UNIVERSITY of BRADFORD

Module Descriptor

Module Details	
Module Title	Engineering And Chemical Thermodynamics
Module Code	CPE5009-B
Academic Year	2024/5
Credits	20
School	School of Engineering
FHEQ Level	FHEQ Level 5

Contact Hours	
Type	Hours
Directed Study	140
Lectures	36
Tutorials	18
Laboratories	6

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. ThermoChemistry
3.One-component systems (Ideal gases, real gases, equations of state, law of corresponding states, fugacity).
4. Phase Equilibria (phase rule, partial molar properties, Duhem's Laws, Raoult's Law).
5. 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:the 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 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.
04	Apply mathematical methods to scientific applications and solve numerical problems.
05	Demonstrate skills in data interpretation, scientific method and systematic problem solving.

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 tutorials will be organised so that the students work in groups discussing problems and solution strategies (LO1-3). Students are required to attempt to solve the tutorial questions prior to the tutorial sessions where challenging questions are resolved.

All lecture notes and tutorial questions will be posted on the VLE (Canvas).
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 the error analysis of the data collected (LO1, LO5). The lab brief guides the students in understanding the calculations needed for the lab report. As part of the lab activities, a pre-lab report (available format on canvas) is submitted at the start of the lab session.

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

The assessment will be by formal (Closed book) examination: (40%) at the end of semester 1 and (40%) at the end of semester 2. Laboratory report (pre-lab and post-lab) 10% for semester 1 and 10% for semester 2. Formative assessment will take the form of online quizzes, as well as orally during the lecture and tutorial sessions.

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Mode of Assessment

Type	Method	Description	Weighting
Summative	Examination - Closed Book	Students are required to answer a range of questions by showing detailed calculations. (2 Hrs)	40%
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Summative	Laboratory Report	A group laboratory report of 1000 words excluding tables, figures, and references. An individual pre-lab report (Sem 1)	10%
Summative	Laboratory Report	A group laboratory report of 1000 words excluding tables, figures, and references. An individual pre-lab report. (Sem 2)	10%

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.

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