London South Bank University

Module Guide

Thermodynamics

EAA_5_967

School of Engineering

2014_15

Level 5

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1. MODULE DETAILS

Module Title:	Thermodynamics
Module Level:	5
Module Reference Number:	EAA_5_967
Credit Value:	1
Student Study Hours:	143
Contact Hours:	58
Private Study Hours:	80
Pre-requisite Learning (If applicable):	[Click and replace]
Co-requisite Modules (If applicable):	[Click and replace]
Course(s):	BEng Chemical and Process Engineering BEng Petroleum Engineering HND Chemical Engineering
Year and Semester	Year 2 semester 1
Module Coordinator:	Dr John Orrin
MC Contact Details (Tel, Email, Room)	Room M306 Tel 02078157950 Email orrinj@lsbu.ac.uk
Teaching Team & Contact Details (If applicable):	Dr Anna Axelsson Rim Saada Hassan Sayed Zabihi Shahri
Subject Area:	Chemical and Petroleum Engineering
Summary of Assessment Method:	70% Examination, 30% Coursework
External Examiner appointed for module:	[Insert the name, position and institution of the subject area external examiner appointed for the module]

2. SHORT DESCRIPTION

Thermodynamics is concerned with the study of heat and work, and the transfer of energy from one form to another in physical and chemical transformation. An understanding of thermodynamics is important in many industrial processes. This unit provides a study of the basic chemical and power thermodynamics.

3. AIMS OF THE MODULE

To provide a thermodynamic basis for the study of chemical processes and energy transfer.

4. LEARNING OUTCOMES

4.1 Knowledge and Understanding

1. Solving material and energy balances for nonreacting and reacting systems using appropriate thermodynamics diagrams and data.
2. Applying the first law of thermodynamics to problems involving energy transfer or thermochemistry.

3. Applying the second law of thermodynamics to problems involving heat and power.
4. Selecting and making use of thermodynamic property data and relations for the modelling of chemical process systems.

4.2 Intellectual Skills

Understanding the mathematical requirements for the solution of engineering problems.

4.3 Practical Skills

Working in a team, performing thermodynamic-relevant experiments and writing technical reports.

4.4 Transferable Skills

The unit contributes to development of the following transferable skills:
1. Manipulate, sort and present data in forms useful for understanding. Select, interpret and validate data, identifying possible errors and inconsistencies.
2. Communicate clearly the findings of experiments, projects and other assignments using written reports, oral and visual presentations.
3. Work effectively in a team, recognising the roles played by different team members.

5. ASSESSMENT OF THE MODULE

This unit will be assessed by coursework and examination.

Element	*Description*	*Weighting*
Coursework	Lab reports	30%
Examination	2 hours examination	70%

Details on submission of lab reports: All lab reports should be addressed to the workshop supervisor, and submitted (within two weeks of the laboratory class) to the Faculty office (Room T313). Any late submission should be discussed with the workshop supervisor in advance of the deadline. You are expected to use the **application form for extension of deadline** for this purpose (*a copy may be obtained from the faculty office).* The University's policy on late submission of coursework and on plagiarism will apply.

6. FEEDBACK

Feedback will normally be given to students 15 working days after the final submission of an assignment or as advised by their module leader.

7. INTRODUCTION TO STUDYING THE MODULE

7.1 Overview of the Main Content

CHEMICAL THERMODYNAMICS (50%)

Volumetric Properties of pure substances

-Phase behaviour of Pure Substances (Week 1)
-Phase diagrams, P-ν diagrams, P-T diagram, Critical Point (Week 1)
Gases :
-Equation of State (Week 1)
-Introduction to non-ideal behaviour: (Week 2)
-Principle of corresponding state. (Week 2)
-Virial equations and applications. (Week 2)
-Van der Waal's equation and other cubic equations. (Week 3)
Liquids :
-Equation of State for liquids (Week 3, Week 4)
-Methods for predicting properties of liquid state. (Week 4)

Thermochemistry

- Application of thermodynamic laws in Thermochemistry. (Week 5)
- Heat Capacity (Week 5)
- Standard heat of reaction, formation and combustion (week 5)
- Enthalpy, Heats of combustion, formation and reaction. (Week 5)
- Hess's law, enthalpy changes, energy balances (Week 5, Week 6)
- Kirchoff's law application to energy balances. (Week 6)
- Adiabatic reaction temperature (Week 6)
- Bond enthalpy (Week 6)
- Bomb calorimeter (Week 7)
- Enthalpy (Week 7)

Introduction to Equilibrium

-Conditions for equilibrium. (week 8)
-Vapour-Liquid equilibrium properties of ideal and nonideal mixtures. (Week 9)
-Vapour-Liquid equilibrium (VLE) for pure substances (Week 9)
-VLE for ideal mixtures (Raoult's law, Txy and Pxy diagrams) (Week 10)
-VLE for non-ideal mixtures ; modified Raoult's law, Azeotropes (Week 10)
- Distribution coefficients (Week 10)
-Flash calculations (Week 10)
-Henry's law (Week 10)

Entropy

- Definition of entropy. Concept of entropy and Gibbs Equations (Week 11)
- Change in entropy in ideal gases. (Week 11)
- Entropy change for solids, liquids and ideal gases (Week 11)
- Entropy change for ideal gas mixtures (Week 11)

Revision (week 12)

POWER THERMODYNAMICS (50%)

Energy transfer in closed systems for pure substances. Heat, work, internal energy (week 1)
Temperature measurement. Isothermal, isobaric, adiabatic processes. Enthalpy.
Enthalpy composition diagrams. Thermal properties of process fluids.
Introduction to steam tables. (Week 2)
Carnot cycle, Rankine cycle (week 3,4)

Rankine with reheat cycle (week 5)
Regenerative cycle (week 6,7)
Combined heat cycles (week 8)
Refrigeration cycles (9,10,11)
Revision (week 12)

7.2 Overview of Types of Classes

Teaching: will be by combined lectures and problem solving exercises to give you practice in solving problems. There will be regular tutorial exercises to help you assess your understanding of the concepts. It is helpful to bring a calculator to all lectures. Your learning will be aided if you make your own notes. You will be expected to take notes at the lecture and expand on this during your private study period.

Practical: Students will complete two of the following experiments. They have been selected to illustrate some practical applications of thermodynamic principles.

1. Bomb calorimeter
2. Falling Film evaporator
3. Heat exchanger
4. Fluidised bed heat transfer

7.3 Importance of Student Self-Managed Learning Time

Student responsibility in the learning and development process will be emphasised. Students are required to undertake directed self-study and prepare solutions/discussions to questions relative to various topic areas. Students will be encouraged to identify for themselves particular problems of difficulty and to use seminar discussions, where appropriate, for the resolution of these. Students must regularly access the Moodle site for this module. They should download the class/lecture material from the Moodle site, and do the recommended reading, before each lecture/class.
Where appropriate, students are also expected to download the relevant seminar questions and study them in advance of each seminar, in order to derive maximum benefit from seminar time. The programme of teaching, learning and assessment gives guidance on the textbook reading required for each week, the purpose of which is to encourage further reading both on and around the topic.

7.4 Employability

Students usually find employment in the oil and gas industries as well as a range of chemical industries including engineering consultancy.

8. THE PROGRAMME OF TEACHING, LEARNING AND ASSESSMENT

SEMESTER 2		
WEEK	TOPIC	READING (CORE TEXT)
1	See above for details of weekly schedule	
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		

9. STUDENT EVALUATION

[Click and replace. A brief summary of the previous module cohort's evaluation and any changes made as a result.]

10. LEARNING RESOURCES

Reading List

P.W. Atkins, J. Paula (2006) The Elements of Physical Chemistry. Oxford University Press.

J.M. Smith, H.C. Van Ness, M.M. Abbott (2001). Introduction to Chemical Engineering Thermodynamics, 5th edition, McGrawHill.

I.M. Kletz, R.M. Rosenberg; *(2000).* Chemical Thermodynamics, Basic Theory and Methods, J.Wiley.

M.J. Moran, H.N.Shapiro (2000). Fundamentals of Engineering Thermodynamics, 4 th edition, J.Wiley & Sons, New York Chichester.

Felder, R. M. And Rousseau, R. W. (2000) Elementary principles of chemical Processes, 3 rd edition, J. Wiley & Sons.