CHEMICAL ENGINEERING

Information Manual Level Four 2009

WELCOME

I congratulate continuing students on your success in examinations last year. It must be very satisfying to have successfully completed another milestone on the journey towards a successful career. Level IV is special in that you have now reached your final year of studies before graduation. During this year you will see the value of the solid foundation laid down in the previous three years of the degree program, especially when you come to do the Plant Design Project, and Chemical Engineering Research Projects will give you an insight into the fascinating world of research. The versatility of Chemical Engineering graduates is well known and this versatility will make you attractive to future employers. As usual, you will find all academic, Professional and technical staff to be approachable, friendly and willing to provide assistance when required. Please do not hesitate to contact the 2009 Level IV Course Advisor, A/Prof XXXXXXXX in the first instance should you require further information or assistance. As you know, as Acting Head of School I am always willing to meet with students, either individually or collectively to discuss any issues you may wish to raise. I offer my best wishes for a successful and enjoyable academic year.

Dr Peter Ashman
Acting Head of School

General Student Information

For further information about the Chemical Engineering School, Engineering North Building, please contact the appropriate person listed below:

Position	Staff Member	Room No.
Acting Acting Head of School	Dr Peter Ashman	N119
Undergraduate Course Advisor	A/Prof Brian O'Neill	N114
Student Advisor Undergraduate Level I	Dr Peter Ashman (Chem) Dr Jingxiu Bi (Pharma)	N119 N212
Student Advisor Undergraduate Level 2	Dr Zeyad Alwahabi (Chem) Dr Jingxiu Bi (Pharma)	N113b N212
Student Advisor Undergraduate Level 3	Dr Ken Davey	N211
Student Advisor Undergraduate Level 4	Dr David Lewis	N212b
Postgraduate Coordinator	Dr David Lewis	N212b
Employment/Industry Liaison	Dr Peter Ashman	N119
Business Manager	Mrs Dianne Parish	N118
School Office Staff	Mrs Mary Barrow Mrs Elaine Minerds Mrs Sue Earle	N120
Workshop Technical Officers	Mr Jason Peak Mr Jeff Hiorns Mr Michael Jung	Engineering Workshop
Computing Engineer	Mr Sanh Tran	N206a
School Safety Officer	Mr Andrew Wright	N115
School Health and Safety Representative	Mrs Elaine Minerds	N120
First Aid Officers	Mrs Mary Barrow Mrs Dianne Parish	N120 N118
Laser Laboratory Coordinator	Dr Zeyad Alwahabi	N212b
Laboratory Coordinator	Mr Andrew Wright	N115
Equal Opportunity	Mrs Mary Barrow Mrs Dianne Parish	N120 N118
Sexual Harassment Contact Officer	Mr Andrew Wright	N115
Equity Officer	Mr Andrew Wright	N115

Assessment Procedures, 2009

The following gives the proposed method of assessment and weighting factors for 2009. Minor changes may occur throughout the year. Students will be informed of these.

NOTES:

1. C.B. = Closed book
   O.B. = Open book

2. There shall be four classifications of pass at an annual examination in any course for the degree as follows: Pass with High Distinction, Pass with Distinction, Pass with Credit, Pass.

   There shall also be a classification of Conceded Pass. A candidate may present for the degree courses for which a Conceded Pass grade has been awarded within he following limits:
   - no course may be presented at the conceded pass level with a unit value greater than 3 units.
   - for any single Bachelor of Engineering program no more that 10% of the courses presented may be at the conceded pass level with a limit of 9 units in total.
   - for all double/combined programs no more than 10% of the courses presented may be at the conceded pass level with a limit of 12 units in total. All rules pertaining to the presentation of conceded passes within the individual programs must also be complied with.
   - articulating students and students with credit transfer may present 10% of their units undertaken at Adelaide at the conceded pass level and this number will be rounded up to a multiple of 3 and will not exceed 9 units in total.

3. Supplementary examinations are held two weeks after the main examination periods:

Mid-year (Semester 1)	20 - 24 July 2009
End of year (Semester 2)	14 - 18 December 2009

   Supplementary examinations are available on academic, medical and compassionate grounds. The decision to grant a supplementary examination is the responsibility of the academic staff.

   Please note: It is strongly recommended that students sit for their exams wherever possible because there is no guarantee that a supplementary will be granted.

   Academic Grounds
   For courses taught by Engineering Schools, 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. Precise details on assessment in each course should be provided by Schools at the beginning of lectures.

   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.

   Medical Grounds
   Applications must be lodged within five (5) working 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.

   Compassionate Grounds
   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 within

five (5) working days of the special circumstances. There is no restriction on the maximum grade awarded for a Compassionate Supplementary.

Students who are awarded a supplementary examination on medical or compassionate grounds will not be able to count the better of the primary and supplementary exams. Sitting a supplementary exam will constitute acceptance of the offer of the supplementary exam and only the supplementary exam result will be recorded (whether it is higher or lower than the first result).

Students granted a Medical or Compassionate Supplementary Examination and also eligible for an Academic Supplementary Examination
For courses taught by Schools in the Faculty of Engineering, Computer & Mathematical Sciences, students granted a medical/compassionate supplementary examination and who are also eligible for an academic supplementary examination should consider their options and before sitting the examination, advise the ECMS Faculty Student Office (ecms_office@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.

4. Tutorials and class exercises held during the year may count towards the mark in any subject. This value will be specified by the lecturer in charge at the commencement of the course.

5. In subjects consisting of a number of components, a minimum mark of 40 must be obtained. This requirement applies to the following subject: CHEM ENG 3003A/B Chem Eng Projects III; CHEM ENG 4025 Chemical Engineering Projects IV, CHEM ENG 4027 Chemical Engineering Research Project (N), CHEM ENG 4026 Chemical Engineering Research Project (H).CHEM ENG 4002A/B Chemical Engineering Research Elective II and CHEM ENG 4020A/B Chemical Engineering Research Elective. A fail will be recorded if the student does not submit satisfactory project work in **ALL** components as specified by the examiner or supervisor.

6. **Exemptions and Status** - In some cases students may be granted status in whole subjects because of related studies taken previously. Exemptions from part of a subject previously attempted may be granted in some cases. You **must apply** for exemption or status, it does not happen automatically. Applications should be submitted to the **School Office** on the appropriate form **no later than** the end of Week 1 (7 March 2009).

7. **Chemical Engineering Honours:** To be eligible for the award of honours a student **should be** enrolled for the complete Fourth Year with the exception of up to 4 Units (composed of electives and/or CHEM ENG 4018 Ind. Econ. Man). In exceptional circumstances this requirement may be varied by the Head of the School. Honours will be awarded for meritorious performance throughout the course. To obtain the final honours mark a weighted average for each year will be evaluated based upon the subject weights shown in a calendar (eg a 2-point subject will contribute 2/24 = 8.33%) and the mark achieved by a student at their **first attempt** (with the exception of subjects where a medical supplementary was awarded). Results from any repeating subjects are **NOT** counted towards honours marks. Weights for the individual years are: Year 2 = 20%, Year 3 = 30%; Year 4 = 50%. Class I Honours requires 75%, Class IIA 70% and Class IIB 65%. Candidates will normally be required to average at least 75% in their final year for the award of Class I Honours.

   There is a selection process to choose candidates who will be permitted to undertake the honours stream in the fourth year of the BE. Those selected for honours may enrol in a specially designated level IV honours course. This course varies from program to program and details are given in the enrolment sheets for each program. The normal minimum requirement for selection for the honours stream is a weighted average of 60% over levels 2 and 3 of the BE, where the relative weighting of the levels is 2:3 respectively.

8. Students may apply **in writing** to have supervised access to their **examination scripts** within **three (3) weeks** of the publication of the provisional examination results.

9. Students who believe they have reasonable grounds for expecting a higher mark may request, **in writing** to the Acting Head of School within **three (3) weeks** of the publication of the results, for a piece of work to be reassessed

10. **Review of Academic Progress:** Engineering implements a review of academic progress policy in accordance with University guidelines. This policy states that students who, in any one year of university study, fail 1/3 or more of their year's enrolment will be subject to review. The review in this case involves a formal letter and an interview with a Course Adviser in the School. The outcome could include referral to

academic or counselling services and restriction of the student's enrolment, such that the student is not permitted to enrol in an overload in the following year. Further failures will result further restrictions and students failing 1/3 or more of their enrolment in each of three consecutive years will have their progress reviewed by the Academic Review Committee. The outcome of this review could include a recommendation for preclusion, compulsory deferment for one semester or one year, or a further restricted enrolment.

11. **University Policy on Plagiarism**: Details are available on the CLPD website at: http://www.adelaide.edu.au/clpd/plagiarism/students

Acting Head of School
February 2009

Calculator Policy

1. **No restrictions** will be placed on the **type/brand** of calculator that may be used by students in an examination where the use of calculators is permitted.
2. Students are expected to own **either** a **graphing** calculator (similar to those used in Year 12 mathematics) or a calculator with a **solve function** (i.e. can iterate & solve non-linear equations). This is particularly useful in the later years of the course.
3. There will be **no restrictions** placed on calculator usage in **an open-book** examination or **an open-book** section of an examination.
4. Students are permitted to use a calculator in **all closed-book** examinations or **all closed-book sections** of an examination unless a **specific direction** is included on the examination cover sheet prohibiting the use of calculators
5. The use of calculators **may be prohibited in a defined part (or all) of a closed-book examination**. In this case, a separate answer book for this section **must be handed-in** before the portion of the paper in which a calculator may be used is commenced.

School Policy and Procedures for Handling Student Complaints and Feedback

The following outlines the necessary steps to make a complaint, offer suggestions or comments, or express concerns about any issue deemed relevant to the School:

1. Bring the matter to the attention of the appropriate member of staff (academic, professional or technical) concerned.
2. If the matter is not resolved by following step 1, it should be discussed with the Year Level Advisor.
3. If the matter remains unresolved after following steps 1 and 2, it should be brought to the attention of the Acting Head of School. If the member of staff concerned in step 1 is the Acting Head of School then the appropriate person in step 3 is the Executive Dean.
4. Steps 1 and/or 2 may be by-passed if the student so desires.
5. If the student wishes to make anonymous complaints, suggestions or comments, a locked Suggestions Box is available on the wall outside the School Office (Room N120, North Engineering Building).

Assessment Procedures 2009 (By Subject)

LEVEL IV						
Subject	**Part**	**Paper No..**	**Type**	**Duration (h)**	**Semest-er**	**Weight**
4003 PROCESS DYNAMICS AND CONTROL					1	(2.0 Units)
	1. Examination	1	C.B.	3		80%
	2. Project and Exercises					20%
4009 ADVANCED CHEMICAL ENGINEERING					2	(2.0 Units)
	1. Examination	1	{C.B.	1		80%
			{O.B.	2		
	2. Tutorials and Assignments					20%
4010 ADVANCED SEPARATION TECHNIQUES AND THERMAL PROCESSES					1	(2.0 Units)
	1. Examination	1	{C.B.	1		80%
			{O.B.	2		
	2. Tutorials					20%
4014 PLANT DESIGN PROJECT					2	(6.0 Units)
	1. Project Report					88%
	2. Examination	1	C.B.	1		12%
4018 INDUSTRIAL ECONOMICS AND MANAGEMENT					2	(2.0 Units)
	1. Examination	1	C.B	3		100%
4025 CHEMICAL ENGINEERING PROJECTS IV						(2.0 Units)
	1. Laboratory Project				1	100%
4026 CHEMICAL ENGINEERING RESEARCH PROJECT (H) **4027 CHEMICAL ENGINEERING RESEARCH PROJECT (N)**						(2.0 Units)
	1. Progress and Final Reports				(FY)	85%
	2. Poster and/or Presentation					15%

Subject	**Part**	**Paper No.**	**Type**	**Duration (h)**	**Semester**	**Weight**
LEVEL IV ELECTIVES:	**Three to be chosen**					(6.0 Units)
4002A/B CHEMICAL ENGINEERING RESEARCH ELECTIVE II					FY	(4 Units)
	1. Progress and final reports					85%
	2. Poster and/or Presentation					15%
4004 MINERALS PROCESSING					1	(2.0 Units)
	1. Examination	1	C.B.	2		75%
	2. Tutorials and Practicals					25%
4008 BIOCHEMICAL ENGINEERING					1	(2.0 Units)
	1. Examination	1	C.B.	2		80%
	2. Assignments					20%
4020A/B CHEMICAL ENGINEERING RESEARCH ELECTIVE					FY	(2 Units)
	1. Progress and final reports					85%
	2. Poster and/or Presentation					15%

4021 COMBUSTION PROCESSES					1	(2.0 Units)
	1. Examination	1	O.B.	2		60%
	2. Assignments					40%
4024 ENVIRONMENTAL ENGINEERING					1	(2.0 Units)
	1. Examination	1	{C.B.	1		80%
			{O.B.	1		
	2. Tutorials					20%
App Mth 4007 COMPUTATIONAL FLUID DYNAMICS						(2.0 Units)

Practical Experience

It is a student's responsibility to organise their own work experience and a booklet listing names of companies who have provided practical work experience to students in the past is available at the School Office. Engineers Australia also provides a booklet to their student members listing a number of Chemical Engineering companies to their Student members.

General

A total of twelve weeks practical experience (of which a minimum of 6 weeks should be under the supervision of a professional engineer) is required and this should be undertaken during the university vacations and normally be completed before beginning the work of Level IV of the course.
It is desirable that at least half of the total number of weeks specified above be spent in an approved chemical factory or research establishment on plant operation or industrial research or development.
The Faculty may grant either partial or total exemption from these requirements to a candidate who produces satisfactory evidence of practical experience obtained before their first enrolment in the Faculty; and in special cases, the Faculty may grant dispensation from the requirements.
Credit will not normally be given for periods of less than three consecutive weeks.
A candidate should seek a variety of practical experience appropriate to the candidate's academic level.
Before beginning a period of practical experience, a candidate may ensure that it will be satisfactory to the Faculty by consulting the Acting Head of School.
Upon completion of each period of practical experience (and no later than the following 31 March) each candidate is required to submit to the Faculty Office, on the prescribed form, a statement of practical experience gained, certified by the employer for approval by the Faculty of Engineering.

To help you find work experience, we have produced a booklet which contains names, addresses and phone numbers of companies you may contact for work experience. This is available from the School of Chemical Engineering Office N120.

STUDENT PLACEMENT PROGRAM AGREEMENT

Students who undertake **unpaid** work experience or a community placement program in connection with their course or approved research work, will only be covered by the University's insurance program if the work is undertaken with the knowledge and consent of the University. To obtain and document this consent the student must complete a **Student Placement Program Agreement** before any work placement can take place. (This form (3 pages) may be found starting on the next page.)

The most important thing to remember is that if a student begins **unpaid** work placement without the approval of the Acting Head of School and the completion of the Student Placement Program Agreement, the University of Adelaide insurance program is **not** available to the student.

STUDENT PLACEMENT PROGRAM AGREEMENT

Part A - Student Details

Family Name ______________________ Given Names ______________________

Student ID # ______________________ Student Phone # ______________________

Degree/Program enrolled ____

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Faculty ______________________________ Campus ______________________

EMERGENCY CONTACT

Name ______________________________ Relationship ______________________

Phone # Work: ______________________ Home: ______________________

Mobile # ______________________________

School Contact

Name ______________________________ Phone # ______________________

As a student on work placement, I agree

1. To attend the workplace to which I have been assigned at the agreed times and days stated below.
2. To notify both my workplace supervisor (named below) and the School Contact above if I am unable to attend for reasons of ill health or any other reason.
3. To present myself in an appropriately dressed fashion ensuring I am wearing any protective clothing which may be required by the Host Organisation.
4. Obey all lawful directions of the workplace to which I have been assigned.
5. To work to my full capacity, with due regard for my legal responsibilities in the workplace.
6. To comply with all Occupational Health & Safety requirements required by the host organisation.
7. To inform the host workplace supervisor and the School administration office of any accident or injury in which I am injured or in which I have injured another party.
8. In the event of an emergency I will contact the School administration office.

Student's Signature:______________________________Date:______________

Part B – Host Organisation

Name: ______________________________ Phone # ______________________

Street address: ____

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Contact Person: ______________________________ Phone # ______________________

Email Address ______________________________ Fax# ______________________

Location of placement ______________________________

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Supervisor Name ______________________ Phone # __________

Date of placement: (From) ______________________ (To) __________

Hours of work: (Start) ______________________ (Finish) __________

Description of task to be performed ______________________________

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Special Conditions (Clothing, safety equipment, parking) __________

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Part C – Conditions

We agree to accept the named student on work placement and to plan an appropriate program for their placement.

All reasonable precautions will be taken in the workplace to ensure the occupational health safety and welfare of the student in a non-discriminatory and harassment free working environment. The School administration office will be notified by our organisation in the case of a student's illness, injury or unexplained absence. The student will not receive any form of reward or stipend for work performed during and placement and will not be used to replace paid workers or be used during any form of industrial dispute. The student is not to be required to undertake any task prohibited by the University, Legislation or insurance requirements.

It is understood by all parties that the University, the host organization or the student may without notice cancel the work placement.

The host organization agrees that they have Occupational Health & Safety procedures in place and the student will receive a safety and workplace induction that will prepare them to safely undertake the tasks and duties of the work placement.

Part D – Insurance

The University maintains a Public Liability insurance policy that will indemnify the host organisation for any negligence act, error or omissions by the student during the period of the work placement. A Certificate of Insurances for Public Liability is enclosed with this Placement Agreement Form.

The host organization agrees to indemnity the University and the student for any injury, loss or damage to student or to University property being used by agreement with the host organisation, resulting from any negligent act or omission by its employees, agents or contractors.

The host organisation agrees to provide 'proof of insurance' for the period of the work placement to the School administration office. The student is not to commence the work placement until the proof of insurance has been sighted.

Host Organisation Authorising Officer Name: ______________________________

Signature ______________________________ Date ______________

Part E - Authorisation

I grant permission for the above named student to undertake a work placement with the above named host organisation in accordance with the conditions and guidelines above:

Acting Head of School

Signature ______________________________ Date ______________

Distribution

1. School administration office
2. Host organisation
3. Student

Adelaide University Undergraduate Scholarships

A list of potential scholarships is available on the web at the followingURL:

http://www.adelaide.edu.au/scholarships/undergrad/

Each year students who achieve a weighted average of over 80% will receive a Dean's Merit Award.

Chemical Engineering Undergraduate Prizes

Level IV Prizes

The K.R. & M.S. Davey Prize in Biochemical Engineering

Whereas Dr. K.R. and Mrs. M.S. Davey have provided to the University the sum of $2,500 for the purpose of establishing a prize to foster the development of biochemical engineering interest and practice within the Discipline of Engineering, the following rules are hereby made:

1. The prize shall be known as the "K.R. and M.S. Davey Prize in Biochemical Engineering".
2. The prize shall consist of a medal and a monetary prize to the value of $100, subject to the availability of funds, or such other amount as shall from time to time be determined.
3. The prize shall be awarded on the recommendation of the Head of the School of Chemical Engineering to the student who obtains the best overall result in the course CHEM ENG 4008 Biochemical Engineering.
4. No award shall be made if there is no candidate of sufficient merit.
5. If, in any year, two or more candidates are of equal merit, the prize shall be shared equally.
6. These rules may be varied from time to time, but the title and general purpose of the prize shall not be changed.

Engineers, Australia Award

The University has accepted the offer of Engineers Australia to provide an annual award of $200 for students enrolled in the degree of Bachelor of Engineering and the following rules are hereby made:

1 .The award shall be known as "The Engineers Australia Award".

2. The award shall be open to students enrolled in Level IV of a program for the degree of Bachelor of Engineering.
3. The Head of each Engineering School may, with the consent of the nominee in each case, recommend for the award up to two candidates, chosen on the basis of academic excellence and qualities of character and leadership.
4. A candidate may be recommended for the award, after consultation with the President of the Institution of Engineers, Australia (S.A. Div.), or the President's nominee.
5. The award shall not be made if, in the opinion of the Faculty of Engineering, Computer & Mathematical Sciences, there is no candidate of sufficient merit.

Note: Engineers Australia will, in addition, present "The Arvi Parbo Medal" to the successful candidate. Amendment to rules subject to approval of the Faculty of Engineering, Computer & Mathematical Sciences, in association with the Institution of Engineers, Australia.

The Lokan Prize

The sum of $200 having been paid to the University by the Adelaide University Engineering Society for the purpose of establishing a prize in memory of Robert Albert Lokan, formerly a student in the School of Mining, it is hereby provided that:

A prize of the value of $35 shall be awarded annually to the student who shall most distinguish himself or herself in the annual examination in the Level IV subject **CHEM ENG 4010 Advanced Separation Techniques and Thermal Processes**; provided that he or she is of sufficient merit.

The Rutter Jewell-Thomas Medal and Prize

1. A medal, and a prize to the value of $250, to be known as "The Rutter Jewell-Thomas Medal and Prize", shall be offered for competition annually.
2. The medal and prize shall be awarded to the student completing Level IV of the undergraduate program in Chemical Engineering whose academic record, over the whole program, is judged best.
3. The prize shall not be awarded if, in the opinion of the Head of the School, there is no candidate of sufficient merit; but, if no award is made in any year, two awards may be made in a later year in which there are two candidates of sufficient merit.

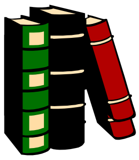
Exchange Opportunities for Engineering Students

Adelaide University has established student exchange programs with around fifty overseas universities, which enable Adelaide students to study overseas for a semester or year and count the work completed towards their Adelaide degree.

Under an exchange program students remain enrolled at the Adelaide University while they are overseas, which means they are still liable for HECS and Student Union fees. As students are still studying towards their Adelaide degree they may still be eligible for AUSTUDY while on exchange if they already receive it. Exchange students do not pay tuition fees to the host university, but must fund their own travel, accommodation and living expenses during the exchange.

There are two types of exchange program - university wide programs in which students from all Faculties may participate, and discipline/Faculty based programs which have been established by a particular School or Faculty for its own students. Some programs are available to both undergraduate and postgraduates, and some to undergraduates only.

Course Notes and Syllabus Requirements for B.E. (Chem.) & Combined Degrees.



The degree course with Honours in BE (Chem.) shall occupy four years of full-time study. Details of BE courses can be found at the following site.

http://www.ecms.adelaide.edu.au/enrol/guides/

B.E. Chem (Energy and Environment)
B.E. Chem (Process and Product Engineering)
B.E. Chem (Food, Wine and Bio-molecular)
B.E. in Sustainable Energy Engineering (Chemical)
B.E. in Pharmaceutical Engineering

Double and Combined Programmes
It is possible for students to enhance their engineering qualifications by combining studies in Engineering with studies in other faculties. Information can also be found at: **http://www.ecms.adelaide.edu.au/enrol/guides/**

The complete Academic Program Rules governing the award of combined degrees is available online as a pdf file from the University's website. The URL is:
www.adelaide.edu.au/calendar/ug/eng

B.E. (Chem.)/B.Sc
B.E. (Chem)/B.Ma&Comp.Sc. (Computer Science focus)
B.E. (Chem)/B.Ma&Comp.Sc. (Mathematics focus)
B.E. (Chem)/B.A.
Arts Studies Combined with the B.E.(Chem)
B.E. (Chem.)/B.Ec.
B.E.(Chem.)/B.Fin..
B.E. (Chem.)/B.Sc (Biotech)
B.E. (Petroleum.)/B.E. (Chemical)

The Bachelor of Engineering degree in the specialisations listed above may be awarded in the Pass or Honours grade. The award of the Honours grade shall be made for meritorious performance in the course with greatest weight given to performance in the later years. The Honours grade may be awarded in one of the following classifications: First Class, Second Class Division A, Second Class Division B. (There is no Third Class for the Bachelor of Engineering degree). To qualify for the degree a candidate shall regularly attend lectures and do written, laboratory, and other practical work (where such is required), and pass examinations in the subjects prescribed in the Specific Course Rules for one of the specialisations listed above. Before being admitted to the degree a candidate shall also submit satisfactory evidence of completion of a period of practical experience in work approved by the Faculty of Engineering as appropriate to the course which the candidate has followed. Candidates are required to complete satisfactorily subjects to the value of 24 Units at each of Levels I, II, III and IV.

Prerequisite Subject Requirements

A student may not normally undertake a subject for which the prerequisite subject requirements have not been satisfied. Although the School of Engineering is reluctant to waive the prerequisite requirements of a subject, it is recognised that there can be situations where it is appropriate. Accordingly, if a student has sound academic reasons for a waiver of the requirement, he or she should apply to the School of Engineering through the Head of the School which offers the subject concerned.

SUMMARY OF AIMS, OUTCOMES ASSESSMENT AND SYLLABUS FOR LEVEL IV CHEMICAL ENGINEERING SUBJECTS

CHEM ENG 4003 PROCESS DYNAMICS & CONTROL

Units:	*2*
Duration:	*Semester 1*
Lecturer:	*Associate Professor Brian O'Neill*
When:	*Refer Timetable under Current Students in MyUni*

Aims

1. to reinforce the concepts introduced in third year control & instrumentation.
2. to introduce the principles of controller tuning.
3. to consider controller design & tuning using the frequency domain.
4. to introduce students to digital & advanced control concepts and techniques.

Outcomes

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

- undertake plant tests to determine dynamic characteristics (e.g. in a first-order plus dead time model).
- tune various forms of controllers (P, PI, PID) using a number of techniques (e.g. open-loop step test, closed-loop step test).
- understand typical control structures for a variety of commonly encountered processes.
- specify advanced controllers (e.g. dead time compensation, feed-forward, IMC, model-based control).
- specify & model multi-variable control structures & de-couplers.

Assessment

Examination	80%
Project and Exercises	20%

Textbook

Stephanopoulos, G., *"Chemical Process Control"* (Prentice Hall)

Syllabus

Revision

fundamentals - control objectives, feedback control, standard elements
dynamic analysis
Laplace transform solution
open-loop responses
stability
PID controllers
block-diagram algebra
closed-loop responses
valve characteristics

Analysis & design by frequency response techniques

why?, stability, index of performance
general frequency response characteristics
Bode and Nyquist diagrams
Bode stability criterion

gain and phase margins
controller design - Zeigler Nichols
controller synthesis
modern tuning algorithms
process identification
transient response from closed-loop frequency response

Analysis and design of complex control systems

dead time and inverse response
IMC tuning and model-based control
multiple loops - cascade, selective control
ratio control, feed forward control

Discrete control

sampling, zero-order hold
z transform
control algorithms
discrete transfer function and digital filters
closed-loop transfer function & response
direct design of digital controller

Multi-variable processes

inventory control
control system synthesis
loop interation and decoupling
state-space formulation

Examples

pH control & chemical reactor control
fuzzy control

Exercises

A variety of problems to illustrate & reinforce concepts introduced in lectures.
Extensive use will be made of the Matlab software package for solution of problems.

GRADUATE ATTRIBUTES:

- The ability to apply knowledge of basic science and engineering fundamentals.
- In-depth technical competence in at least one engineering discipline.
- Confidence to tackle real-world problems and issues central to engineering and to work as individuals and cooperatively in multidisciplinary and multicultural teams.
- Ability to utilise a systems approach to design and operational performance.
- Understanding of professional and ethical responsibilities and commitment to them; and expectation of the need to undertake lifelong learning, and capacity to do so.
- Enthusiasm and interest for undertaking life-long learning and the continual updating of their engineering skills.

CHEM ENG 4009: ADVANCED CHEMICAL ENGINEERING

Units value:	*2*
Duration:	*Semester 1*
Lecturer:	*Professor Mark J. Biggs*
When:	*Refer Timetable under Current Students in MyUni*

Aims:
To provide a broad introduction to nanotechnology and, consequently, a basis for further independent study of the subject.

Outcomes:
On successful completion of the course, you should be able to:

1. discuss and explain what makes the nanoscale special;
2. discuss and explain a number of nanotechnologies;

3. discuss and explain aspects of nanotechnology design, manufacture and testing;
4. use your understanding of nanotechnology to develop scoping designs of some nanotechnologies; and
5. use your understanding to learn independently about aspects of nanotechnology not covered in the course.

Assessment:

Assessment will be via coursework (50%) and exam (50%). The coursework will be in the form of a group scoping design exercise that will be made up of two separate parts: (a) submission of an interim design (34%); and (b) presentation of the final design (66%). The exam will be two hours in length and you will be required to answer two out of three questions in an open book format.

Text Books:

There is no one specific recommended text for the course. Instead, you will be from time to time referred to texts and journal articles, which you are expected to consult for greater detail beyond that provided in the lectures. You should also read more widely around the topics covered in the lectures and the design exercise. Copies of the overheads and links to various other online resources will be provided on MyUni.

Syllabus:

1. What is the nanoscale and what makes it different from other scales: why the nanoscale is important; case studies demonstrating non-classical behaviour at the nanoscale.
2. Case studies demonstrating successful and emergent nanotechnologies: nanocomposites; biosenors; magnetic nanoparticles; etc.
3. Introduction to top-down manufacture: vapour deposition; etching; lithography; etc.
4. Introduction to nanotechnology instrumentation and characterisation: atomic force microscope (AFM); scanning tunnelling microscope (STM).
5. Introduction to bottom-up manufacture: self assembly; molecular machines; nanofactories.
6. Introduction to design of nanotechnologies: molecular and mesoscopic forces; nanotechnology design methodologies; molecular and mesoscale modelling.
7. Introduction to health and safety aspects of nanotechnology: some of the ‘scare stories’; potential health-related concerns over nanoscale entities such as nanoparticles and nanotubes.

Graduate attributes:

- The 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 utilise a systems approach to design and operational performance.
- Ability to function effectively as an individual and in multi-disciplinary and multicultural teams; with the capacity to be a leader or manager as well as an effective team manager.
- Understanding the social and environmental responsibilities of the professional engineer, and the need for sustainable development.
- Confidence to tackle real-world problems and issues central to engineering and to work as individuals and cooperatively in multidisciplinary and multicultural teams.
- Enthusiasm and interest for undertaking life-long learning and the continual updating of their engineering skills.

CHEM ENG 4010: ADVANCED SEPARATION TECHNIQUES & THERMAL PROCESSES

Units value:	*2.0*
Duration:	*Semester 1*
Lecturers	*Dr Ken Davey*
	Mr Michael Brauer
When:	*Refer Timetable under Current Students in MyUni*

Aims

To extend the knowledge of Level IV chemical engineering students in the areas of separation and thermal processes likely to be of use for the completion of their design projects and likely to be of use to practising chemical engineers. The emphasis is on design aspects.

Outcomes

At the end of the course the students should be able to:

1. Apply the knowledge gained to relevant aspects of the subject 4014 Plant Design Project.
2. Understand the methodologies used in the design of multi-component distillation and gas absorption systems and be able to relate the theory to the methods used in the various distillation simulation and design packages.
3. Understand the methodologies used for the design and operation of multiple-effect evaporator systems, cooling tower and industrial drying systems.
4. Understand the basic principles of the application of membrane technology to various separation processes.

Assessment

Final Examination	80%
Years Work (Tutorial/tests):	20%

References

E.J. Henley and J.D. Seader, *Equilibrium Stage Separation Operations in Chemical Engineering*, Wiley, (1981)

C.J. King, *Separation Processes* 2nd Edition, McGraw-Hill, (1980)

T.K. Sherwood, R.L. Pigford and C.R. Wilke, *Mass transfer*, McGraw-Hill, (1975)

A.S. Foust, et al., *Principles of Unit Operations*, 2nd Ed. Wiley (1980).

Syllabus

Part I	Multicomponent Distillation
Part II	Thermal Processes
Part III	Gas Absorption
Part IV	Membrane Processes

Part I Multicomponent Distillation

1. Introduction and general review of the equipment used:
   - tray columns
   - random packed columns
   - structural (high efficiency) packings
2. The equilibrium stage model and the multicomponent flash calculation:
   - partial and total condensers
   - partial and total reboilers
   - the general equilibrium stage model with feed product and heat removal/addition on every stage
   - the multi-component flash calculation
   - the Rachford-Rice formulation V/F, bubble-point and dew-point calculation
3. Multi-component flash calculations (control):
   - the multi-component phase envelope
   - component $ø_i/f_i$ determination
   - specifications of the flash process
   - flash calculations with K_i dependent on composition
   - computer algorithms for multi-component flash
4. Approximate methods for multi-component distillation:
   - key components and split specifications
   - design vs rating calculations

- determination of column pressure and a condenser system
- refrigerated condensers

5. Approximate methods for multi-component distillation (continued)
   - calculation of minimum theoretical stages - the Fenske equation
   - use of the Fenske equation to estimate non-key compositions at actual/total reflux
6. Approximate methods for multi-component distillation (continued)
   - the determination of minimum reflux by the Underwood method
     - the equations of condition at minimum reflux
     - Underwood's first and second equations
     - the roots of the Underwood equation and the common roots
     - the determination of minimum reflux
   - refining estimates of $x_{i,D}$ with Underwood's equation
   - Underwood's methods for non-adjacent keys
   - Application limits (wide boiling feeds)
   - the Gilliland correlation
   - feed stage location
7. Rigorous equation methods for the general multi-component distillation problem (rating calculations)
   - terminology
   - the available equations (MESH)
   - equation "tearing"
8. Derivation of the Wang-Henke method:
   - the component balances (M)
   - the equilibrium relationships (E)
   - the summations (S)
   - the energy (enthalpy) balances (H)
9. The Wang-Henke solution algorithm:
   - the matrix equations
   - outline of the overall Wang-Henke algorithm
   - the energy balances and the torn variable computation
   - the convergence criteria for the algorithm
10. Introduction of the Napthali-Sandholm algorithm:
    - the non-suitability of Wang-Henke for "non-ideal" systems
    - the Napthali-Sandholm problem formulation vs Wang-Henke

Part II Thermal Processes

1. Evaporation and evaporation equipment
2. Boiling heat transfer:
   - pool boiling and critical heat flux
   - boiling heat transfer correlations
   - boiling inside tubes
   - boiling point elevation (Duhring plot)
   - experimental heat transfer coefficients
3. Multiple effect evaporator systems
   - general arrangements
     - forward, backward, parallel and mixed feeds
     - definition of economy
   - the development of the design equations
     - mass balances
     - energy balances
     - heat transfer rate equations
   - methods for manual calculation
4. Condensing equipment and condenser design:
   - barometric leg condensers
   - design allowances
   - non-condensable venting
5. Evaporator system operation
   - details of alternate feed arrangements
   - advantages and disadvantages of alternate feed arrangements
   - start-up and shut-down of evaporator systems.
6. Vapour carrier - gas systems:
   - psychrometric charts

- derivation of basic properties for construction of charts
- wet-bulb temperature and adiabatic saturation
- air-water systems and the Lewis relationship

7. Cooling towers:
   - general equipment
   - development of the design equations (simultaneous heat and mass transfer)
8. Cooling tower design methods:
   - graphical methods
     - graphical methods
     - the operating line and the minimum gas rate
   - "analytical" methods
   - fogging problems and the gas condition line
   - determination of coefficients in operating equipment
9. Drying processes (solids):
   - drying mechanisms
   - equilibrium data
   - static batch drying
   - cross circulation drying (radiation and conduction affects)
10. Drying process (solids) (continued)
    - through circulation drying
    - continuous drying

Part III Gas Absorption

1. Equipment for gas absorption
   - tray columns
   - packed columns
   - spray towers
   - special equipment
2. Gas absorption with chemical reactions
   - kinetic regimes and rate equations
   - design method
3. Gas absorption in tray towers
   - stage calculations for concentrated systems
   - approximate methods for dilute systems
4. Multicomponent gas absorption
   - analytical design methods
   - graphical design calculations
   - non-isothermal operations

Part IV Membrane Processes

Principles and applications of membrane processes:

1. Microfiltration
   - ultrafiltration
   - reverse osmosis
2. Pervaporation
   - electrodialysis
   - gas separation
   - facilitated transport

GRADUATE ATTRIBUTES:

- The ability to apply knowledge of basic science and engineering fundamentals.
- In-depth technical competence in at least one engineering discipline.
- Ability to utilise a systems approach to design and operational performance.
- Ability to focus on the integration of process safety considerations with environmental concerns, waste minimisation and control system specifications.
- Confidence to tackle real-world problems and issues central to engineering and to work as individuals and cooperatively in multidisciplinary and multicultural teams.
- Enthusiasm and interest for undertaking life-long learning and the continual updating of their engineering skills.

CHEM ENG 4014: PLANT DESIGN PROJECT

Units:	*6.0*
Duration:	*Semester 2*
Lecturer:	*Dr David Lewis*
When:	*Refer Timetable under Current Students in MyUni*

Outcomes

1. Design Project

The successful completion of the design project should provide the student with:

1. An understanding of the importance of teamwork in general project work.
2. An understanding of how the design process requires the integration and application of knowledge gained in the various sub-disciplines covered in the four years of the undergraduate course.
3. An understanding of how economic criteria and other constraints affect choices made from the set of available options considered during the design process.
4. An understanding of how to deal with problems arising from incomplete initial information and the 'open-ended' nature of design problems.

2. Lecture/Tutorial Program

At the end of the course students should have:

1. An understanding of how design projects are handled in an industrial context.
2. An understanding of the paramount importance of safety management in the process industries and in particular how safety considerations can be taken into account at the design stage.
3. An understanding of the importance of economic as well as technical performance parameters through the full life-cycle of a process plant.
4. An understanding of energy integration, co-generation (steam/power) and steam reticulation systems as typically encountered in chemical process plants.

Assessment

Project Report	88%
Examination	12%

Reference Books

R. King, *Safety in the Process Industries*, Butterworth-Heinemann, (1990)
M.S. Peters and K.D. Timmerhaus, Plant Design and Economics for Chemical Engineers, 5th ed McGraw-Hill, (2003)
J.C. Mecklenburgh (Ed), Process Plant Layout, George-Godwin (1985)
T. Kletz, Hazop and Hazan: Notes on the Identification and Assessment of Hazards, 2nd ed (1986).
Guidelines for Chemical Process Quantitative Risk Analysis, AIChE (1989), ISBN 0-8169-0402-2
Branan, C.R., Rules of Thumb for Chemical Engineers, 4th Ed, Elsevier Science & Technology Books, 2005
Sinnott, R.K., Coulson & Richardson's Chemical Engineering, Vol 6
Chemical Engineering Design, 3rd Ed, Butterworth-Heinemann, 1999

Syllabus

1. **Design Project**

Students must complete the process design of a medium to large scale chemical process and must complete other design work as required associated with plant equipment specification and layout. In addition a full analysis of the expected economic performance must be completed. The project is normally completed as a member of a four to six person team.

2. **Lecture/Tutorial Program**

The basic aim is to cover material relevant to the process and plant design project that has not been specifically covered elsewhere in the undergraduate course. To this end three broad categories are covered:

- General design matters and the industrial context of design projects;
- Utilities (steam/power);
- Safety Management Systems

Part I ***General Design Lecture***

1. Introduction to process and plant design:
   - general process concepts
   - the system concept

- the importance of safety
- flowsheet types
  - block diagrams
  - process flowsheets (mass and energy balances)
  - batch process flowsheets
  - engineering flowsheets (engineering line diagrams, piping and instrument diagrams)

There is also a Tutorial on sources of relevant data and information held in the Barr Smith Library as part of the introduction to process and plant design.

2. The industrial context of projects:
   - financing
   - feasibility studies
   - product rate vs time curves
3. The mean daily design rate:
   - production targets (annual)
   - between day variations in production
   - within day variation in production
   - MCR (Maximum Continuous Rating) and unit capacity selection
4. Plant layout:
   - general principles
   - plant items
   - pipework and services
5. Quality assurance in design:
   - design control
   - document control
   - process control
   - training

Part II ***<u>Steam/Power Utilities</u>***

1. Steam raising equipment:
   - overall plant context
   - mainline boilers and package boilers (water-tube)
     - steam drum
     - superheaters
     - economiser
     - air heaters
2. Steam raising equipment: (continued)
   - fire-tube boilers
   - water treatment and de-aeration treatment
   - waste-heat boilers
   - combined cycles
3. Steam/Power systems:
   - provision of steam to process (heating and live steam injection, pressure control)
   - desuperheaters
4. Steam/Power systems: (continued)
   - calculation of available electric power generation
   - condensing/pass-out systems
5. Design constraints and allowances:
   - initial steam pressures and feed-water requirements
   - initial steam temperatures
   - moisture in condensing turbines
   - header systems and distribution allowances
   - boiler feed pumps and cavitation
6. Steam heating in process systems:
   - general system configurations
   - steam trapping and condensate removal
   - types of steam trapping equipment
7. Design and selection of steam trapping facilities:
   - steam trap selection
   - loading steam lines
   - management of condensate return

Part III ***<u>Safety Management Systems</u>***

1. Overview of safety management in designing and operating process systems:
   - Design - the specification of objects subject to constraints
     - physical constrains
     - legal and social constraints
     - economic constraints
     - insurance company rules
   - attitudes and OH&S
   - the track record of the process industries - the complexity and scale of modern process plants
   - some major incidents (Flixborough, Bhopal, Serveso, Piper Alpha)
   - duties of care (how often? how big? how careful?)
   - standards and codes
   - methodologies for hazard reduction (eg HAZOP and HAZAN)
   - inherently safe design concepts

   Tutorial Piper-Alpha video
2. HAZOP studies (background)
   - the need for a systematic means of identifying the hazards we create
   - preliminary hazard assessment at the conceptional design stage
   - the HAZOP study as design approaches completion
   - HAZOP as a team effort, the need for commitment and relevant knowledge and experience
   - HAZOP identifies problems – some solutions are obvious but most require further investigation
   - the structure of HAZOP meetings
3. Detailed outline of the HAZOP method:
   - continuous processes
   - batch processes
   - example
4. Introduction to fault trees:
   - the context and perceptions of risk
   - protective systems and the asymptotic approach to zero risk
   - the necessity to set risk targets (tolerable risk vs benefits desired), practicable reduction and reasonably practical reduction
   - the FAR (fatal accident rate) definition and statistical data
   - qualitative aspects of fault trees and the underlying assumptions
   - quantitative estimates of risk
5. Quantitative methods and fault tree reduction
   - classic laws of probability
   - Poisson processes and the exponential distribution
   - "AND"/"OR" combinations of events
   - concepts of system demand and protective systems failure (eg Hazard rate = demand rate x probability of coincident protective system failure)
   - fault tree reduction and minimum "cut sets" (Boolean algebra)
6. Protective systems and reliability
   - the "bath-tub" curve
   - the exponential distribution function and proof-testing
   - fail "danger"
   - definition of Fractional Dead Time (FDT)
   - multiple protective systems
   - the main sources of error in Hazard analysis
   - management aspects of protective systems
7. Process example of hazard analysis
   - fault tree exercise
8. Safe work permits:
   - general need
   - principles
   - equipment isolation and vessel entry
   - management

Industrial Liaison

In relation to lecture and tutorial material by academic staff, contact with external industrial practitioners is encouraged. The current program includes sessions provided by external specialists in the areas of Safety Management at the Plant and Enterprises level and in the Design of Protective Systems (Relief Systems, Trips etc.)

GRADUATE ATTRIBUTES:

- The 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 utilise a systems approach to design and operational performance.
- Ability to function effectively as an individual and in multi-disciplinary and multicultural teams; with the capacity to be a leader or manager as well as an effective team manager.
- Understanding the social, cultural, global and environmental responsibilities of the professional engineer, and the need for sustainable development.
- Understanding of professional and ethical responsibilities and commitment to them; and expectation of the need to undertake lifelong learning, and capacity to do so.
- Ability to focus on the integration of process safety considerations with environmental concerns, waste minimisation and control system specifications.
- Confidence to tackle real-world problems and issues central to engineering and to work as individuals and cooperatively in multidisciplinary and multicultural teams.
- Enthusiasm and interest for undertaking life-long learning and the continual updating of their engineering skills.

CHEM ENG 4018: INDUSTRIAL ECONOMICS & MANAGEMENT

Units: 2
Duration: *Semester 2*
Coordinator: *Associate Professor Brian O'Neill*
When: *Refer Timetable under Current Students in MyUni*

Aims

1. Section A: to introduce students to a variety of operations research tools.
2. Section B: to familiarise students with the tools required to evaluate the economics of projects.
3. Section C: to introduce students to the key strategies & functions of management.

Outcomes

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

1. understand the financing of projects and financial mathematics.
2. estimate the capital and operating costs of projects
3. understand the functions, problems and techniques available to project and production managers.
4. understand the techniques available for quality control
5. solve simple management problems using classic optimisation algorithms (e.g. linear programming, dynamic programming, etc.)

Textbook

nil

Syllabus

Section A - Operations Research

1. Decision Theory
   decision making under risk - expected value analysis, expected opportunity loss, expected value of perfect information, utility, subjective probabilities
   decision making under uncertainty - Laplace, Maximin & Hurwicz criteria, decision trees.
2. Dynamic Programming

Fundamental Concepts - Decomposition, optimality principle, decision variables, transition variables, stage returns, stage optimisation, recursion and the recursive return function. Applications - capital budgeting, production and inventory planning, routing problems.

3. Linear Programming
   Model formulation and examples, standard formulation, special cases.
   Simplex method:
   Tableau, computational process, examples
   Non-basic solutions
   Method of penalty, Big M method
   Duality and Sensitivity:
   Primal-Dual relationship
   Sensitivity of solution to changes in b_i and c_i
   Changes in constraint coefficients a_i
   Addition of new constraints or variables.
4. Integer LP Programming
   Problem formulation, nonlinear objective functions, constraint linearisation.
   Graphical approach
   Branch-and-Bound Method
   Examples: capital budgeting, location-allocation problems, fixed cost problems, curve approximation.
5. Multiple Objective Programming
   Goal Programming
   Model formulation, over and underachievement variables
   Weighted goals
   Decision variables, system constraints, goal constraints.
6. Geometric Programming
   The polynomial function
   Traditional engineering optimisation, degree of difficulty, constraint handling.

Section B -Topics for Industrial Economics and Management

1. Introduction to Accounting
   - types, functions, assumptions, doctrine
   - financial reporting, balance sheet, income statement, cash flow statement.
   - types and uses of financial ratios.
   - accounting issues - depreciation, revenue recognition, etc.
2. Types of business enterprise and their characteristics
   - types of capital (fixed, working)
   - sources of capital, including cost of raising
   - gearing
   - shareholder returns, imputation
   - cost of shareholders funds
3. Introduction to costs and economics
   - definition of costs and revenues including fixed, variable, marginal, incremental, sunk, etc.
   - break-even point
   - production costs - single, joint, byproducts
   - direct and indirect costs
   - allocation of indirect costs
   - simple economic concepts (micro and macro)
4. Costs continued
   - range of taxes levied on business
   - income tax
   - valuation of stocks
   - depreciation - defined and methods
   - capital gains
   - expense versus capital
   - dividend imputation

5 & 6 Financial Mathematics
   - interest rates - types and characteristics
   - concepts of discounting
   - present and future values of single payments and annuities

- equivalence concept (for present value)
- leasing
- equivalent interest rates
- continuous compounding and flat rate interest
- use of discount tables
- mortgage repayments, superannuation, evaluation

7. Capital and Operating Cost Estimation
   - types of capital cost estimate, accuracy range and cost to prepare
   - estimating terminology
   - methods of estimating cost
   - techniques - scaling factors, hand factors, price adjustment, escalation, inflation, overheads, overseas price adjustment
   - start-up and commissioning costs
8. Estimation of Operating Costs
   - methodology
   - sources of data
   - generalised methods
   - components of total labour costs

   Operating Cost Discussions
   - economic basis
   - methodology
   - worked examples
   - need to avoid sub-optimisation

9 & 10 Investment analysis
- investment defined
- payback methods (pre/post tax)
- NPV method
- IRR method
- advantages/disadvantages of methods
- multiple IRR solution problem
- capital rationing
- PWPI adaption of NPV method
- mutually exclusive projects - modifications to IRR method
- how to handle inflation
- risks associated with investment (technical/commercial)
- use of EMV type approach
- sensitivity analysis
- non-economic justification

11 & 12 Evaluation of Investments
- individual or differential analysis
- cash flow calculations
- worked examples
  - rent or buy, taxation rules, bid evaluation
  - different lives, acceleration projects.

13. Leases
    - types
    - financial leave advantages/disadvantages
    - case study
14. Problems continued
    - fix or repair (value of depreciation tax claim credits)
    - evaluation of minimum cost option to provide steam and power
15. Budgets
    - capital, operating
    - characteristics
    - how prepared.

    Project Life Cycle
    - describe process from initial concept through to final approval of project
    - case study
    - plant closure/shutdown economics
    - case study

- what you need to present to get projects approved in industry

16. Economic Analysis
    - what can go wrong
    - limitations
    - how to use
    - value of information

    Course overview

    Problem solving checklist

    Examination requirements and pitfalls

    Immediate and future value of ability to do sound economic analysis

Section C - Strategies and Functions of Management

1. Introduction
   General; Engineers as an initiator/supporter/resource
2. Historical perspective
   Scientific management; human relations movement; modern synthesis
3. Functions of management
   Traditional approach; directions of change
4. Planning
   Elements and process of planning; process plant business and operations planning; use of networks in project planning.
5. Control
   Elements and process of control; quality assurance/TQM/customer focus; statistical process control.
6. Leading
   Basics of motivation; leadership theories; changing role of managers/supervisors; issues - work ownership, realising full potential of employees; discussion - engineer as employee and as leader (?)
7. Organising
   Elements and process of organising; characteristics of structures, flexibility continuum; project teams and matrix structures; self directed teams.
8. Projects
   Characteristics of projects; key aspects of planning and controlling a project.
9. Communications
   Communications model; interpersonal communication skills; written communications; verbal communications and formal presentations.
10. Industrial Relations
    Brief history of unions in Australia; Australian Industrial Relations Commission; unions and employer organisations; resolution of disputes; current situation and trends.

Assessment:

Final Examination 100%

GRADUATE ATTRIBUTES:

- In-depth technical competence in at least one engineering discipline.
- Ability to utilise a systems approach to design and operational performance.
- Ability to function effectively as an individual and in multi-disciplinary and multicultural teams; with the capacity to be a leader or manager as well as an effective team manager.
- Understanding the social, cultural, global and environmental responsibilities of the professional engineer, and the need for sustainable development.
- Understanding of professional and ethical responsibilities and commitment to them; and expectation of the need to undertake lifelong learning, and capacity to do so.
- Ability to focus on the integration of process safety considerations with environmental concerns, waste minimisation and control system specifications.
- Confidence to tackle real-world problems and issues central to engineering and to work as individuals and cooperatively in multidisciplinary and multicultural teams.
- Enthusiasm and interest for undertaking life-long learning and the continual updating of their engineering skills.

CHEM ENG 4025 CHEMICAL ENGINEERING PROJECTS IV

Units: *2*
Duration : *Semester 1*
Lecturer: *Professor Mark J. Biggs*
When: *Refer Timetable under Current Students in MyUni*

Aims:

1. Fostering practical skills relevant to the discipline of chemical engineering
2. Further develop individual problem-solving and project management skills
3. Develop leadership, management and teamwork skills by performing work in small groups
4. Practice written and oral communication skills

Outcomes:

On successful completion of the course, you should be able to:

1. Appraise a practical situation and develop a requirements statement to meet a need demanded by that situation.
2. Demonstrate knowledge of safe laboratory practice.
2. Demonstrate an ability to work as part of a team.
3. Demonstrate an ability to plan and coordinate group work.
4. Demonstrate good verbal communication skills.
5. Demonstrate engineering report writing skills.

Content:

Overview:

Four projects from the following lists will be allocated to each group.

A.1	Fluidisation aerosol filtration	B.1	Solids flow
A.2	Pneumatic converging	B.2	Bubble formation
A.3	Cooling tower	B.3	Non-Newtonian fluid flow
A.4	Continuous thickener	B.4	Distillation column

Groups should elect a different project leader for each project. Before work commences, this person is expected to discuss with the Lecturer their preparation and plan for the projects and submit a report in the form on a **one-page memo** outlining the aims and objectives of the project, the principles involved, and the procedure to be followed. **T**he elected group leader is also responsible for leading the project, and for the preparation and submission of the project report, which must be submitted **by a date specified by the Lecturer**.

Except for the strict timetable to facilitate the organisation of the Chemical Engineering Laboratories, all projects may be considered to be open-ended. Groups are free to organise their own programmes and develop experimental methods and approaches as appropriate to their projects **within the time and resource limitations or the School**.

Assessment:

The project leader is assessed on organisational and managerial abilities as displayed in the planning stage and submitted one-page memo (10%) and on the submitted project reports (60%).

Team members are graded by their project leader according to their contribution to the projects (3 × 4% = 12% overall) and to the final report (3 × 6% = 18% overall).

The one-page memo and project reports are both graded on technical content (60%) and presentation (40%).

Key dates:

First week of Semester	Introduction and allocation of projects
Second week of Semester	First laboratory session commences

Graduate attributes:

- The 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 utilise a systems approach to design and operational performance.
- Ability to function effectively as an individual and in multi-disciplinary and multicultural teams; with the capacity to be a leader or manager as well as an effective team manager.
- Confidence to tackle real-world problems and issues central to engineering and to work as individuals and cooperatively in multidisciplinary and multicultural teams.
- Enthusiasm and interest for undertaking life-long learning and the continual updating of their engineering skills.

CHEM ENG 4026 CHEMICAL ENGINEERING RESEARCH PROJECTS (H)
CHEM ENG 4027 CHEMICAL ENGINEERING RESEARCH PROJECTS (N)

Units:	*2*
Duration :	*Semester 2*
Lecturer:	*Dr Ken Davey*
When:	*Refer Timetable under Current Students in MyUni*

Aims:
Students are required to:
1. Satisfactorily complete a research project of about 120 hours duration, including a written report on a topic specified by the School and supervised by an academic member of staff.
2. Present a poster and/or short seminar on their project results at the end of Semester 2.

The aims are to:
- Foster research skills
- Teach effective written communication
- Teach effective presentation skills

Assessment
An initial assessment of each student's work is made by the supervisor. A meeting of all project supervisors is then convened to:
a) Directly compare student submissions based on the initial assessment.
b) Rank all submissions and agree on a final mark.

The contribution of each of the elements of the final mark are:

Progress and final reports	85%
Poster and/or seminar presentation	15%

Content:
Students may select from two different styles of projects: (i) Traditional research projects and (ii) Applied research projects.

Key Dates:

Wednesday, 28 February 2009 (3:10 – 4.00)	Introduction and distribution of project list
Friday 9 March 2009	Project allocation

GRADUATE ATTRIBUTES:

- The 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 utilise a systems approach to design and operational performance.
- Ability to function effectively as an individual and in multi-disciplinary and multicultural teams; with the capacity to be a leader or manager as well as an effective team manager.
- Understanding the social, cultural, global and environmental responsibilities of the professional engineer, and the need for sustainable development.
- Understanding of professional and ethical responsibilities and commitment to them; and expectation of the need to undertake lifelong learning, and capacity to do so.
- Ability to focus on the integration of process safety considerations with environmental concerns, waste minimisation and control system specifications.
- Confidence to tackle real-world problems and issues central to engineering and to work as individuals and cooperatively in multidisciplinary and multicultural teams.

- Enthusiasm and interest for undertaking life-long learning and the continual updating of their engineering skills.

Level IV Electives

CHEM ENG 4002A/B: CHEMICAL ENGINEERING RESEARCH ELECTIVE II

Units value	*4.0*
Duration:	*Full Year*
Lecturer:	*Dr Peter Ashman*
When:	*Refer Timetable under Current Students in MyUni*

This subject may only be undertaken with the permission of the Acting Head of School

Students enrolling in this subject must be concurrently enrolled in CHEM ENG 4026: Chemical Engineering Research Project (H)

Aims

Students are required to:

1. Satisfactorily complete a research project of about 120 hours duration (in addition to the 120 hours allocated for CHEM ENG 4026) , including a written report on a topic specified by the School and supervised by an academic member of staff.
2. Present a poster and/or short seminar on their project results at the end of Semester 2.

The aims are to:

- Foster research skills
- Teach effective written communication
- Teach effective presentation skills

Assessment

The contribution of each of the elements of the final mark are:

Progress and final reports	85%
Poster and/or seminar presentation	15%

GRADUATE ATTRIBUTES:

- The 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 utilise a systems approach to design and operational performance.
- Ability to function effectively as an individual and in multi-disciplinary and multicultural teams; with the capacity to be a leader or manager as well as an effective team manager.
- Understanding the social, cultural, global and environmental responsibilities of the professional engineer, and the need for sustainable development.
- Understanding of professional and ethical responsibilities and commitment to them; and expectation of the need to undertake lifelong learning, and capacity to do so.
- Ability to focus on the integration of process safety considerations with environmental concerns, waste minimisation and control system specifications.
- Confidence to tackle real-world problems and issues central to engineering and to work as individuals and cooperatively in multidisciplinary and multicultural teams.
- Enthusiasm and interest for undertaking life-long learning and the continual updating of their engineering skills.
-

CHEM ENG 4004: MINERALS PROCESSING

Units value:	*2*
Duration:	*Semester 1*
Lecturer:	*Dr Themis Carageorgos*
When:	*Refer Timetable under Current Students in MyUni*

Assumed Knowledge:

Calculus I, II; Physics I, II, Basic notions of Statistics; Organic and inorganic chemistry.

Teaching Method:

- ✓ Theory will be presented along with examples and tutorial exercises**.**
- ✓ ***CLASS SLIDES AND TUTORIAL EXERCISES ARE POSTED IN MYUNI.***
- ✓ I will be at lectures and tutorials, so please contact me there if you have any questions or at my office under appointment (phone: 83038046). You are also encouraged to resolve your doubts after every lecture.

Assessment:
The course will be assessed with a weighting of 25% for each of two quizzes and 50% based on the result of the final exam.

Aims
Students successfully completing this course will be able to understand and use the principles involved in the concentration of minerals from ores, using the appropriate physico-chemical properties of the minerals. They will also be able to recover concentrates of different minerals and have a background in the fundamentals of main equipments design.

Course Synopsis:

The course gives the first principles that govern various unit operations in minerals processing along with examples to illustrate how fundamental principles can be used in real-world applications. The mass balance equations, required for all mining operations, are showed and also applied in several examples. The current equipments and operating practice are showed and explained.

Main features of mineral processing for practical engineer:

- ✓ Clear understanding of unit operations as crushing, grinding, classification, density-based separations, froth flotation, sedimentation and tailings disposal.
- ✓ Mass balance considerations for each unit operation in order to evaluate the outcome.
- ✓ Environmental considerations and greenhouse requirements.

Content:

1 – Introduction
2 – Ore Handling
3 – Flowsheets and Mass Balance
4 – Particle Size Analysis
5 – Crushing

6 – Grinding
7 – Classification: Screens
8 – Classification: Cyclones
9 – Gravity Concentration
10 – Magnetic and Electrostatic Separations
11 – Froth Flotation
12 – Flocculation & Thickening
13 – Filtration
14 – Drying
15 – Tailing Disposal and Environmental Considerations

Text books:

The textbooks indicated are:
1 - B.A. Wills, "Mineral Processing Technology", Butterworths / Heinemann, 1981 (ISBN 0750644508).

2 - "Principles of Mineral Processing", edited by Maurice C. Fuerstenau and Kenneth N. Han, SME, 2003 (ISBN 0-87335-167-3).

3 – "Minerals and Metal Extraction – An Overview", L.C. Woollacott and R.H. Eric, 1994, (ISBN: 1-874832-42-0).

GRADUATE ATTRIBUTES:

- The ability to apply knowledge of basic science and engineering fundamentals.
- In-depth technical competence in at least one engineering discipline.
- Confidence to tackle real-world problems and issues central to engineering and to work as individuals and cooperatively in multidisciplinary and multicultural teams.
- Ability to utilise a systems approach to design and operational performance.
- Understanding of professional and ethical responsibilities and commitment to them; and expectation of the need to undertake lifelong learning, and capacity to do so.
- Enthusiasm and interest for undertaking life-long learning and the continual updating of their engineering skills

CHEM ENG 4008: BIOCHEMICAL ENGINEERING

Point Value:	*2.0*
Duration:	*Semester 1*
Lecturer:	*Dr David Lewis*
When:	*Refer Timetable under Current Students in MyUni*

Aims

The aims of the course are to extend the knowledge of level III Chem Eng 3010 (6441) Introduction to Biochemical Engineering in the areas of Recombinant Technology, Fermentation, Quantitative Risk Analysis, Process Economics, Air Sterilisation, and Downstream Processing likely to be of use to practicing chemical engineers. Emphasis throughout is placed on problem solving and illustrative worked examples.

Outcomes:

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

1. Demonstrate an understanding of genetic engineering and recombinant technology.
2. Explain the role of biochemical engineering in biological process and biotechnology, with particular emphasis on bacteria and yeasts – in the food and fermentation industries.
3. Demonstrate an understanding of genetics and the role of recombinant cultures.
4. Explain the industrial and theoretical basis of air sterilization, mechanisms, mass transfer paths and equipment design.
5. Combine a knowledge of molecular characteristics of bioproducts and microbial interactions with that common unit operations.
6. Make design calculations for a number of fermentations.
7. Critically assess upstream operations on downstream operations of product recovery in fermentations.
8. Critically assess requirements for down stream processing in single and multistage operations.
9. Apply a Quantitative Risk Assessment (QRA) to at least one process unit operation.
10. Size, specify and design equipment for solid-liquid separations

Assessment

Tutorials	20%
Final Examination	80 % (2 h CB)

The final examination permits **a choice from a number of questions.** Please note that if more than the stipulated number is attempted **the lowest total mark** will be used for assessment.

Syllabus

1. *Review of Microbiology and Introduction to Genetic Engineering*: molecular genetics and protein synthesis, recombinant DNA and genetic engineering (1L).
2. *Recombinant Technology*: overview, essential steps, special enzymes (1L, 2T)
3. *Stability of Recombinant Micro-organisms*: defective segregation of plasmid, structural instability from mutations, methods of stabilisation, illustrative problem (1L)
4. *Fermentation Kinetics of Recombinant Cultures*: growth rate and fraction of plasmid-carrying cells, generation, Continuous Stirred Tank Fermenter (CSTG) (1L)
5. *Biological Process and Biotechnology Overview*: definitions, biochemical engineering, applications of biotechnology, four key-questions for process development and design, advantages/disadvantages of biological processes, fermentation (a definition), some journals covering areas of bioprocesses (1L)
6. *Air Sterilisation for Aerobic Fermentations*: typical rates and filter types, mechanisms, impaction, interception, diffusion, combined mechanisms, effect of multiple layers and packing, illustrative problem (1L)
7. *Agitation and Aeration* mass transfer path, basic mass transfer concepts, molecular diffusion, mass transfer coefficient, mechanism of mass transfer, correlation for mass transfer coefficient, illustrative problem (1L, 1T).
8. *Measurement of Interfacial Area*: photographic technique, light transmission technique, correlations, gas sparging with no mechanical agitation, gas sparging with mechanical agitation, gas hold-up, power consumption (1L, 1T)
9. *Determination of Oxygen-Absorption Rate*: design parameters for oxygen uptake, sodium suphite oxidation method, dynamic gasing-out, direct measurement, dynamic technique, correlations, bubble column, mechanically agitated vessel, illustrative problem (1L, 1T)
10. *Scale-up*: Similitude, geometric, dynamic, criteria of scale-up, criteria of agitation intensity, shear-sensitive mixing, illustrative problem (1L, 1T)
11. *Downstream Processing*: introduction, examples of bio-processing products, solid-liquid separation, filtration, centrifugation, cell rupture, physical methods, high pressure, ultrasonicator, chemical methods, surfactants, biological methods, recovery, extraction, single stage, multi stage, cross current extraction, counter current extraction, adsorption, adsorption isotherm, adsorption operation, single stage, multistage, fixed bed, purification, precipitation, chromatography, electrophoresis, membranes, illustrative problems (L, 2T)
12. *Quantitative Risk Assessment*: Illustrative Problem (2L, 1T)
13. *Microbial Interactions and Competition*: definitions, neutralism, commensalisms, mutalism (symbiosis), examples, competitions, microbial competition in a CSTF (chemostat), selection and competition in a CSTF, competition for growth-limiting substrate, effect of chemotaxis on competition, predation, stability of large food webs, illustrative problem (2L, 1T)
14. *Manufacture of Biological Products*: organic acids, alcohols and ketones, amino acids, antibiotics, vitamins, enzymes, therapeutic proteins, polysaccharides, single cell protein, insecticides (1L)

15. *Economic Analysis of Bioprocesses*: Capital and Manufacturing costs, manufacturing cost estimates, operating costs, fixed and overhead costs, illustrative problem (2L).
16. *Case Study*: (penicillin)/recombinant proteins (1L, 1T)

Texts

Blanch H W & Clark D S 1996 *Biochemical Engineering* Marcel Dekker NY.
Bailey J E & Ollis D F 1986 *Biochemical Engineering Fundamentals* 2nd Ed. (McGraw-Hill Kogakusha).

Recommended Reading

Biotechnology and Food Process Engineering 1990 (Ed. Schwartzberg H G & Rao M A) IFT Pub. Chicago USA..
Aiba S, Humphrey A E & Millis N F 1973 *Biochemical Engineering* 2nd Ed. University of Tokyo Press
Fryer P J, Pyle D L & Reilly C D 1997 *Chemical Engineering for the Food Industry* Blackie London.
Perry R H & Green D W *Perry's Chemical Engineer's Handbook* 6 th Edn. McGraw-Hill.
Stanier R Y, Doudoroff M & Adelberg E A *General Microbiology* 4th Edn. Mc Millan.

GRADUATE ATTRIBUTES:

- The ability to apply knowledge of basic science and engineering fundamentals.
- In-depth technical competence in at least one engineering discipline.
- Ability to communicate effectively, not only with engineers but also with the community at large.
- Confidence to tackle real-world problems and issues central to engineering and to work as individuals and cooperatively in multidisciplinary and multicultural teams.
- Ability to utilise a systems approach to design and operational performance.
- Understanding of professional and ethical responsibilities and commitment to them; and expectation of the need to undertake lifelong learning, and capacity to do so.
- Enthusiasm and interest for undertaking life-long learning and the continual updating of their engineering skills.

CHEM ENG 4020A/B: CHEMICAL ENGINEERING RESEARCH ELECTIVE

Units value	*2.0*
Duration:	*Full Year*
Lecturer:	*Dr Peter Ashman*
When:	*Refer Timetable under Current Students in MyUni*

This subject may only be undertaken with the permission of the Acting Head of School

Students enrolling in this subject must be concurrently enrolled in CHEM ENG 4026: Chemical Engineering Research Project (H)

Aims

Students are required to:

1. Satisfactorily complete a research project of about 60 hours duration (in addition to the 120 hours allocated for CHEM ENG 4026) , including a written report on a topic specified by the School and supervised by an academic member of staff.
2. Present a poster and/or short seminar on their project results at the end of Semester 2.

The aims are to:

- Foster research skills
- Teach effective written communication
- Teach effective presentation skills

Assessment

An initial assessment of each student's work is made by the supervisor. A meeting of all project supervisors is then convened to:

a) Directly compare student submissions based on the initial assessment.
b) Rank all submissions and agree on a final mark.

The contribution of each of the elements of the final mark are:

Progress and final reports	85%
Poster and/or seminar presentation	15%

GRADUATE ATTRIBUTES:

- The 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 utilise a systems approach to design and operational performance.
- Ability to function effectively as an individual and in multi-disciplinary and multicultural teams; with the capacity to be a leader or manager as well as an effective team manager.
- Understanding the social, cultural, global and environmental responsibilities of the professional engineer, and the need for sustainable development.
- Understanding of professional and ethical responsibilities and commitment to them; and expectation of the need to undertake lifelong learning, and capacity to do so.
- Ability to focus on the integration of process safety considerations with environmental concerns, waste minimisation and control system specifications.
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- Enthusiasm and interest for undertaking life-long learning and the continual updating of their engineering skills.

CHEM ENG 4021 Combustion Processes (Chemical Engineering) MECH ENG 1621 Combustion Technology and Emissions Control (Mechanical Engineering)

Units:	*2*
Duration:	*Semester 1*
Subject co-ordinator:	*Dr Peter Ashman*
Other Lecturers:	*Dr Zeyad Alwabahi, Dr Gus Nathan, Dr Bassam Dally,*
When:	*Refer Timetable under Current Students in MyUni*

Aim:

To equip students with the necessary knowledge and skills to understand and analyse the design and performance of modern combustion systems with a view to maximising output and minimising air pollution

Outcomes:

The aim of the subject is to equip students with the necessary knowledge and skills to understand and analyse the design and performance of modern combustion systems with a view to 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 areodynamics and fuel properties. It will cover issues involved in understanding the fundamentals of combustion science, selection of fuel and fuel alternatives, the design principals involved in reducing pollutant emissions and safety consideration. It will assess major combustion systems and various modelling techniques and predictive tools which can be used to design combustion systems.

Assessment:

Assessment is principally by examination (60%), with the remaining marks allocated for submitted tutorials, assignments and design exercises (40%). The examination is 2 hours duration and will be open book. A design exercise, conducted during the later half of the semester, will form a significant fraction of the non-exam assessment for this subject.

Textbook:

There is no single textbook that covers all of the material covered in this course. However the text "An Introduction to Combustion" by Steven R Turns, is recommended as being a good value text that covers much of the relevant material.

Syllabus

- **Introduction:** The role of combustion in society and the transition toward sustainability;
  - Applications and industrial systems
  - The different stages of combustion: volatile release/gas combustion, char burning, residual ash
  - The key properties on which combustion depends: temperature, mixture-ratio
-
- **Stoichiometry & Thermochemistry:** Basic chemical reactions, energy release and temperatures.
- **Premixed Flames:** Laminar premixed flames; flame speed; stabilisation & quenching; turbulent premixed flames;
- **Nonpremixed Flames:** Laminar nonpremixed flames; Stabilization; theoretical descriptions
- Flame length; turbulent nonpremised flames; flame stability;
- **The Complementary Roles of Scaling, Modelling and Measurements:**
  - Why are models necessary?
  - Why are measurements necessary?
  - Why developing industrial models requires measurements and models in different scale systems.
  - Different methods of scaling and their application to industrial combustion systems.
  - Approaches to modelling of industrial systems.
  - What do measurements reveal about turbulent flames.
  - Approaches to measurements: the complementary role of probes and laser techniques.
- **Heterogeneous Combustion**
  - An introduction to the properties of coal affecting combustion performance:

- Fuel handling issues for liquid and solids fuels;
- **Process Efficiency**
  - Mass and Energy Balances:
  - Fundamentals of design of real combustion systems.
- **Explosions:**
  - Characteristics of gas, oil vapour and dust explosions.
  - Secondary explosions – causes of casualties in explosion
  - Dust fires
  - Explosion protection
- **NOx Formation and control of other pollutants:**

GRADUATE ATTRIBUTES:

- The 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 utilise a systems approach to design and operational performance.
- Ability to function effectively as an individual and in multi-disciplinary and multicultural teams; with the capacity to be a leader or manager as well as an effective team manager.
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- Ability to focus on the integration of process safety considerations with environmental concerns, waste minimisation and control system specifications.
- Confidence to tackle real-world problems and issues central to engineering and to work as individuals and cooperatively in multidisciplinary and multicultural teams.
- Enthusiasm and interest for undertaking life-long learning and the continual updating of their engineering skills.

Instructions to Undergraduate Students Working in Undergraduate Laboratories

General

The University of Adelaide recognises its obligation to take all reasonable precautions to safeguard the health, safety and welfare of its employees and students while they are at work. The University of Adelaide also believes that students leaving this University must take with them an attitude that accepts good health and safety practice as normal. To this end, University Laboratory Conduct Procedures have been developed and where practical must be adhered to by all that work in School laboratories. It is strongly recommended that new students and research workers familiarise themselves with the University Laboratory conduct procedures and view the film entitled "Safety in Laboratories" available from the Occupational Health & Safety Unit.

Persons who fail to comply with these procedures may be prohibited from working in laboratories.

The University procedures should be read in conjunction with the Australian Standard 2243, "Safety in Laboratories", Parts 1 to 10 inclusive. Australian Standards can be accessed via a link through the Barr Smith Library.

The School acknowledges the University Laboratory Conduct Procedures and recognises the specific requirements of chemical engineering laboratories. With this in mind the department has formulated specific laboratory regulations which reflect the particular nature of its laboratories. Laboratory users are reminded that these School procedures are in addition to the Universities requirements.

Engineering North Emergency Procedures

R.A.C.E

*** Remove**
*** Alert**
*** Contain**
*** Evacuate**

Immediately upon discovering a fire or other emergency

1. Remove Others.

Do not put yourself or others at risk.

2. Alert Others

Sound the Alarm.
Break glass type alarm points are situated in the corridors.
Telephone for Help. *RING 35444*
Explain location and extent of fire or emergency.
AFTER HOURS An emergency telephone is located on the ground floor of the north engineering building near the main southern entrance. (Marked X on the evacuation map.)

3. Contain the Emergency

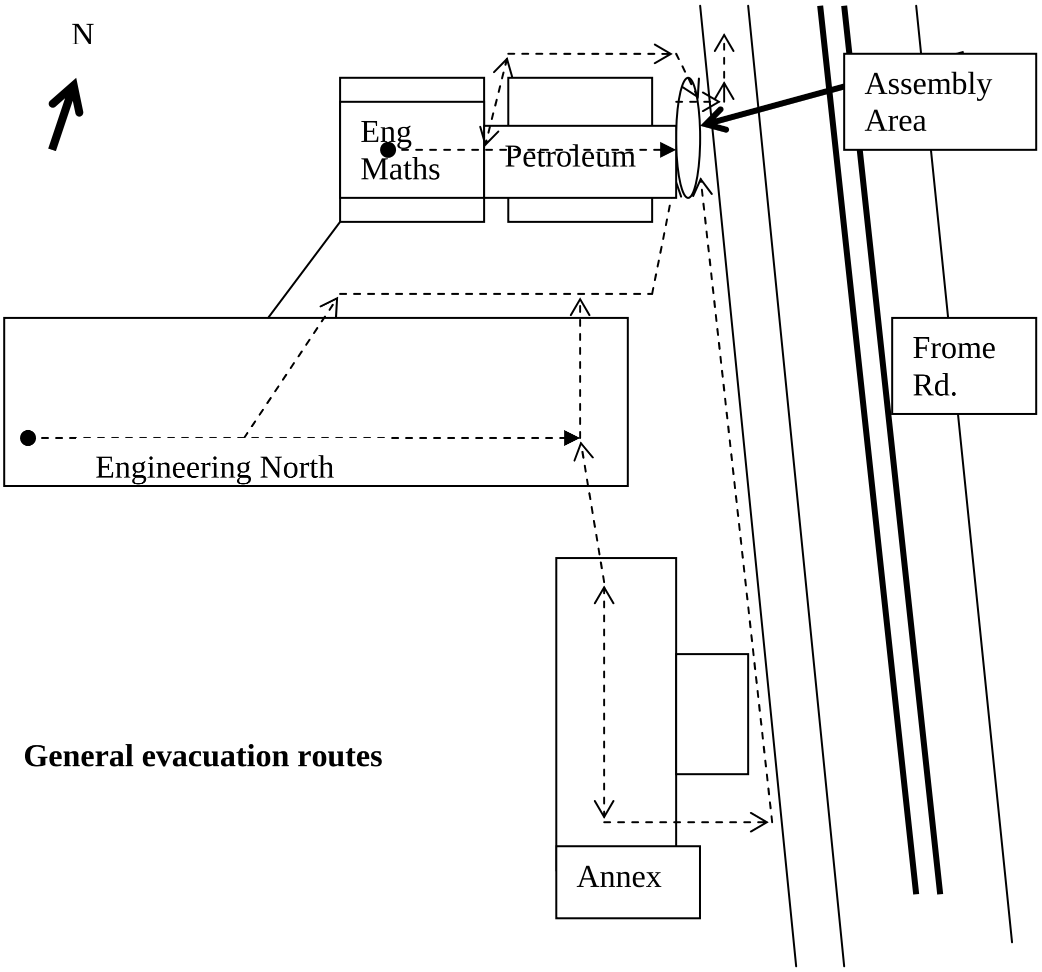
Fight the fire ONLY if safe to do so. Do not put yourself or others at risk.

4. Evacuate

The evacuation alarm will sound firstly as a "**Beep-Beep"** sound. This is the alert phase. You should prepare to evacuate by making your area safe. This means switching of equipment and collecting your personal belongings. The alert phase will then change to the evacuate phase which is a "**Whoop- Whoop"** sound. This will be accompanied by a verbal instruction.
This means ALL occupants MUST EVACUATE.
Proceed via the safest route to the assembly area. Take your personal effects, keys, bags, etc. with you as you may not be able to re enter the building. Follow Exit Signs or the directions of wardens in red hats.
DO NOT RE-ENTER THE BUILDING until permitted to do so by authorised persons.

Assembly Area

*All occupants **must** assemble on the School of Petroleum Engineering gardens with overflow onto Frome Road footpath under instructions from wardens.*



General evacuation routes

BOMB THREAT PROCEDURE
(Endorsed by University Council April 1995)

NOTIFY security on 35444 and the supervisor of the area.

FOLLOW the instructions of the wardens in red hats.

SCHOOL EQUITY POLICY

The school of Chemical Engineering has an Equity, Diversity and Sexual Harassment Policy. The policy is a statement of the school's commitment to providing a workplace for all staff, students and visitors that is free from harassment and bullying, deals with all people in a fair and equitable way and respects the diversity of peoples who engage with the department. The school has a Equity Officer who is trained in equity, diversity and anti-harassment matters and who may be consulted at any time to confidentially assist in matters of concern.

The School equity officer is Andrew Wright, Room N115, North Engineering Building