

Module Details	
Module Title	Engineering And Chemical Thermodynamics
Module Code	CPE5009-B
Academic Year	2020/1
Credits	20
School	Department of Chemical Engineering
Subject Area	Chemical and Process Engineering
FHEQ Level	FHEQ Level 5
Pre-requisites	N/A
Co-requisites	N/A

Contact Hours	
Type	Hours
Online Lecture (Synchronous)	39
Online Tutorials (Synchronous)	20
Laboratories	1
Directed Study	140

Availability	
Occurrence	Location / Period
BDA	University of Bradford / Academic Year

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

Semester 1- 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's Laws, Raoult's Law).
4. Reaction Equilibria (Standard free energy change, equilibrium constants, prediction of free energy changes, Electrochemical cells)

Semester 2- 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: 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.

Learning Outcomes

Outcome Number	Description
01	Understand and critically evaluate the principles of engineering and chemical thermodynamics and be able to apply these principles to the design and analysis of simple processes.
02	Explain the factors that influence positions of equilibrium in physical and chemical changes
03	Determine equilibrium constants, and other thermodynamic parameters.

Learning, Teaching and Assessment Strategy

Learning outcomes will be achieved through interactive lectures, tutorials and laboratory sessions. The online lectures (primarily on Zoom) will be organised so that the students participate and discuss during the sessions (LO1-4).

The online tutorials (primarily on Zoom) will be organised so that the students work in groups discussing the problem at hands and its solution (LO1-3). All lecture notes and tutorial questions and their solutions will be posted on the VLE.

The laboratory sessions will be conducted with students in groups to observe the heat pumps and heat transfer apparatuses in operation, explained by the Instructors who will show what manipulations normally are required to collect the readings. During the sessions, the students will be challenged to explain the objectives of the experiments, the operation of the experiment and error analysis of the data collected (LO1, LO5). Videos will be provided in case of restrictions imposed by lockdown. The lab brief guides the students in understanding the calculations needed for their examination in semester2.

The Learning outcomes covered by the examinations include an understanding of the fundamental principles of engineering and chemical thermodynamics and application of these principles to the thermodynamics involved in chemical engineering processes (LO1-4/LO1, LO4, LO5).

The assessment will be by formal (online, open book) examination: (50%) at the end of semester 1 and (50%) at the end of semester 2. Formative assessment will take the form of online quizzes, as well as orally during the lecture and tutorial sessions.

Mode of Assessment

Type	Method	Description	Length	Weighting
Summative	Examination - Open Book	Students are required to answer a range of questions by showing detailed calculations.	1 hour 30 mins	50%
Summative	Examination - Open Book	Students required to answer a range of qns by showing detailed calculations	1 hour 30 mins	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.