University of Jordan
School of Engineering
Chemical Engineering Department

الجامعة الاردنية
كلية الهندسة
قسم الهندسة الكيميائية

ABET-Course Syllabus

1. **Course number and name: (0905323) Chemical Engineering Thermodynamics (2)**
2. **Class schedule:** 2 Credits Hours
   a. Time and place: Sec.1: Sun. and Tue.08:00-09:00, and Sec. 2: Sun. and Tue. 010:00-11:00
   b. Office hours: TBA
3. **Instructor:** Dr. Ali Kh. Al-matar
   Office Tel. number: 5355000, Ext.: 22890
   Email: aalmatar@ju.edu.jo

4. **Textbook:** Smith, J. M.; Van Ness, H. C.; and Abbott, N.M., Introduction to chemical engineering thermodynamics, 7th Edition, McGraw-Hill, New York, 1999.

   Other references:

   Books:

   - Sandler, S. I., Chemical, biochemical and engineering thermodynamics, John Wiley and Sons, Fourth Edition, New York, 2006.
   - Winnick, J., Chemical engineering thermodynamics, John Wiley and Sons, New York, 1998.
   - Matsoukas, T., Fundamentals of Chemical Engineering Thermodynamics, Pearson, Upper Saddle River, new Jersey, 2013.
   - De Nevers, N., Physical and Chemical Equilibria for Chemical Engineers, , John Wiley and Sons, Second Edition, New York, 2012.

   Journals:

   - Journal of chemical and engineering data, http://pubs.acs.org/journal/jceaax
   - Fluid phase equilibria http://www.journals.elsevier.com/fluid-phase-equilibria
   - The Journal of Chemical Thermodynamics http://www.journals.elsevier.com/the-journal-of-chemical-thermodynamics/

5. Website: The course on the University E-Learning system: https://elearning.ju.edu.jo//

6. **Course information:**
   a. Catalog description Relationships among thermodynamic properties: equations, tables, diagrams. Estimation of auxiliary physical properties. Properties of mixtures and solutions: fugacity of gases and liquids, ideal and non-ideal solutions, activity and standard states, Gibbs-Duhem equation. Physical equilibria among phases: phase rule, vapor-liquid equilibria for various systems. Equilibrium phase diagrams. Chemical reactions equilibria (if time permits).
   b. Prerequisite: 0905322 Thermodynamics (1)
   c. Course classification: Mandatory course in the B.Sc. program.

7. Specific goals of the course:

This course is devoted primarily to the basic principles and practical applications of fluid mechanics. Upon the successful completion of the course, the student will be able to:	Chemical Engineering program outcomes:										
	a	b	c	d	e	f	g	h	i	j	k
Evaluate thermodynamic properties from pressure/volume/temperature (*PVT*) relations.	■				■						■
Predict the (*PVT*) behavior of real fluids using equations of state (EOS) and generalized correlations.	■				■						■
Develop from the first and second laws the fundamental property relations to estimate thermodynamics properties such as enthalpy, Gibb energy, and entropy values from *PVT* and heat-capacity data.	■				■						■
Develop generalized correlations which provide estimates of property values in the absence of complete experimental information.	■				■						■
Apply solution thermodynamics fundamentals to solve VLE problems including bubble point, dew point, and flash calculations using ideal gas and ideal solution models.	■				■						■
Understand the fundamental concepts of solution thermodynamics including chemical potential, fugacity, activity, partial molar properties, ideal/real solutions, and excess properties.	■				■						■
Choose appropriate models for calculating real phase equilibrium.	■				■						■
Use simulation and computational tools such as Exce to estimate phase equilibria.	■				■						■

8. Course topics: Course topics will be covered through around 28 (50 minutes) classes according to the following distribution:

Content	Textbook	# of lectures
Volumetric properties of pure fluids: PVT behavior of pure substances, Virial equations of state, application of the Virial equations, cubic equations of state, generalized correlations for gases, generalized correlations for liquids.	Chapter 3	4
Thermodynamic properties of fluids: Property relations for homogeneous phases, residual properties, residual properties by equations of state, two-phase systems, thermodynamic diagrams, tables of thermodynamic properties, generalized property correlations for gases	Chapter 6	4
Introduction to Vapor liquid equilibrium: the nature of equilibrium, the phase rule. Duhem's theorem, VLE: qualitative behavior, simple models for vapor/liquid equilibrium, VLE by modified Raoult's law, VLE from K-value correlations	Chapter 10	4
Midterm exam		
Theory of solution thermodynamics: fundamental property relation, the chemical potential and phase equilibria, partial properties, ideal-gas mixtures, fugacity and fugacity coefficient: pure species, fugacity and fugacity coefficient: species in solution, generalized correlations for the fugacity coefficient, the ideal solution, excess properties.	Chapter 11	6
Applications of solution thermodynamics: liquid-phase properties from VLE data, models for the excess Gibbs energy, property changes of mixing, heat effects of mixing processes.	Chapter 12	4

Final Exam

9. Policies and procedures:

Attendance. Students are expected to attend each class session and they are responsible for all material, announcements, and schedule changes discussed in class. University policy states that teachers must keep a record of attendance throughout the semester and may impose academic penalties commensurate with the importance of the work missed because of unexcused absences.

Lateness. Coming late to class is disruptive and may be treated as an unexcused absence.

Homework. There will be homework assignments in this course. Students are encouraged to discuss assignments, but *every student must turn in his/her own written solutions in his/her own words*. However, students must submit homework individually. Each assignment should be presented in a neat organized manner, with a cover page including the course title, student's name, homework number, and due date. It is better to write problem statement before its solution; do not turn in solutions only. Late assignments will not be accepted. *Problem set solutions will not be posted*; it is your responsibility to make sure you find out how to solve the problems by, for example, discussing them with me during classes or office hours. All cases of academic dishonesty will be handled in accordance with university policies and regulations.

Quizzes. There will be a number of announced/unannounced quizzes during the semester. Students are expected to be ready to take a quiz any time they have a class. There will be no make-up quizzes.

Teamwork. Some projects may be performed by groups of no more than three students. The topics will be decided after the midterm exam. One final project report will be submitted by each group.

Computer skills. You are encouraged to use computer softwares such as excel, Matlab, or Polymath to perform the required computations and to represent your findings in graphs or tables. A project will require the use of HYSYS process simulator package.

Grading Policy. A weighted average grade will be calculated as follows:

- Midterm exam 30%
- Quizzes and HW 6%
- Project(s) 18%
- Instructor evaluation 6%
- Final exam 40%

10. Contribution of Course to Meeting the Professional Component:

This course contributes to building the fundamental concepts in thermodynamics and its applications in Chemical Engineering.

10. Relationship to Program Outcomes (%):

A	B	C	D	E	F	G	H	I	J	K
5				5		1		1		1

10. Relationship to Chemical Engineering Program Objectives:

PEO1	PEO2	PEO3	PEO 4
√	√	√	√

Prepared by: Dr. Ali Kh. Al-matar
Last Modified: September 16, 2017