هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

Course Specifications

Course Title:	**Thermodynamics**
Course Code:	**4022135-3**
Program:	**Chemistry and Industrial Chemistry**
Department:	**Chemistry**
College:	**Applied Science**
Institution:	**Umm Al-Qura University**

Table of Contents

A. Course Identification

1. Credit hours: 3
2. Course type **a.** University ☐ College ☐ Department ☑ Others ☐ **b.** Required ☑ Elective ☐
3. Level/year at which this course is offered: 3rd level/2nd year
4. Pre-requisites for this course (if any)**:** Volumetric Analytical Chemistry & Calculus
5. Co-requisites for this course (if any)**:---**

6. Mode of Instruction (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	**Traditional classroom**	√	79 %
2	**Blended**	---	---
3	**E-learning**	√	21%
4	**Distance learning**	---	---
5	**Other**	---	---

7. Contact Hours (based on academic semester)

No	Activity	Learning Hours
Contact Hours		
1	**Lecture**	22
2	**Laboratory/Studio**	30
3	**Tutorial**	--
4	**Others** (E-learning + Exams + office hours)	13
	Total	**65**

B. Course Objectives and Learning Outcomes

1. Course Description

The course deals with the basic principles of thermodynamics including heat, energy, laws of thermodynamics and their applications, exothermic and endothermic reactions as well as pontaneous and non spontaneous processes.

2. Course Main Objective

By the end of this course the students will be able to describe and explain:

1. Fundamental principles of thermodynamics.
2. Application of thermodynamic laws in various fields.
3. Physical intuition, mathematical reasoning, and problem solving skills.
4. Analyzing thermodynamic data and predicting the processes spontaneity.

3. Course Learning Outcomes

CLOs		Aligned PLOs
1	**Knowledge:**	
1.1	**Identify the theoretical background and different laws of chemical thermodynamics**	**K1**
1.2	**Recognize the different thermodynamic terms and physical properties of materials related to thermodynamics**	**K2**
2	**Skills:**	
2.1	**Apply the thermodynamic laws**	**S1**
2.2	**Familiar with systems and various thermodynamic processes and their applications.**	**S1**
2.3	**Compare between various thermodynamic systems**	**S2**
2.4	**Classify thermodynamic systems**	**S2**
2.5	**Analyze the thermodynamic data**	**S2, S3**
2.6	**Predict the spontaneity of the reactions**	**S1**
2.7	**Practice and adapt chemical experiments and techniques in thermodynamics**	**S3**
2.8	**Collect a data using computers and internet to find all information related to thermodynamics and their applications**	**S5**
3	**Values:**	
3.1	**Write and present a chemical report related to thermodynamics.**	**V2**

C. Course Content

No	List of Topics	Contact Hours
1	General concepts of thermodynamics.	**2**
2	Heat, energy and work (the mechanical equivalent of heat). Different types of systems	**2**
3	Thermodynamics variables and characteristics of intensive, extensive and thermodynamics processes.	**2**
4	Zero and first laws of thermodynamics and their applications.	**2**
5	The relationship between enthalpy change and internal energy change, heat capacity	**2**
6	The Jules-Thompson's effect, Adiabatic and isothermal expansions, Determination of Joule's coefficient from heat capacity measurements.	**2**
7	Thermochemistry. Exothermic and endothermic reactions. Kirchhoff's law, Hess's law and its applications.	**2+2E=4**
8	The second law of thermodynamics and its applications.	**2**
9	Mid-term exam.	**2**
10	Spontaneous and non spontaneous processes. Heat machines and thermal efficiency	**2**
11	Heat transfer to work. Carnot cycle (efficiency and compression ratio) Otto cycle.	**2E**

12	Entropy. Gibbs free energy, work function, Gibbs and Gibbs –Helmholtz Equations.	**1+1E=2**
13	Van't Hoff Equations, Chemical Equilibrium and spontaneity.	**1+1E=2**
14	Third law of thermodynamics and its applications.	**2**
Total		30

Practical part

• Instructions on rules and methods of safety at chemical lab.
• Introduction to the objectives of thermodynamics and various types of thermo-chemical reactions.
• Determination of the heat capacity and specific heat of the calorimeter using distilled water.
• Determination of the heat capacity of the calorimeter using solutions.
• Determination of the heat capacity for different concentration of sodium chloride solutions.
• Determination of the heat of neutralization between acid and alkali.
• Determination of the heat of salvation of ammonium chloride as an endothermic reaction at infinite dilution.
• Determination of the heat of salvation of sodium hydroxide as an exothermic reaction at infinite dilution.
• Hess's Law.
• Determination of the higher critical temperature for water-phenol system.
• Determination of the lower critical temperature in two component system.
• Three component systems.

D. Teaching and Assessment

1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
1.0	**Knowledge**		
1.1	**Identify the theoretical background and different laws of chemical thermodynamics**	Lecture and web-based study	Mid-term and final Exams
1.2	**Recognize the different thermodynamic terms and physical properties of materials related to thermodynamics**	Lecture	Mid-term and final Exams
2.0	**Skills**		
2.1	**Apply the thermodynamic laws**	Discussion	Group work report
2.2	**Familiar with systems and various thermodynamic processes and their applications.**	Lecture	Mid-term and final Exams
2.3	**Compare between various thermodynamic systems**	Library visits	Group work report
2.4	**Classify thermodynamic systems**	Lecture Web-based study	Mid-term and final Exams
2.5	**Analyze the thermodynamic data**	E-Learning	Assignments on blackboard

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
2.6	**Predict the spontaneity of the reactions**	Self-directed study	Assignments on blackboard
2.7	**Practice and adapt chemical experiments and techniques in thermodynamics**	Lab work	Practical Lab exam
2.8	**Collect a data using computers and internet to find all information related to thermodynamics and their applications**	Self-directed study	Assignments on blackboard
3.0	**Values**		
3.1	**Write and present a chemical report related to thermodynamics.**	Lab work	Practical Lab report and Exam
3.2	**Work individually and in a team to perform a thermodynamics experiment.**	Lab work	Practical Lab report and Exam

2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	E-learning	All weeks	5%
2	Assignments and activities.	All weeks	5%
3	Mid-term Exam.	8	20 %
4	Practical Lab work (report and Exam)	11	30 %
5	Final Exam. (2 hours exam)	12	40 %

***Assessment task** (i.e., written test, oral test, oral presentation, group project, essay, etc.)

E. Student Academic Counseling and Support

Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice:

- Weekly office hours for discussion with the students.
- Academic advising for students.

Availability of Staff members to provide counseling and advice

F. Learning Resources and Facilities

1.Learning Resources

Required Textbooks	• Physical Chemistry, Amazon logo Silbey, R. R. Alberty, M. Bawendi, 4th ed., John Wiley & Sons, 2004. • Physical Chemistry, Peter Atkins & Julio de Paula, 10th ed., W. H. Freeman and Company, 2014. • Advanced Physical Chemistry, B. S. Bahl, S. Chand & Co., New Delhi, India, 1993.
Essential References Materials	Thermodynamics: an engineering approach, Yunus A. Cengel and Michael A. Boles, 7 th. SI ed., McGraw- Hill, London, 2011.
Electronic Materials	• http://www.chemweb.com • http://www.sciencedirect.com • http://www.rsc.org • Websites on the internet relevant to the topics of the course

Other Learning Materials	Not required

2. Facilities Required

Item	Resources
Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)	Well-equipped lecture halls.
Technology Resources (AV, data show, Smart Board, software, etc.)	Computer and data show.
Other Resources (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	No other requirements.

G. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Quality of learning resources	Students	Complete the questionnaire evaluation of the course periodically.
Effectiveness of teaching and assessment.	Program Leaders	Observation of students performing a task.
Extent of achievement of course learning outcomes.	Peer Reviewer	Checking selected exam papers, and student assignments.

Evaluation areas (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)
Evaluators (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
Assessment Methods (Direct, Indirect)

H. Specification Approval Data

Council / Committee	Quality committee and department counsel
Reference No.	1st meeting
Date	2022

Head of Chemistry Department

Dr Moataz Morad