CHEN90007 Advanced Thermo & Reactor Engineering

Credit Points:	12.5
Level:	9 (Graduate/Postgraduate)
Dates & Locations:	2016, Parkville This subject commences in the following study period/s: Semester 2, Parkville - Taught on campus.
Time Commitment:	Contact Hours: 1 x 2 hour lecture + 2 x 1 hour lecture + 1 x 1 hour tutorial per week Total Time Commitment: Estimated 200 hours
Prerequisites:	see below
Corequisites:	None
Recommended Background Knowledge:	None
Non Allowed Subjects:	None
Core Participation Requirements:	For the purposes of considering request for Reasonable Adjustments under the Disability Standards for Education (Cwth 2005), and Students Experiencing Academic Disadvantage Policy, academic requirements for this subject are articulated in the Subject Description, Subject Objectives, Generic Skills and Assessment Requirements of this entry.The University is dedicated to provide support to those with special requirements. Further details on the disability support scheme can be found at the Disability Liaison Unit website: http://www.services.unimelb.edu.au/disability/
Coordinator:	Dr Anthony Stickland
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Prerequisites:

Subject	Study Period Commencement:	Credit Points:
CHEN30001 Reactor Engineering	Semester 1	12.50

(Prior to 2010 CHEN40003 Reactor Engineering)

Subject	Study Period Commencement:	Credit Points:
ENGR30002 Fluid Mechanics	Semester 1, Semester 2	12.50

(Prior to 2013 ENGR30001 Fluid Mechanics and Thermodynamics)

Subject Overview:

AIMS

This subject is divided into advanced thermodynamics (approximately 9 weeks) and advanced reactor engineering (approximately 3 weeks).
The laws of thermodynamics, which govern energy and the direction of energy flow, are amongst the most important fundamentals of chemical engineering that students learn during their course. This subject revises and expands the students' understanding of the conservation of energy, learnt through subjects such as Chemical Process Analysis and Fluid Mechanics. In addition the students learn about the concepts of entropy and equilibrium, which form the basis for the topics of phase equilibrium, mixture properties, mixture equilibrium, reaction equilibrium and interfacial equilibrium – topics that stretch across the entire chemical engineering curriculum.

	The reactor engineering component of the course focuses on heterogeneous reactions and the influence of mass transfer on chemical reactions and reaction design. The topics are solid-catalysed reactions, fluid-fluid reactions and fluid-solid reactions. During the subject, students learn about the effect of mass transfer on the overall rate of reaction and how to account for heterogeneous systems in reactor design. The concepts covered by this subject provide the fundamental basis for chemical and process engineering and are utilised throughout all sectors of industry by engineers. This subject provides students with the ability to perform detailed calculations of complex systems to predict the performance and thus design process unit operations. **INDICATIVE CONTENT** The advanced thermodynamics component focuses on the definitions and applications of the laws of thermodynamics, especially the implications of entropy and equilibrium on phases, mixtures, chemical reactions and interfaces: # 1st Law of Thermodynamics: Closed and open systems, Unit operations, Thermodynamic cycles # 2nd Law of Thermodynamics: Entropy, Reversibility and Spontaneity, Gibb's Equations, Thermodynamic Identities and Maxwell Relations # Phase Equilibria of Pure Substances: Equilibrium Criteria, Fugacity # Mixtures and Phase Equilibria of Mixtures: Partial Molar Properties, Gibbs-Duhem equation, Chemical Potential, Species Fugacity, Activity Coefficients, Vapour-Liquid equilibrium, Colligative Properties, Liquid-Liquid equilibrium # Chemical Reactions and Reaction Equilibria: Equilibrium Constant, Species Activity # Interfacial Thermodynamics: Surface Tension, Adsorption Isotherms. The advanced reactor engineering component focuses on mass-transfer limitations in multi-phase chemical reactions and reactor design: # Non-ideal flow in reactors # Rate controlling mechanisms (film resistance control, chemical reaction control, surface and pore diffusion control, ash layer diffusion, shrinking core mechanisms, effectiveness factors and Thiele modulus) # Kinetic regimes for fluid-fluid and gas-fluid reactions # Fluid-particle reaction design # Catalytic reactor systems.
Learning Outcomes:	**INTENDED LEARNING OUTCOMES (ILOs)** On completion of this subject the student is expected to: 1 Apply the laws of thermodynamics to closed and open systems including thermodynamic cycles 2 Discuss a range of approaches to estimate fluid phase equilibria in one and two component systems 3 Estimate the physical properties of mixtures, especially non-ideal mixtures 4 Predict the equilibria of chemical reactions 5 Understand and identify the different rate controlling mechanisms in reactor design 6 Solve problems in the design of heterogeneous reacting systems and in particular catalytic reactor systems.
Assessment:	10 x weekly online quizzes worth 10 marks each (10%). Each quiz reinforces the week's lectures. Assessed weeks 2 -11. Intended Learning Outcomes (ILOs) 1 to 6 are addressed One hour written mid-semester test (10%). Held around week 7. ILO's 1 to 4 are addressed in the test One written team assignment not exceeding 1000 words per team member (10%). Time commitment of approximately 13-15 hours of work per team member. Due week 9. ILO's 1 and 2 are addressed in the assignment One three-hour written closed book examination (70%). Held end-of-semester exam period. ILO's 1 to 6 are addressed in the exam. Hurdle requirement: A mark of 40% or more in the end of semester examination is required to pass the subject
Prescribed Texts:	Sandler, S.I., 2006,Chemical, Biochemical, and Engineering Thermodynamics, 4th Edition Levenspiel, O., 1999,Chemical Reaction Engineering, 3rd Edition, Wiley
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:	During this subject the student will practice the ability to: # Provide in-depth technical competence in engineering fundamentals # Undertake problem identification, formulation and solution # Utilise a systems approach to design and operational performance.
Notes:	**LEARNING AND TEACHING METHODS** The subject is delivered through a combination of lectures and tutorials. The tutorials include aspects of student-centred learning. Regular online quizzes are used to assist student progress and understanding. Students also complete an assignment which reinforces the material covered in lectures. **INDICATIVE KEY LEARNING RESOURCES** Students have online access to lecture slides and lecture recordings through the subject LMS site. The site also contains tutorials and worked solutions for tutorials and past exams. The key texts for the subject are: # Sandler, S.I., 2006,Chemical, Biochemical, and Engineering Thermodynamics, 4th Edition, # Levenspiel, O., 1999,Chemical Reaction Engineering, 3rd Edition, Wiley **CAREERS / INDUSTRY LINKS** The skills and knowledge learnt in this subject are crucial to the understanding of chemical engineering and the careers of chemical engineers. They provide the basis for solving problems of interest in nearly all industries, including petrochemical, mining and minerals processing, energy generation and pharmaceuticals, to name a few.
Related Course(s):	Doctor of Philosophy - Engineering Master of Philosophy - Engineering
Related Majors/Minors/ Specialisations:	B-ENG Chemical Engineering stream B-ENG Chemical and Biomolecular Engineering stream Master of Engineering (Biochemical) Master of Engineering (Chemical with Business) Master of Engineering (Chemical)