UNIVERSITY of BRADFORD

Module Descriptor

Module Details	
Module Title:	Engineering and Chemical Thermodynamics
Module Code:	CPE5009-B
Academic Year:	2019-20
Credit Rating:	20
School:	Department of Chemical Engineering
Subject Area:	Chemical and Process Engineering
FHEQ Level:	FHEQ Level 5
Pre-requisites:	
Co-requisites:	

Contact Hours	
Type	**Hours**
Lectures	48
Tutorials	24
Laboratory	3
Directed Study	125

Availability	
Occurrence	**Location / Period**
BDA	University of Bradford / Semester 2 (Feb - May)

Module Aims

To review Thermodynamics as the science of energy conversion; to apply the subject to the analysis of simple processes; to introduce heat transfer.
This module studies the interrelation of heat and work with chemical reactions or with physical changes of state within the confines of the laws of thermodynamics applied to the design and analysis of chemical engineering processes and unit operations.

Outline Syllabus

Engineering Thermodynamics
1. Introduction to energy and the First Law of Thermodynamics

1.1 Systems, energy, work, heat, properties, First Law.
1.2 Processes: constant volume, constant pressure, adiabatic, isothermal, cycles.
2. Second Law of Thermodynamics
2.1 Entropy via temperature -entropy diagrams.
2.2 Reversible and irreversible processes: principle of increasing entropy.
3. Flow processes
3.1 Steady flow; mass flow equation; steady flow energy equation.
4 Properties of Fluids
4.1 Liquids and vapours: steam tables
4.2 Ideal gases.
5. Application to non-flow and flow processes
6. Mixture of Gases and Vapours
6.1 Mixtures of gas, and gases and vapours.
6.2 Psychrometrics.
7. Heat Transfer
7.1 Conduction, convection, radiation, evaporation.
7.2 Overall heat transfer coefficients.
7.3 Heat transfer correlations.
7.4 Heat exchangers.
Chemical Thermodynamics
1. Thermodynamic properties (First law of Thermodynamics, internal energy, enthalpy, Gibbs Free Energy, Maxwell Relationships, specific heat data, Gibbs-Helmholtz equation, open systems)
2. One-component systems (Ideal gases, real gases, equations of state, law of corresponding states, fugacity)
3. Phase Equilibria (phase rule, partial molar properties, Duhem Law, Raoult's Law)
4. Reaction Equilibria (Standard free energy change, equilibrium constants, prediction of free energy changes, Electrochemical cells)

Learning Outcomes	
1	Review the fundamental principles of thermodynamics and heat transfer and their application to the analysis of simple processes.
2	Measure and evaluate energy balances.
3	Explain the factors that influence positions of equilibrium in physical and chemical changes.
4	Determine equilibrium constants, and other thermodynamic parameters.
5	Apply mathematical methods to scientific applications and solve numerical problems.

Learning, Teaching and Assessment Strategy

Theory, implementation, application, and critical analysis is gained through lectures, tutorials, case studies and directed study. Engineering application and evaluation is gained from lab sessions.

Assessment of understanding, application and critical analysis by examination; assessment of engineering application assessed by laboratory coursework

Mode of Assessment

Type	Method	Description	Length	Weighting
Summative	Laboratory Report	Heat pumps and heat transfer		15%
Summative	Examination - closed book	Students required to answer 3 questions from 5 (Engineering Thermodynamics)	1.5 hours	35%
Summative	Examination - closed book	Students required to answer 3 questions from 4 (Chemical thermodynamics)	1.5 hours	50%
Referral	Examination - closed book	Students required to answer 3 questions from 5 (Engineering Thermodynamics)	1.5 hours	50%
Referral	Examination - closed book	Students required to answer 3 questions from 4 (Chemical thermodynamics)	1.5 hours	50%

Reading List
To access the reading list for this module, please visit https://bradford.rl.talis.com/index.html.

Please note:

This module descriptor has been published in advance of the academic year to which it applies. Every effort has been made to ensure that the information is accurate at the time of publication, but minor changes may occur given the interval between publishing and commencement of teaching. Upon commencement of the module, students will receive a handbook with further detail about the module and any changes will be discussed and/or communicated at this point.