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| CHPR4401 and CHPR4402  Chemical Engineering Design Project  Part 1 and 2  Dr Matt Hardin |

School of Mechanical Engineering  
Faculty of Engineering, Computing and Mathematics

**UNIT OUTLINE**

**Semester 1 2010**

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ESSENTIAL ADMINISTRATIVE INFORMATION

|  |  |
| --- | --- |
| **Unit Title** | Chemical Engineering Design Project Part 1 and 2 |
| **Unit Code** | CHPR4401 and CHPR4402 |
| **Unit Coordinator** | Dr Matt Hardin |
| **School** | Mechanical Engineering |
| **Credit Value** | 12 (Each Part is worth 6) |
| **Additional requirements** | Nil |
| **Handbook Website** | http://units.handbooks.uwa.edu.au/units/chpr/chpr4401 |
| **Unit Website** | Access is via WebCT |
| **Faculty or School Website** | Nil |
| **Contact Hours** | Lecture: 3-6 Tuesdays in G11 (Both parts)  Consultation: as required with lecturer |

## Important Notice

The Unit Outline (this document) gives the student important information about the unit, its aims, outcomes, materials, programme and assessment.

Note that important information relating to policies, examinations, expectations, copyright, referencing, academic misconduct assistance with communication skills is available on the Faculty website though <http://www.ecm.uwa.edu.au/studentnet/exams> .

You are required to be aware of and fulfill your responsibilities under the University’s rules, policies and procedures so it is important that you review the content of these in detail.

UNIT COORDINATOR

Every unit has a person who is responsible for the overall administration of that unit. This person is the Unit Coordinator. If you cannot contact the person who is teaching you or if you have further queries about this unit, you may wish to contact the Unit Coordinator for this unit. Their contact details are below: [insert only the details required]

|  |  |  |
| --- | --- | --- |
|  | **Unit Coordinator:** | Dr Matt Hardin |
| **Email:** | math@mech.uwa.edu.au |
| **Phone:** | 6488 7153 |
| **Fax:** | N/A |
| **Building:** | Mechanical Engineering |
| **Room:** | 2.01c |
|  | **Contact Hours:** | As required and by appointment |

TEACHING STAFF

The lecturer(s) for this unit and their contact details are below:

|  |  |  |
| --- | --- | --- |
| Insert Photo here if available | **Your lecturer:** |  |
| **Email:** |  |
| **Phone:** |  |
| **Fax:** |  |
| **Building:** |  |
| **Room:** |  |
|  | **Contact Hours:** |  |

|  |  |  |
| --- | --- | --- |
| Insert Photo here if available | **Your lecturer** |  |
| **Email:** |  |
| **Phone:** |  |
| **Fax:** |  |
| **Building:** |  |
| **Room:** |  |
|  | **Contact Hours:** |  |

To contact your lecturer or tutor, please use email. Allow for a response time of 2 working days.

INTRODUCTION

This is the capstone unit for the Chemical Engineering Degree. It will allow you to bring together much of your previously learnt engineering knowledge on a real, practical problem. It contributes 12 points of the whole year assessment.

The Institution of Chemical Engineers (IChemE) and the Institution of Engineers Australia (IEAust) also place a high priority on this subject as part of your entry into the profession.

The project is also quite different to the majority of subjects that you have done over the past three years. It is a team effort and open ended.

Many problems you have faced in your course so far are artificially contrived with the solution known to the instructor. In the industrial world you will normally work as a team on open-ended projects where communication amongst members is vital. There is no ''right'' solution! - just the "best" solution in the time available.

One of the goals of this subject is to introduce you to such a work process. The staff will endeavour to give advice and support to you as you proceed in the project. The group will be managed by its members. There needs to be a leader who co-ordinates activities. It is the responsibility of the group members to ensure that the project progresses at an appropriate rate. Good communication within the group is essential and this will be reflected in your final mark. It will show your efforts at teamwork and your ability to communicate your design to academic staff, tutors and engineering consultants.

LEARNING OUTCOMES

On successful completion of this unit you will be able to:

1. Compare different processes for meeting design brief specifications
2. Develop a series of unit operations and unit processes to achieve the chosen overall process
3. Size and design equipment to carry out the above unit operations and unit processes
4. Conduct a detailed mechanical design of a piece of processing equipment
5. Develop and justify a control scheme for a chosen process
6. Prepare and present P&IDs and PFDs to a professional standard
7. Carry out economic, risk, safety and environmental analysis of a chosen design
8. Present results of a team or individual process in a clear written format.

LEARNING ACTIVITIES

This is problem based unit. You will be presented with a design brief and asked to submit a total of eight written reports. Continuous assessment and feedback is provided to enhance learning. The first seven assignments guide you through the design process and build upon each other leading to a final package to be submitted at the end of the year. The final package covers the whole project from process selection through equipment selection, sizing and mechanical design to an analysis of the safety, environmental impact and economics of the proposed design.

The first seven assignments are marked promptly and then discussed in hour long, team based meetings to give you feedback on the technical and non-technical (e.g. presentation) quality of their submissions. These meetings are in addition to any other consultation. As the assignments depend on each other this feedback was necessary to ensure that errors were not propagated throughout the year and improvements can be made in both technical and non-technical aspects of the design.

Lectures will be given throughout the semester to ensure that you have the necessary framework to complete your project.

STUDENT FEEDBACK

We welcome your feedback as one way to keep improving this unit. Later this semester, you will be encouraged to give unit feedback through ***SURF***, UWA’s online student feedback system. Recent changes to this unit in response to student feedback include:

1. Material is organised better on the WebCT site.
2. Team membership takes into account the final year thesis demands of students.
3. The collaboration with environmental has altered so that they are working off the chemical design rather than the other way round.
4. Fixed up ratios of marks to better reflect difficulty of different submissions.

TEXT BOOK & RESOURCES

## Recommended Texts:

You do not have to purchase the following textbooks but you may like to refer to them.

* IChemE (2000) *A Guide to Capital Cost Estimating*, 4th Edition, IChemE.
* Perry, R.H. & Green, D. (2007) *Perry’s Chemical Engineer’s Handbook*, 8th Edition, McGraw-Hill.,
* Ulrich, G.D. (1984) *A Guide to Chemical Engineering Process Design and Economics*, Wiley
* Peters, M.S. & Timmerhaus, K.D. (1991) *Plant Design and Economics for Chemical Engineers*, 4th Edition, McGraw-Hill,
* (2002) *Ullman’s Encyclopaedia of Chemical Technology*, 6th Edition, Wiley-VCH.
* (2001) *Kirk-Othmer Encyclopaedia of Chemical Technology*, 4th Edition, Wiley.
* Lewis, R.J. (1997) *Sax’s Dangerous Properties of Industrial Materials, 6th ed*, Van Nostrand Reinhold.
* CCPS (1989) *Guidelines for Chemical Process Quantitative Risk Analysis*, Center for Chemical Process Safety (CCPS) of the AIChE.
* LeVine, R. (1988) *Guidelines for Safe Storage and Handling of High Toxic Hazard Materials*, Center for Process Safety of the AIChE.
* OSHA (1990) *OSHA Regulated Hazardous Substances: Health, Toxicity, Economic and Technological Data*, U.S. Dept. of Labor.
* Roach, S.A. (1992) *Health Risks from Hazardous Substances at Work: Assessment, Evaluation and Control*, Pergamon.
* Coulson, J.M., Richardson, J.F. *Chemical Engineering –Volumes 1- 6,* Butterworth Heinemann (actually many authors and years but identifiable by the series title)

## Technical Requirements

* Nil

## Software Requirements

* Nil

ASSESSMENT DETAILS

## Assessment Mechanism

The assessment for this unit consists of the following items. The figure in brackets is the percentage of the mark for the whole project i.e. the two units.

|  |  |  |  |
| --- | --- | --- | --- |
| **Assessment Tasks** | **Worth** | **Due** | **Unit Learning Outcome Assessed** |
| 1 Scoping Report (Team written report) | 10 (5%) | 12 March 2010 | 1,8 |
| 2 Mass and Energy Balance and Process Selection (Team Written Report ) | 20 (10%) | 13 April 2010 | 1,2,6,8 |
| 3 Equipment Specification (Team Report with Individual Sections) | 15 (7.5%) | 12 May 2010 | 3,8 |
| 4 Final PFD Mass and Energy Balance(Team Seminar and Executive Summary) | 15 (7.5%) | 28 May 2010 | 1,2,6,8 |
| 5 Detailed equipment design (Individual Report) | 10 (5%) | 6 August 2010 | 3,4,8 |
| 6 Control and Instrumentation (Team Report with Individual Sections) | 20 (10%) | 10 September 2010 | 5,6,8 |
| 7 Economic, Environmental and Safety analysis (Team Report with Individual Sections) | 30 (15%) | 1 October 2010 | 1,7,8 |
| 8 Final Submission (Team Report and Seminar) | 80 (40%) | 22 October 2010 | 1,2,3,4,5,6,7,8 |
| TOTAL | **100%** |  |  |

Full marking sheets will be available on the WebCT site. All assessment is due at 2:00 PM on the due date. It must be submitted to the lecturer or to a person nominated by the lecturer. If this is not possible for some reason the assignment must be submitted to the School of Mechanical Engineering Office andbe time stamped. Work received after 2:00 PM without prior permission will be marked for feedback purposes but will have a score of zero recorded.

The assessment is as follows:

**SEMESTER 1**

Assessment item 1

This is a literature review on known processes that will perform the desired task. Process routes, environmental and safety issues, capacity limitations and economic issues are to be evaluated. This is a team report of approximately 5000 words. It is worth 5% of the total marks for the course.

Assessment item 2

This submission details your process selection, team planning and mass and energy balances. You will identify key process parameters, explain design decisions, present your mass and energy balances in the form of a process flow diagrams and tables giving property data for all components and streams and give an evaluation of process variability and utility requirements. This is a team report of maximum 15 pages (including drawings). It is worth 10% of the total marks for the course.

Assessment item 3

This is the specification for all of the equipment in your section. For each piece of equipment you will be required to list it in an equipment schedule (1 page), give the basis of selection, basis for the shortcut design such as residence time, heat load, throughput, product quality, operating P and T, etc. The shortcut design is to give the size of equipment and a simple outline sketch of the equipment. The foregoing are all individual tasks. Your final PFDs will need to be presented, these will be allocated a team mark i.e. every member of the team will get the same mark. PAFs are required for team management but will not modify your marks for this submission. It is worth 7.5% of the total marks for the course.

Assessment item 4

This submission is an executive summary of your design (maximum 20 pages) detailing the process chosen the types of equipment chosen, the mass and energy balance, the utilities requirements and other relevant engineering decisions. It will allow the reader to fully understand your decisions up to this point and serve as the basis document for your further detailed design in second semester. In addition, a 20 minute presentation (10 minutes for questions) of the summary will be given to your class members. Other members of the academic staff will be present. This presentation will be graded separately by all staff present as well as your peers. The criteria for the oral presentation will be the same as the written with the multiplier based on the quality of the oral presentation (e.g. slides, clarity, organisations etc.). The written component will count 70% and the oral 30%. It is worth 7.5% of the total marks for the course.

**SEMESTER 2**

Assessment item 5

This is a detailed equipment design of one piece of equipment including drawings. A PAF is required with this assessment for team management purposes but it will not affect the mark. It is worth 5% of the total marks for the course.

Assessment item 6

This is the summary of your control and instrumentation system. It includes a detailed specification of each control loop and a detailed P and ID for each section. There will be a 2 page summary of the overall control strategy and philosophy in addition to the individual sections. The control loops will also be evaluated across all of the sections to ensure that they do not conflict in any way. PAFs are required for team management but will not modify your marks for this submission. All team members will get the same team mark. It is worth 10% of the total marks for the course.

Assessment item 7

This report is a complete economic, safety and environmental analysis of the design. The economic analysis includes estimated capital and operating costs, sensitivity analyses and economic projections of performance for the purpose of decision making. The safety analysis will include major hazards associated with the design (chemical, physical and electrical) and how these have been mitigated (either in the design or the operation). The environmental analysis will describe the environmental impacts of the design and operation of the plant and describe how these have been mitigated. This is a team submission. PAFs will modify the overall marks. It is worth 15% of the total marks for the course.

Assessment item 8

This report is an overall summary of the complete design and analysis. It will have all of the material produced up to now and additional material as specified on the unit website. It is worth 40% of the unit marks.

**Peer Assessment Forms**

Every student must complete and submit a peer assessment form with every assignment. The use of these forms will be explained in the first lecture. Failure to submit a form will result in a penalty.

## Referencing Style

Students should use the Harvard referencing style when preparing assignments. More information can be found on this style from the Library web site: http://www.library.uwa.edu.au/help/education,\_training\_\_and\_\_support\_relevant\_to\_your\_faculty/faculty\_of\_engineering,\_computing\_\_and\_\_mathematics

## Assignment Marking

Assignments will be marked promptly and a feedback meeting with the team will be held in the following working week with the marker. It is up to the team to organise the time for this meeting and ensure that all team members are present.

This unit’s marks may be scaled in line with the Faculty of Engineering. Computing and Mathematics policy on Assessment Practices and Procedures. For more information see http://www.ecm.uwa.edu.au/for/students/assess

## Academic Conduct

### Academic Conduct Essentials

It is a University requirement that all newly enrolled students complete a short compulsory online unit called Academic Conduct Essentials (ACE) within the first 10 weeks of semester. ACE can be accessed via WebCT (<http://webct.uwa.edu.au/webct/entryPageIns.dowebct> ).

To find out more about Academic Integrity, look at these great resources:

* Student Services, who run workshops on Academic Integrity <http://www.studentservices.uwa.edu.au/ss/learning>
* http://www.ryerson.ca/academicintegrity/index.html , a series of flash videos from a Canadian University exploring Academic Integrity
* http://www.lc.unsw.edu.au/onlib/plag.html which takes you to an on-line quiz where you test your understanding of plagiarism, and where there are links to other universities’ academic integrity pages.

### Plagiarism Monitoring - (include this section if it applies)

Some (or all) assessments in this unit will be monitored for plagiarism using Turnitin plagiarism detection service (see <http://turnitin.com>). Students who do not want assignments retained in the Turnitin database, must lodge a special request prior to the submission date. For further advice see

STUDENTS’ RIGHTS AND RESPONSIBILITIES

It is the responsibility of every student to be aware of all relevant legislation, policies and procedures relating to their rights and responsibilities as a student. These include:

* the Student Charter,
* the University’s Guiding Ethical Principles,
* the University’s policy and statements on plagiarism and academic integrity,
* copyright principles and responsibilities,
* the University’s policies on appropriate use of software and computer facilities,
* the use of calculators in exams
* students’ responsibility to check enrolment,
* deadlines, appeals, and grievance resolution,
* student feedback,
* other policies and procedures
* electronic communication with students

See <http://www.secretariat.uwa.edu.au/home/policies/charter> and <http://www.ecm.uwa.edu.au/studentnet/exams> for comprehensive information on all of the above.

Faculty Policy for Appeals: If you believe that the assessment of a piece of your work does not reflect its worth, and if that piece of work contributes to your final assessment, you may formally appeal against the assessment. For more information about the faculty policy for appeals, see http://www.ecm.uwa.edu.au/for/students/exams

The Student Guild employs a number of Education Officers who provide information, support and advocacy with a range of academic matters <http://www.guild.uwa.edu.au/home/student_assistance/academic_help> . or

**Guild Student Centre**

Opening Hours: 8.30am - 5.00pm, Monday to Friday  
Location: Ground floor, Guild Village, near Bankwest ATM machine.  
Mailing Address: M300, 35 Stirling Highway, Crawley Western Australia 6009  
Phone: +61 8 6488 2295  
Fax: +61 8 6488 1200  
Email (general): [enquiries@guild.uwa.edu.au](mailto:enquiries@guild.uwa.edu.au)  
Email (confidential): education@guild.uwa.edu.au

ADDITIONAL INFORMATION

## Telephone Contacts:

If you have a query relating to administrative matters such as:-

* requests for deferment of study
* difficulties with accessing online study materials
* obtaining assessment results

Please contact your Unit Coordinator.

If you have a query relating to other matters such as:-

* missed assessments
* missing part of Semester
* being considered for special consideration

Please contact the Faculty Reception:

6488 3061

enquiries-ecm@admin.uwa.edu.au

Location: 2nd Floor, Electrical Engineering Building, Fairway Entrance No 3; Carpark No 15 (see: <http://www.uwa.edu.au/campus_map?id=1891> <http://www.uwa.edu.au/campus\_map?id=1891> for a Google interactive map)"

UNIT SCHEDULE

**Note**: The intended schedule for this unit is shown in the table below. The schedule is to be used as a guide and is subject to change.

### Semester 1 2010

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **WEEK** | **DATE** | **MODULE/CHAPTER/TOPIC:** | **ASSESSMENT** | **DUE DATE** |
|  | **22 Feb** | Introduction to Unit. Teams and Team building. |  |  |
|  | **1 March** | Background to Project. Process evaluation. Project Management. |  |  |
|  | **8 March** | Report writing. Preparing PFDs | Submission 1 | 12/3/10 |
|  | **15 March** | Consultation |  |  |
|  | **22 March** | Consultation |  |  |
|  | **29 March** | Consultation |  |  |
|  | **5 April** | Easter Break | |  |
|  | **12 April** | Shortcut Design | Submission 2 | 13/4/10 |
|  | **19 April** | Shortcut design II. Materials Selection. |  |  |
|  | **26 April** | Consultation |  |  |
|  | **3 May** | Consultation |  |  |
|  | **10 May** | Consultation | Submission 3 | 12/5/10 |
|  | **17 May** | Consultation |  |  |
|  | **24 May** | Presentation by Students | Submission 4 | 28/5/10 |
|  | **31 May** | Study Week | |  |
|  | **7 June** | Examinations – None for this Unit | |  |
|  | **14 June** | Examinations – None for this Unit | |  |

### Semester 2 2010

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **WEEK** | **DATE** | **MODULE/CHAPTER/TOPIC:** | **ASSESSMENT** | **DUE DATE** |
|  | **26 July** | Detailed Design |  |  |
|  | **2 August** | Detailed Design | Submission 5 | 6/8/10 |
|  | **9 August** | Control Loops and PandIDs |  |  |
|  | **16 August** | Risk Assessment and FMEA |  |  |
|  | **23 August** | Economic analysis |  |  |
|  | **30 August** | Environmental Impact Assessment |  |  |
|  | **6 September** | Consultation | Submission 6 | 10/9/10 |
|  | **13 September** | Study Break | |  | |
|  | **20September** | Plant Layout and HAZOP |  |  |
|  | **27 September** | Consultation | Submission 7 | 1/10/10 |
|  | **4 October** | Consultation |  |  |
|  | **11 October** | No Classes |  |  |
|  | **18 October** | No Classes | Submission 8 | 22/10/10 |
|  | **25 October** | No Classes |  |  |
|  | **1 November** | Study Week | |  | |
|  | **8 November** | Examinations – None for this Unit | |  | |
|  | **15 November** | Examinations – None for this Unit | |  | |