbers

Navier Stokes Equations (8%)

- derivation of equations for mass, momentum, and energy conservation

Classification of PDEs (4%)

- method of characteristics

Finite Difference Techniques (21%)

- explicit, implicit, Crank-Nicolson techniques for 1-D heat equation
- upwind schemes for advection equation
- iterative solution techniques for Laplace's equation
- alternating direction implicit technique

Finite Volume Technique (4%)

- applications to parabolic and elliptic PDEs

Finite Element Technique (21%)

- method of weighted residuals and Galerkin technique
- applications to parabolic and elliptic PDEs
- 1-D linear and 2-D triangular and quadrilateral elements
- applications to Navier Stokes equations

Grid Generation (8%)

- transformation from irregular to rectangular grid schemes
- metrics, inverse metrics
- adaptive grid schemes

Turbulence (8%)

- time averaging
- transformation of Navier Stokes Equations
- turbulence models

Process of Modelling (5%)

- 9-step process for developing a numerical model

Text book: No textbook is required

Recommended Reading: There are a significant number of references in the library; search under the topic of 'Computational Fluid Dynamics'.

Experiments: Computer Laboratory based experiments (through hands-on project work) designed to explore the application of the numerical methods introduced in this course.

Computational Techniques for Engineering Applications

Course Code: MECH ENG 4046

Course Type: Elective

Credit: 2 Units

Offered in Semester: Two

Pre-requisites / Assumed Knowledge: Thermo-Fluids I, Diff Eq & Fourier Series, Statics, Dynamics, Stress Analysis

Teaching Method: 36 hours lectures and tutorials

Assessment: Assignments 20%, Projects 20%, final exam 60%

Course Objectives: On completion of the course, students should:

- Have a good understanding of the principles of current computational techniques applied to solid and fluid mechanics;
- Be equipped with basic understanding of the mathematical representation of the various processes involving the transfer and conservation of heat, mass, energy and momentum;
- Have a deep understanding of limitations and applications of current techniques and codes to solve complex engineering problems;
- Have developed analytical cognitive skills and improve problem solving skills in these areas.

Graduate Attributes to be Developed:

- ability to apply knowledge of basic science and engineering fundamentals;
- ability to communicate effectively, not only with engineers but also with the community at large;
- in-depth technical competence in at least one engineering discipline;
- ability to undertake problem identification, formulation and solution;
- ability to utilise a systems approach to design and operational performance;
- ability to function effectively as an individual and in multi-disciplinary and multi-cultural teams, with the capacity to be a leader or manager as well as an effective team member;
- understanding of the principles of sustainable design and development; and
- expectation of the need to undertake lifelong learning, and the capacity to do so.

Course Synopsis: The course will equip the students with the necessary knowledge to use advance computational techniques to solve problems related to flow and solid mechanics. In particular, students will have hands on experience in using computational fluid dynamics and finite element analysis to solve engineering problems.

Content:

Lecture 1: (Week 1)

Numerical tools in engineering.
Numerical methods (finite volume, finite element, spectral methods).
Computational fluid dynamics (CFD) concepts.
Classification of partial differential equations (PDEs).

Lecture 2: (Week 1)

Equations of fluid motion (Navier-Stokes equations).
Classifications of flow problems.

Lecture 3: (Week 2)

Fundamentals of grid generation.
Mesh & Elements Types

Tute 1: CATS, 2 Hours (Week 2)

Introduction to GAMBIT.
In-class exercise (mixing elbow)

Tute 2: Classroom 1 hour (Week 3)

Del/Grad, PDE classification – examples
NS equations – 1 example

Lecture 4: (Week 3)

Discretisation and numerical errors
Convergence, consistency, and stability.
Boundary conditions

Tute 3: Classroom 1 hour (Week 4)

Discretisation schemes – example
One-dimensional steady-state diffusion problem.

Lecture 5: (Week 4)

Finite volume method discretisation schemes

Lecture 6: (Week 5)

Turbulence – phenomenon and equations
Closure problem
Turbulence modelling

Tute 4: CATS, 2 Hours (Week 5)

Introduction to Fluent.
In-class exercise (mixing elbow)

Tute 5: Classroom 1 hour (Week 6)

Explicit .vs. Implicit Schemes (Diffusion)

Lecture 7: (Week 6)

Staggered grid, Pressure interpolation
Pressure-Velocity Coupling (SIMPLE, SIMPLEC, PISO) algorithms.

Lecture 8: (Week 7)

Advanced CFD Applications
Radiation Modelling

Tute 6: CATS, 2 Hours (Week 7)

Turbulence Models (mixing elbow)
CFD Projects Allocation

Lecture 9: (Week 8)

Combustion Modelling

Tute 7: CATS, 2 Hours (Week 8)

Projects Q&A session
General Review

Tute 8: CATS, 1 Hours (Week 9)
Introduction to ANSYS
Tute 9: CATS, 2 Hours (Week 9)
Stress analysis of a structure
Lecture 10: (Week 10)
Fundamentals of Finite Element Analysis
Tute 10: CATS, 2 Hours (Week 10)
Static stress analysis and heat transfer analysis
Lecture 11: (Week 11)
Vibration analysis
Tute 11: CATS, 2 Hours (Week 11)
Vibration analysis of a structure
Projects Q&A session
Lecture 12: (Week 12)
Modelling real structures
Tute 12: CATS, 2 Hours (Week 12)
Contact problem
General Review

Text book: N/A

Recommended Reading:

- **Turbulence Modelling for CFD**, D.C. Wilcox, *D C W Industries*, 2002
- **Computational Fluid Dynamics for Engineers**, K.A. Hoffman, S.T. Chiang, *EES, Austin Texas, USA*, 1989
- **Turbulent Flows**, Stephen B. Pope, *Cambridge University Press*, 2000
- **Finite element handbook** / H. Kardestuncer, editor-in-chief ; D.H. Norrie, project editor ; part editors, F. Brezzi ... [et al.] Published: New York : McGraw-Hill, c1987 Description: 1 v. (various pagings) : ill ; 25 cm. Other Author(s): Kardestuncer, Hayrettin Norrie, Douglas H. (Douglas Hector), 1929- Brezzi, F (Franco), 1945
- **Finite Element Computational Fluid Mechanics,** A.J. Baker Published: Washington : Hemisphere Pub. Corp, c1983
- **Building better products with finite element analysis**, V. Adams, A. Askenazi : OnWord Press, c1999
- **Finite Element Analysis: Theory and Applications with ANSYS, Second Edition,** S. Moaveni : Prentice Hall; c2003

Experiments: N/A

Engineering Acoustics

Course Code: MECH ENG 4004

Course Type: Elective

Credit: 2 Units

Offered in Semester: One

Pre-requisites / Assumed Knowledge: Level II Applied Mathematics courses with an aggregate value of 6 units, MECH ENG 3012 Vibrations, MECH ENG 3017 Engineering and the Environment.

Teaching Method: 36 hours lectures and tutorials, including one CATS session

Assessment: Assignments 20%, laboratory experiment 10% and final exam 70%

Course Objectives: On completion of the course, students should:
- Have a good understanding of the principles of acoustics.
- Be able to assess complex occupational and environmental noise problems using acceptable assessment criteria.
- Have a good understanding of the importance of protecting the community from excessive noise and how it damages the hearing mechanism.
- Be able to use instrumentation for noise measurement and understand the type of measurements appropriate for various situations.
- Have a good understanding of noise source types and of how sound propagates outdoors.
- Have a good understanding of sound fields in rooms and how they may be controlled.
- Have a good understanding of the principles of muffler design and noise issues associated with duct breakout and exhausts.
- Be able to design noise control fixtures and develop strategies to reduce occupational and environmental noise to acceptable levels.
- Have a deep understanding of the responsibility of engineers to the community in terms of providing a safe healthy environment.
- Understand the need to undertake lifelong learning.

Graduate Attributes to be Developed:
- ability to apply knowledge of basic science and engineering fundamentals;
- in-depth technical competence in at least one engineering discipline;
- ability to undertake problem identification, formulation and solution;
- ability to function effectively as an individual and in multi-disciplinary and multi-cultural teams, with the capacity to be a leader or manager as well as an effective team member;
- understanding of the social, cultural, global and environmental responsibilities of the

professional engineer, and the need for sustainable development;
- understanding of the professional and ethical responsibilities and commitment to them;
- expectation of the need to undertake lifelong learning, and the capacity to do so.

Course Synopsis: The fundamentals of sound wave description and propagation, the hearing mechanism, acoustic instrumentation, noise criteria, sound source types and radiated sound fields, outdoor sound propagation, sound power measurement techniques, sound in enclosed spaces, sound transmission loss, acoustic enclosures, mufflers, vibration reduction for noise control.

Content:

FUNDAMENTALS OF ACOUSTICS (20%)
- wave equation and its application
- sound power, sound pressure and sound intensity
- plane and spherical waves

THE HUMAN HEARING MECHANISM (5%)
- physical properties and insights into how it works
- subjective response to sound pressure
- pitch
- masking.

INSTRUMENTATION REVIEW (2%)

NOISE CRITERIA REVIEW (3%)

SOUND SOURCES (20%)
- monopoles, dipoles and quadrupoles
- line sources
- coherent and incoherent plane sources
- directivity
- sound propagation outdoors; ground effects, air absorption, atmospheric turbulence and temperature gradient effects.

SOUND POWER (5%)
- radiation impedance and the radiation field of a sound source
- sound power measurements
- sound pressure measurements in the laboratory and in the field
- sound intensity measurements
- surface vibration measurements.

SOUND IN ENCLOSED SPACES (15%)
- low frequency analysis
- high frequency analysis
- reverberation time, reverberant and direct sound fields
- sound absorbers
- prediction of sound levels generated by interior sound sources.

ACOUSTIC ENCLOSURES AND BARRIERS (15%)
- sound transmission loss, STC rating, single and double walls
- acoustic enclosure design
- acoustic barrier design
- pipe wrappings.

MUFFLERS (15%)
- dissipative and reactive silencer design
- acoustic plenums
- exhaust stack directivity
- duct breakout noise

Text book: Engineering Noise Control" 3rd. Edn., by DA Bies and CH Hansen. Spon Press, London (2003). Extensive notes are also available.

Recommended Reading: See list provided with the course notes

Experiments: Advanced Measurement

Environmental & Architectural Acoustics

Course Code: MECH ENG 4026

Course Type: Elective

Credit: 2 Units

Offered in Semester: Two

Pre-requisites / Assumed Knowledge: MECH ENG 4004 Engineering Acoustics

Teaching Method: 34 hours lectures and tutorials

Assessment: Assignments (30%) and final exam (70%) with 2 hours written and 1 hour computer modelling; both of which must be passed

Course Objectives:

- Environmental Acoustics
  - Identify and quantify noise sources for environmental assessment
  - Use the outdoor noise propagation modelling program **Sound Plan** to predict noise levels, produce noise level contours and rank sources
  - Compare the predicted model with the appropriate legislation and standards
- Architectural Acoustics
  - Understand and quantify noise parameters to satisfy criteria for room usage
  - Use the ray-trace computer modelling package **EASE** to predict indoor room acoustics
  - Apply absorptive and reflective surfaces to a room to achieve the desired acoustic environment
- Numerical Acoustics
  - Understand the application of Finite Element Analysis to acoustic modelling

Course Synopsis: This course will provide an introduction to the use of computer modelling in environmental, architectural and the general noise level and acoustic performance prediction.

Content:

- Environmental Acoustics (10L + 4T)
  - Outdoor sound propagation
  - Review of relevant state, national and international standards
  - Application to transport noise
- Architectural Acoustics (10L + 4T)
  - Room acoustic descriptors
  - Room to room sound transmission
  - Ray-tracing techniques to predict indoor acoustics
- Numerical Acoustics (3L + 3T)

- Equations for acoustic FEA modelling

Text book: No textbook is required as extensive notes will be available from the School Office

Recommended Reading: Engineering Noise Control" 3rd. Edn., by DA Bies and CH Hansen. Spon Press, London (2003)

Experiments: None

Finance for Engineers

Course Code: MECH ENG 4039

Course Type: Elective

Credit: 2 Units

Offered in Semester: Two

Pre-requisites / Assumed Knowledge: Available to students in specified programs only, please check Academic Rules of the program in which you are enrolling.

Teaching Method: 36 hours lectures and tutorials

Assessment: Assignments 60% Test 40%

Course Objectives: On completion of the course, students should:
- Understanding cost behaviour
- Understand the basic elements of costing systems
- Be familiar with basic financial statements and capital budgeting
- Apply these understandings to project management

Graduate Attributes to be Developed:
- ability to communicate effectively, not only with engineers but also with the community at large;
- ability to undertake problem identification, formulation and solution;
- ability to function effectively as an individual and in multi-disciplinary and multi-cultural teams, with the capacity to be a leader or manager as well as an effective team member;
- understanding of the social, cultural, global and environmental responsibilities of the professional engineer, and the need for sustainable development;
- understanding of the professional and ethical responsibilities and commitment to them; and
- expectation of the need to undertake lifelong learning, and the capacity to do so.

Course Synopsis: This course aims to provide Engineers with an introduction to the fundamentals of business decision-making common to all forms of organisation. The course focuses on the requirements of project management, including the need to communicate complex financial arguments effectively. It is designed to provide students with a basic understanding of financial statements, capital budgeting, cost behaviour and costing systems.

Content:

Focus on decision making (25%)
(a) Business organisation
(b) Introduction to cost behaviour
(c) Activity-based costing

Accounting for planning and control (20%)
(a) Master budget
(b) Flexible budgets and variance analysis
(c) Responsibility accounting

Financial management (25%)
(a) Time value of money and risk
(b) Capital budgeting

Product costing (10%)
(a) Cost allocations

Basic financial accounting (20%)
(a) Basic concepts and techniques
(b) Cash flow *versus* accounting income
(c) Understanding financial statements

Text book: Introduction to Management Accounting, 13th Edition, Horngren, Sundem and Stratton, Prentice Hall International, 2004.

Recommended Reading: None

Experiments: None

Fracture Mechanics

Course Code: MECH ENG 4003

Course Type: Elective

Credit: 2 Units

Offered in Semester: Two

Pre-requisites / Assumed Knowledge: MECH ENG 2002 Stress Analysis and Design, MECH ENG 3005 Solid Mechanics, APP MTH 2000 Differential Equations and Fourier Series

Teaching Method: 36 hours lectures and tutorials

Assessment: Assignments, FE project and final exam

Course Objectives: The aim of this course is to develop an understanding of the mechanics of fracture of engineering materials and structures under static and dynamic loading. This understanding is essential for the assessment of integrity and durability of structures and structural components in the presence of structural defects, so as to ensure reliability and safety.

Course Synopsis: Intended for a first course in the mechanics of fracture at a senior undergraduate level. The focus of this course is on the principles of linear elastic and elasto-plastic fracture mechanics and their application to engineering design. The material is presented in a conversational, yet rigorous, manner with the focus on basic concepts, models and techniques devised to solve specific engineering problems. The choice of the subject matter was determined largely by needs of aeronautical and mechanical engineering, although it is believed that the subject matter will be found just as useful for mechatronic, civil engineering and naval architecture.

Content:
FUNDAMENTALS OF ELASTIC AND PLASTIC BEHAVIOURS OF SOLIDS – 10%
(a) Review of Solid Mechanics
(b) An Overview of Plasticity Theory

MODELS OF FRACTUE– 10%
(a) Static Failure
(b) Fatigue Failure
(c) Corrosion and Creep
(d) Dynamic Fracture

BRITTLE FRACTURE – 10%
(a) Case History
(b) The Energy Balance Approach

(c) The Irwin-Orowan Postulate

LINEAR ELASTIC ANALYSIS OF CRACKED BODIES – 10%
(a) Modes of Crack-Tip Deformation
(b) Stress Intensity Factor
(c) Methods Adopted in the Determination of Stress Intensity Factor

CRACK-TIP PLASTICITY– 10%
(a) Plastic Zone
(b) Plane Stress and Plane Strain Fracture Toughness
(c) R-Curves
(d) ASTM Recommendations

ELASTO-PLASTIC FRACTURE MECHANICS – 10%
(a) The J-Integral
(b) The CTOD
(c) Techniques for the Determination of J-Integral
(d) CTOD Design Curves

FATIGUE CRACK GROWTH – 10%
(a) Fatigue Life Prediction
(b) Variable-Amplitude Loading
(c) Mechanics of Short Cracks

STRUCTURAL INTEGRITY OF MECHANICAL COMPONENTS – 20%
(a) Design Against Brittle Fracture
(b) Fatigue Design Philosophies
(c) Role of Residual Stresses in Fatigue

EXPERIMENTAL TECHNIQUES IN FRACTURE MECHANICS – 10%
(a) Optical
(b) Compliance Method
(c) Electrical Potential Method
(d) Ultrasonic Techniques
(e) Acoustic-Emission Techniques

Text book: None, Extensive lecture notes are provided.

Recommended Reading:
(1) Fracture Mechanics: Worked Examples by P.A. Withey, J. F. Knott ,
(2) Meguid, S.A., Engineering Fracture Mechanics, Elsevier Applied Science, 1989.
(3) Principles of Fracture Mechanics, by Robert J. Sanford, Prentice Hall College Div; 1st edition, 2002
(4) Engineering Fracture Mechanics (Journal).

Experiments: None

Fundamentals in Non-Linear Computational Mechanics

Course Code: MECH ENG 4000

Course Type: Elective

Credit: 2 Units

Offered in Semester: Two

Pre-requisites / Assumed Knowledge: Level II Applied Mathematics courses, especially APP MTH 2002 Vector Analysis and Complex Analysis

Teaching Method: 36 hours lectures and tutorials

Assessment: Continuous assessment 30%, final exam 70%

Graduate Attributes to be Developed:
- ability to apply knowledge of basic science and engineering fundamentals;
- ability to communicate effectively, not only with engineers but also with the community at large;
- in-depth technical competence in at least one engineering discipline;
- ability to undertake problem identification, formulation and solution;
- ability to utilise a systems approach to design and operational performance;
- understanding of the social, cultural, global and environmental responsibilities of the professional engineer, and the need for sustainable development;
- understanding of the principles of sustainable design and development;
- understanding of the professional and ethical responsibilities and commitment to them; and
- expectation of the need to undertake lifelong learning, and the capacity to do so.

Course Synopsis: The course introduces the basic concepts of continuum mechanics which are understood to be prerequisites for modern computational formulations such as the finite element method. While the course provides the language for understanding the handbook of any modern commercial finite element package, of interest for those merely interested in applications, the material covered is nevertheless fundamental for research in many fields of engineering. The course covers: the basic mathematics of tensor algebra, non-linear concepts of strain and stress, classification of constitutive laws, weak and strong forms of field equations, introduction to finite element formulations.

Content:
Introduction to tensor algebra and tensor analysis;
kinematics of deformation;
stress tensors;
fundamental laws and balance equations;
constitutive laws;

fundamentals of the finite element method.

Text book: None

Recommended Reading:
Finite Element Method: Volume 1, The Basis, O. C. Zienkiewicz et. al; Butterworth-Heinemann 5th Edition 2000; Introduction to the Mechanics of a Continuous Medium, Lawrence E. Malvern, Prentice Hall, 1977; Introduction to Tensor Calculus and Continuum Mechanics, J.H. Heinbockel, Trafford, 2001

Experiments: None

Hypersonic Flow (Aerospace)

Course Code: MECH ENG 4040

Course Type: Elective

Credit: 2 Units

Offered in Semester: One

Pre-requisites / Assumed Knowledge: Levels One to Three Aerospace / Mechanical Engineering

Teaching Method: 24 lectures and 12 tutorials

Assessment: 30% Assignments and Tutorials and 70% Assessment

Course Objectives: On completion of the course, students should:
- Understand basic theories in high-speed aerodynamics;
- Be able to understand and analyse the design and performance of modern high-speed aircraft and re-entry vehicles;
- Be able to develop soundly-based high-speed flight vehicle designs;
- Have developed a deep understanding for the area of high-speed aerodynamics;
- Have developed problem solving and analytical skills i.e. identifying main issues in compressible flow problems, simplifying the problems and solving them using standard techniques.

Graduate Attributes to be Developed:
- Ability to apply knowledge of basic science and engineering fundamentals;
- In-depth technical competence in at least one engineering discipline;
- Ability to undertake problem identification, formulation and solution;
- Ability to utilise a system-based approach to design and operational performance.

Course Synopsis: The aim of this course is to introduce students to the fundamentals and practical aspects of supersonic and hypersonic flows and the design and operation of high-speed vehicles. The course deals with the theory of compressible flow; flow in pipes, variable-area ducts and engine intakes; supersonic external flow around wings and bodies; hypersonic flows theory and the flow around hypersonic vehicles, including re-entry vehicles.

Content:
INTRODUCTION TO COMPRESSIBLE FLOW 10%

10. Isentropic Processes of Ideal Gases (Review)
11. Stagnation or Total Properties
12. 1-Dimensional Isentropic Wave theory
13. Mach Waves

14. Shock Waves

FLOW IN A VARIABLE-AREA DUCT 25%
- Isothermal-Isentropic Flow
- Isoenergetic, Isentropic Flow of an Ideal Gas
- Mass Flow Relations and Choking
- Flow in a Converging Nozzle
- Flow in a Convergent-Divergent Nozzle
- Convergent-Divergent Supersonic Diffusers
- 1-D Frictional Flow in a Duct
- 1-D Flow with Heat Addition
- Aircraft intake systems

EXTERNAL FLOWS 15%
- Compression and Expansion Waves
- External Flow Patterns
- Lift and Drag
- Linearised theory & compressibility corrections
- Critical Mach number
- Aerofoils in Transonic & Supersonic Flow
- Design Considerations

SHOCK – EXPANSION THEORY 10%
- Oblique shock waves – wedge flow
- Oblique shock waves – conical flow
- Expansion waves
- Calculation procedures
- Ackeret theory

SUPERSONIC BOUNDARY LAYERS 5%
- Boundary layer structure
- Effects of Mach number and Reynolds number
- Aerodynamic heating

EXPERIMENTAL METHODS 10%
- Schlieren, Shadowgraph & Interferometry
- Flow Facilities - Wind Tunnels & Shock-Tube Tunnels

HYPERSONIC FLOW 20%
- Inviscid Hypersonic Flow
- Local Surface Inclination Methods
- Approximate methods
- High-temperature Gas Dynamics

RE-ENTRY VEHICLES 5%
- Design of Re-Entry Vehicles

- Re-Entry Path

Text book: Lecture notes are available from the Departmental Office.

Recommended Reading:
Bertin, J. J. Hypersonic Aerothermodynamics, AIAA Education Series, 1994.

Gerhart, Gross & Hochstein, Fundamentals of Fluid Mechanics. Second Edition, 1993.

John D. Anderson, "Modern Compressible Flow with Historical Perspective", 3rd Edition, Mc Graw Hill.

Experiments: None

Introduction to Physics Research III

Course Code: PHYSICS 3007

Course Type: Elective

Credit: 2 Units

Offered in Semester: Two

Pre-requisites / Assumed Knowledge: None

Teaching Method: 2 hours of lectures/seminars/tutorials per week. 20 hours project work

Assessment: Assignments (40%), presentations (20%), laboratory report (40%).

Course Objectives: On completion of the course, students should:
- Understand a number of techniques which underlie a broad spectrum of physics, and to be able to understand the application of those techniques to a number of topics.
- Have an understanding of the ways in which physics is developed, discussed and reported.
- Be able to make a professional presentation, both orally and by writing a report of publication standard.

Graduate Attributes to be Developed:
This course is intended to develop in students the following generic attributes:
- Ability to apply knowledge of basic science and engineering fundamentals;
- Ability to design experiments which will optimise their data analysis.
- Ability to model experiments in a straightforward way using Monte Carlo techniques.
- Ability to use some standard packages for experimental data analysis.

Course Synopsis: This course aims to:
- To provide an understanding of some important techniques in modern physics.
- To enable students to develop some skills required in a professional physics environment.

Content:
Topics include:
- <u>Fundamentals of experimental design. (15%)</u>

Designing experiments to optimise unbiased analysis. This will be approached through an examination of classic experiments in physics.
- <u>Monte Carlo modelling of experiments (15%)</u>

An introduction to the modelling of experimental processes to better understand the limitations of statistical analysis issues involved in more classical experimental analysis techniques.

- Statistics for experimental analysis (15%)

An investigation of the crucial roles of systematics in modern experimentation, and an examination of ways in which limitations of classical experimental analysis can be overcome.

- Presentation techniques (15%)

An introduction to various techniques for the effective presentation of data.

- Introduction to research practice (40%)

This involves a critical review of a specified physics research paper, or the performance of a small, instructive research project. The intention is to analyse the approach to the work, and to be able to make a critical analysis of any conclusions drawn.

Text book: There is no set text book, lecture notes will be provided as necessary.

Recommended Reading: Reference will be made to experiments described in physics journal literature.

Experiments: Some small research experiments may be required to supplement understanding of experimental techniques in the literature. These will be based on individual student interest.

Materials Selection and Failure Analysis
(not offered in 2005)

Course Code: MECH ENG 4024

Course Type: Elective

Credit: 2 Units

Offered in Semester: Two

Pre-requisites / Assumed Knowledge: Level 1 Materials

Teaching Method: 36 hours lectures and tutorials

Assessment: Assignments 30%; three-hour written examination 70%

Course Objectives:
On completion of the course, students should:

- Understand the process of materials selection and be able to use available tools for making decisions on materials selection for engineering applications.
- Understand and be able to identify the common modes of failure of engineering components.
- Have, and be able to use, a framework for assessing engineering failures including determining the mode of failure and making recommendations on failure prevention/materials selection.

Graduate Attributes:

- Ability to apply knowledge of basic science and engineering fundamentals assured through written examination and assignments
- Ability to communicate effectively, not only with engineers but with the community at large developed through in-class discussion, case studies and presentations
- In-depth technical competence in at least one engineering discipline assured through written examination and assignments
- Ability to undertake problem definition, formulation and solution assured through written examination and assignments
- Ability to utilise a systems approach to design and operational performance developed but not assured
- Ability to function effectively as an individual in multi-disciplinary and multi-cultural teams, with the capacity to be a leader or manager as well as an effective team member practiced in case studies but not assured
- Understanding of the social, cultural, global and environmental responsibilities of the professional engineer, and the need for sustainable development emphasized in lectures and assured through written examination and assignments
- Understanding of the principles of sustainable design and development emphasized in

lectures and practiced in assignments

- Understanding of professional and ethical responsibilities and commitment to them assured through class discussion written examination and assignments
- Expectation of the need to undertake lifelong learning and the capacity to do so assured through the requirement to undertake additional reading and literature searches to complete assignments.

Course Synopsis: To introduce students to various tools that can be used to select the appropriate material for a given application. Examination of various failure modes to allow students to identify these modes in real samples and apply material selection and failure analysis techniques to failure prevention.

Content:

<u>MATERIALS AND THE DESIGN PROCESS</u> (2 lectures, 1 tutorial - 8%)

<u>MATERIALS SELECTION</u> (5 lectures, 7 tutorial - 34%)
(a) Material selection (1 lectures, 2 tutorial)
(b) Shape factors (2 lectures, 1 tutorial)
(c) Process selection (1 lecture, 1 tutorial)
(d) Other factors affecting materials selection (1 lecture, 3 tutorials)

<u>FAILURE INVESTIGATION INTRODUCTION</u> (2 lectures - 5%)

<u>FAILURE MODES</u> (11 lectures, 6 tutorials - 48%)
(a) Overload (2 lectures, 1 tutorial)
(b) Fatigue (2 lectures, 1 tutorial)
(c) Creep (2 lectures, 1 tutorial)
(d) Corrosion (4 lectures, 2 tutorials)
(e) Wear (1 lecture, 1 tutorial)

<u>CASE STUDIES IN FAILURE INVESTIGATION</u> (2 tutorials - 5%)

Text book: Extensive notes are provided – no textbook needed

Recommended Reading: 'Materials Selection in Mechanical Design', Second Edition, MF Ashby, Butterworth Heinemann Publishing

Experiments: None

Mechanical Signature Analysis

Course Code: MECH ENG 4033

Course Type: Elective

Credit: 2 Units

Offered in Semester: One

Pre-requisites / Assumed Knowledge: MECH ENG 2011 Mechatronics IM, APP MTH 2000 Differential Equations and Fourier Series

Teaching Method: 36 hours lectures and tutorials

Assessment: Assignments (30%) and final exam (70%), both of which must be passed

Course Objectives:

- Understand the behaviour of the mechanical system, by analyzing the vibration signature
- Predict the performance of a machine, from a knowledge of the history of the vibration signature
- Diagnose faults in the machine, from a knowledge of the "fault" vibration signatures

Course Synopsis: This course will provide an introduction to mechanical signature analysis; vibration measurement and instrumentation; signal processing and analysis; filtering; frequency domain analysis; vibration monitoring; introduction to condition monitoring and fault diagnosis; rotor balancing.

Content:

- Signal processing and analysis (8L + 5T)
    - Signal types
    - Digitization
    - Time domain windows
    - Aliasing
- Frequency domain analysis (4L + 1T)
    - DFT
    - Averaging
    - Frequency analysis functions
- Vibration measurement and Instrumentation (2L)
    - Transducers
    - Portable and on-line analysis & monitoring instrumentation
- Machine Condition Monitoring (10L + 6T)
    - Maintenance philosophies
    - Machine selection
    - Machine faults

- Fault analysis & diagnosis

Text book: No textbook is required as extensive notes will be available from the School Office

Recommended Reading: Nil

Experiments: None

Robotics M

Course Code: MECH ENG 4027

Course Type: Elective

Credit: 2 Units

Offered in Semester: One

Pre-requisites / Assumed Knowledge: MATHS 1007A/B Mathematics 1, MECH ENG 2001 Mechatronics IM, MECH ENG 2005 Machine Dynamics, MECH ENG 3009 Automatic Control II

Teaching Method: 24 hours lectures and 12 tutorials

Assessment: Project 10%, assignments 20%, final exam 70%

Course Objectives: On completion of the course, students should:

- Have a good understanding of the basics of robotic systems.
- Be able to define the needs, acquire necessary information and select appropriate robots for various industrial applications.
- Have a good understanding of robot design and development processes.
- Be able to operate and program industrial robot for simple applications.
- Be able to apply the knowledge learned for the design and development of simple robots.
- Have a good understanding and be able to explain the principles of robot kinematics, dynamics, motion planning, trajectory generation and control.
- Understand the basics of image processing techniques for robotic applications.
- Have a deep understanding of the responsibility of engineers for the safety issues and the importance associated with the use of robots for various applications.
- Understand the need to undertake lifelong learning.

Graduate Attributes to be Developed:

- ability to apply knowledge of basic science and engineering fundamentals;
- ability to communicate effectively, not only with engineers but also with the community at large;
- in-depth technical competence in at least one engineering discipline;
- ability to undertake problem identification, formulation and solution;
- ability to utilise a systems approach to design and operational performance;
- ability to function effectively as an individual and in multi-disciplinary and multi-cultural teams, with the capacity to be a leader or manager as well as an effective team member; and
- expectation of the need to undertake lifelong learning, and the capacity to do so.

Course Synopsis: Classification of robotic systems; transformation of coordinates; kinematics and inverse kinematics; Jacobians and robot dynamics; trajectory generation; robotic modelling; control loops for robots; machine vision basics.

Content:

Introduction to robotic systems (5%)

- definitions for various robotic terms
- industrial robots and applications
- mobile robots and applications
- parallel robots and applications
- New development and trends of robotics

Spatial descriptions (8%)

- coordinate frames
- coordinate translation and rotation
- homogeneous transformation
- compound transformation
- raw-pitch-yaw and euler angles
- inversed rotation matrix

Kinematics (17%)

- forward kinematics
- denavit-hartenberg notation
- joint space and cartesian space
- inverse kinematics
- solvability of the inverse kinematics problems
- algebraic solution and geometric solution
- pieper's solution
- kinemtaics of parallel robots

Jacobians (17%)

- linear and rotational velocity of rigid bodies
- motion of the links of a robot
- velocity propagation from link to link
- angular and linear velocities of robot links
- Jacobians
- singularities
- static forces propagate from link to link
- Jacobians in force domain

Dynamics (20%)

- Lagrangian formulation
- Kinetic and potential energy
- Euler dynamic formulation
- the force and torque acting on a link

Trajectory generation (13%)

- introduction
- joint space schemes
- cartesian schemes

Position and force control (8%)

- control of manipulators
- control law partitioning
- trajectory following control
- nonlinear and varying systems
- model-based control for manipulators
- current industrial robot control systems

Image processing and analysis (12%)

- histogram, edges, and other basics
- applying filters and noise reduction
- convolution mask
- sampling and quantization
- thresholding and connectivity
- binary image
- thresholding and hough transform
- segmentation
- binary morphology operations
- image analysis
- object recognition
- stereo imaging

Text book: Craig, J. J., *Introduction to Robotics, Mechanics and Control,* 2nd Edition, Addison Wesley, 1989

Recommended Reading:

- LOW, K.H., "Robotics, principles and systems modeling," 2nd edition, Prentice Hall, 2004
- Schilling, R. J., *Fundamentals of Robotics - Analysis & Control*, Prentice Hall, 1991;
- Lewis, F. L., Abdallah, C. T., Dawson, D. M., *Control of robot manipulators,* Macmillan Publishing Company, 1993;
- Web sites, such as: www-sop.inria.fr/saga/personnel/merlet/merlet_eng.html.

Experiments: None

Topics in Welded Structures

Course Code: MECH ENG 4025

Course Type: Elective

Credit: 2 Units

Offered in Semester: One

Pre-requisites / Assumed Knowledge: CHEM ENG 1003 MaterialsI

Teaching Method: 36 hours lectures and tutorials

Assessment: Laboratory classes 10%, assignments 20%, final exam 70%

Course Objectives: On completion of the course, students should:
- Understand the options for materials joining;
- Understand the issues surrounding joining of common engineering materials and the influence of the joining process on the materials' properties;
- Understand the role of defects in failure and be able to assess the criticality of defects in simple situations;
- Assess the health and safety risks associated with a welding operation;
- Be able to prepare a basis welding procedure, being aware of the role of standards.

Graduate Attributes to be Developed:
- ability to apply knowledge of basic science and engineering fundamentals;
- ability to communicate effectively, not only with engineers but also with the community at large;
- in-depth technical competence in at least one engineering discipline;
- ability to undertake problem identification, formulation and solution;
- ability to utilise a systems approach to design and operational performance;
- ability to function effectively as an individual and in multi-disciplinary and multi-cultural teams, with the capacity to be a leader or manager as well as an effective team member;
- understanding of the professional and ethical responsibilities and commitment to them; and
- expectation of the need to undertake lifelong learning, and the capacity to do so.

Course Synopsis: This course presents the concepts behind welding and joining technology. These include welding and joining techniques, equipment and consumables, weldability of engineering materials, economics, standards, health and safety, testing and repair. The concepts are then applied to the design and fabrication of engineering components, process plant and structures. Repair and reclamation of components will also be covered. The importance of selecting the correct welding process and parameters for a particular application will be demonstrated by investigating several case studies. Since a weld/joint can have a profound effect on the performance of a component depending on the in-service conditions it experiences, the influence of service environment will be investigated. At the end of the course students should have the concepts to assist in the selection of processes and parameters to make appropriately designed, sound joints, fit for service in the operating environment.

Content:

WELDING PROCESSES (4 lectures, 1 tutorial - 14%)
- (a) Welding processes (3 lectures)
- (b) Weldability, thermal models and residual stress (1 lecture, 1 tutorial)

PHYSICS OF ARC WELDING (2 lectures, 1 tutorial - 8%)

MATERIALS (3 lectures, 1 tutorial - 12%)

JOINING OF ENGINEERING MATERIALS (7 lectures, 2 tutorials - 25%)
- (f) Carbon steels (3 lectures, 1 tutorial)
- (g) Stainless steels (2 lectures, 1 tutorial)
- (h) Non ferrous metals (1 lecture)
- (i) Plastics (1 lecture)

WELDING DEFECTS (1 lecture – 3%)

FAILURE AND FRACTURE (1 lecture, 1 tutorial - 5%)

STANDARDS (2 lectures, 1 tutorial - 8%)

WELDING ECONOMICS (1 lecture – 3%)

HEALTH AND SAFETY (1 lecture – 3%)

CASE STUDIES IN WELDING FAILURE INVESTIGATION (5 tutorials - 14%)

WELDING DEBATE (2 tutorials – 5%)

Text book: No text book is needed – extensive notes are provided

Recommended Reading: Lancaster, J. F., *Metallurgy of Welding*, 6th Edition, Abington Publishing, UK

Experiments: Welding and joining

Transform Methods and Signal Processing

Course Code: APP MTH 4043

Course Type: Elective

Credit Points: 2 Units

Offered in Semester: Two

Pre-requisites / Assumed Knowledge: Level II Applied Mathematics courses with an aggregate value of 6 units

Teaching Method: 30 hours lectures and tutorials

Assessment: 10% assignments, 30% project, final exam 60%

Course Objectives: Students should gain a good understanding of transform methods such as the Fourier and Wavelet transforms, and how they are used in real applications, in particular in signal processing.

Graduate Attributes:
- ability to apply knowledge of basic science and engineering fundamentals;
- ability to communicate effectively, not only with engineers but also with the community at large;
- in-depth technical competence in at least one engineering discipline; and
- ability to undertake problem identification, formulation and solution.

Course Synopsis: Introduces various transform techniques including DFT and FFT as well as wavelet transforms, and introduces the basic principles of signal processing to provide an understanding of the fundamentals, implementation and applications of signal processing. At the end of the course students should have good concepts of various transform techniques used in communication theory and information theory, discrete-time signals in both time and frequency domains use of wavelet transforms for signal analysis.

Content:

Introduction (8%)
- integral transforms (e.g. Fourier, Radon, ...)
- basis functions (transforms as a change of basis)

Continuous time Fourier Transform (8%)
- basic waves, and power terminology
- Fourier series recap
- transform properties
- examples

- direct measurement of spectra

Discrete time Fourier Transform (DFT) (17%)

- sampling (time, and quantization effects, aliains, Nyquist)
- DFT and its properties
- Fast Fourier Transform (FFT)
- 2D signals and transforms
- applications: compression, and steganography (digital watermarks)

Filters and linear systems (17%)

- terminology (FIR, IIR, high-pass, low-pass)
- filters and the Convolution Theorem
- z-transforms
- Gibb's phenomena
- ARMA filters
- application: noise reduction, anomaly detection
- block diagrams and linear systems
- 2D filters and image processing
- FT and its relationship to linear systems

Radon transform (4%)

- application to tomography

Random process (8%)

- white and filtered noise
- spectral density and autocovariance

Parceval, Rayleigh and Plancheral theorems (4%)

- generalized Fourier transform

Windowing (17%)

- transient signals
- leakage and windows
- uncertainty principle
- short time Fourier Transform (and spectrogram)
- regularity, compactness and decay
- Gabor functions and transform

Wavelets and multiresolution analysis (17%)

- wavelets as sub-band filters
- multiresolution approximation
- pyramidal decomposition algorithm
- 2D wavelets:
- Applications:
  - fingerprint compression
  - 1/f noise and self-similarity

Text book: No textbook is required

Experiments: None