CHEN90019 Advanced Heat & Mass Transport Processes

Credit Points:	12.5
Level:	9 (Graduate/Postgraduate)
Dates & Locations:	2015, Parkville This subject commences in the following study period/s: Semester 1, Parkville - Taught on campus.
Time Commitment:	Contact Hours: An average of 4 hours of lectures per week + 1 x four hour laboratory class per semester Total Time Commitment: Estimated 200 hours
Prerequisites:	Students must have completed the following subject (or equivalent) prior to enrolling in this subject:

Subject	Study Period Commencement:	Credit Points:
CHEN30005 Heat and Mass Transport Processes	Semester 1, Semester 2	12.50

Corequisites:	None
Recommended Background Knowledge:	None
Non Allowed Subjects:	None
Core Participation Requirements:	For the purposes of considering applications for Reasonable Adjustments under the Disability Standards for Education (Cwth 2005) and Students Experiencing Academic Disadvantage Policy, this subject requires all students to actively and safely participate in laboratory activities. Students who feel their disability may impact upon their participation are encouraged to discuss this with the Subject Co-ordinator and the Disability Liaison Unit http://www.services.unimelb.edu.au/disability/
Coordinator:	Prof Ray Dagastine
Contact:	Email: **rrd@unimelb.edu.au (mailto:rrd@unimelb.edu.au)**

Subject Overview:

AIMS

This subject provides an advanced focus on the heat and mass transport processes that are part of the core knowledge and problem solving skills basis for chemical engineering unit operations. In addition, an advanced understanding of these transport processes will help enable students in the design of larger scale chemical engineers processes, particularly in the capstone deign project subject) as well as in chemical product design.
The heat and mass transport processes covered in this subject include: diffusion/mass transfer, mass transfer with chemical reaction, mass transfer coupled with adsorption, conduction and radiation. The process will are applied to the design of separation unit operations including multi-component distillation, adsorption, solvent extraction, gas-liquid contactors with reactions. A number of problems in practical heat transfer scenarios involving condition and radiation are include as well.
The unit operations covered in the subject using the above processes include: Multicomponent and azeotropic distillation, including short cut and rigorous techniques for the prediction of column performance. Applications of liquid extraction, liquid-liquid equilibria; single-stage extraction, choice of solvent/feed ratio; continuous counter-current multistage extraction and the effect of axial dispersion. Adsorption and ion exchange - types of absorbents, fixed bed adsorber models, isothermal equilibrium and non-equilibrium design and operation. Application of mass transfer with reaction to equipment performance and design in gas-liquid contactors.

INDICATIVE CONTENT

	The heat and mass transport processes covered in this subject include: diffusion/mass transfer, mass transfer with chemical reaction, mass transfer coupled with adsorption, conduction (including: Fourier's Law of heat conduction; multi-dimensional heat transfer equations; steady-state heat conduction and the Laplace equation; steady-state conduction with distributed heat source and the Poisson equation; simplified equation for steady-state heat conduction; fins; transient heat conduction and the diffusion equation; examples of simple solution of transient heat conduction; brief introduction to numerical methods for heat conduction problems) and radiation (basic principles of radiation; shape factors (viewfactors); radiation between grey surfaces in the network approach; applications of networks for various situations). The unit operations covered in the subject using the above processes include: Multicomponent and azeotropic distillation, including short cut and rigorous techniques for the prediction of column performance. Applications of liquid extraction, liquid-liquid equilibria; single-stage extraction, choice of solvent/feed ratio; continuous counter-current multistage extraction and the effect of axial dispersion. Adsorption and ion exchange - types of absorbents, fixed bed adsorber models, isothermal equilibrium and non-equilibrium design and operation. Application of mass transfer with reaction to equipment performance and design in gas-liquid contactors.
Learning Outcomes:	**INTENDED LEARNING OUTCOMES (ILO)** On completion of this subject the student is expected to: 1 Apply the principles of heat transfer to conduction and radiation heat transfer problems 2 Analyse and design separation operations including adsorption and ion exchange, multicomponent distillation, solvent extraction, and gas-liquid contactors 3 Use Aspen to design multi-component and azeotropic distillation separations 4 Apply heat and mass transfer process principles to scenarios other than unit operations 5 Predict simple temperature profiles in reacting systems 6 Ability to apply knowledge of basic science and engineering fundamentals 7 Ability to undertake problem identification, formulation and solution
Assessment:	A written 1-hour mid-semester test (20%); held on or around week 6. Intended Learning Outcomes (ILOs) 2 to 6 are addressed in the mid-semester test Up to five problem sets (20%); distributed across the semester. Overall time commitment of approximately 25-30 hours. ILOs 1 to 6 are addressed in the problems sets One end-of-semester written 3-hour exam (60%). ILOs 1 to 6 are addressed in exam. The examination paper will consist of problems designed to test whether the student has acquired the ability to apply fundamental principles to the solutions of problems involving heat and mass transfer processes and unit operations. Most of the problems set for the exam will be similar in style to those undertaken during the problem sets and online tutorials, but some problems will require the student to show that they can extend themselves beyond the level examples of problems they have already seen. Hurdle requirement: An overall mark of 50% and a mark of 40% or more in the end of semester examination are required to pass the subject
Prescribed Texts:	None
Breadth Options:	This subject is not available as a breadth subject.
Fees Information:	Subject EFTSL, Level, Discipline & Census Date, http://enrolment.unimelb.edu.au/fees
Generic Skills:	# Ability to apply knowledge of basic science and engineering fundamentals # Ability to utilise a systems approach to design and operational performance # Ability to learn, condense and take notes on technical materials in a lecture setting # Ability to undertake problem identification, formulation and solution # Capacity for independent thought # Ability and self-confidence to comprehend complex concepts, to express them lucidly and to confront unfamiliar problems.
Notes:	**LEARNING AND TEACHING METHODS** The subject will be delivered through a combination of lectures, online tutorials, online pre-recorded content and the assignment of problems sets. Students will also complete one experiment that will reinforce the material covered in lectures.

	INDICATIVE KEY LEARNING RESOURCES # "Chemical Engineering Vol. 2" by Coulson & Richardson, Pergamon # "Heat Transfer" by Holman, McGraw-Hill # "Mass Transfer Operations" Treybal, R.E., McGraw Hill # "Conceptual Design of Distillation Systems", by Doherty and Malone, McGraw Hill Students will have access to skeleton lecture notes. The subject LMS site contains recorded lecture slides and annotations using a tablet PC during lecture, online tutorials, pre-recorded video content, a repository of additional example problems, past exam questions, example Aspen files and rough solutions to worked problem sets. **CAREERS / INDUSTRY LINKS** The skills gained in this subject are crucial to the career of a process engineer or working in separations. They will be important for students wishing to progress to jobs in engineering design offices and in operational roles within a wide range of industries including petrochemicals, food processing, wastewater treatment, minerals processing and pulp and paper manufacture. Most if not all of the example problems in the subject are motivated by real world examples.
Related Course(s):	Master of Philosophy - Engineering Ph.D.- Engineering
Related Majors/Minors/ Specialisations:	B-ENG Chemical Engineering stream Master of Engineering (Biochemical) Master of Engineering (Chemical with Business) Master of Engineering (Chemical)