Course E-Syllabus

1	**Course title**	Chemical Engineering Thermodynamics II– 0905322
2	**Course number**	0905322
3	**Credit hours**	3
	Contact hours (theory, practical)	45 hr (theory)
4	**Prerequisites/corequisites**	0905321 - Chemical Engineering Thermodynamics I Students are expected to have sufficient knowledge pertaining to the following: Physical Chemistry, CHE Principles I and II, and process simulators.
5	**Program title**	B.Sc. in chemical Engineering
6	**Program code**	5
7	**Awarding institution**	The University of Jordan
8	**School**	Engineering
9	**Department**	Chemical Engineering
10	**Level of course**	undergraduate, Bachelor degree
11	**Year of study and semester (s)**	2020/2021 (Spring semester)
12	**Final Qualification**	
13	**Other department (s) involved in teaching the course**	--------
14	**Language of Instruction**	English
15	**Teaching methodology**	☐Blended ☐✓ Online
16	**Electronic platform(s)**	■Moodle ■Microsoft Teams ☐Skype ☐Zoom ☐Others: Facebook group
17	**Date of production/revision**	2021

18 Course Coordinator:

Name: Dr. Ali Al-Matar
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19 Other instructors:

None

20 Course Description:

Physical equilibria among phases: phase rule, vapor-liquid equilibria for various systems. Equilibrium phase diagrams. Solution thermodynamics: Properties of binary mixtures and solutions: fugacity of gases and liquids, ideal and non-ideal solutions, activity and standard states, Gibbs-Duhem equation. Chemical reaction equilibria. Use of available software.

21 Course aims and outcomes:

A- Aims:

This course aims at providing BSc students in the chemical engineering department with sufficient knowledge in thermodynamic concepts and applications.

1. Evaluate thermodynamic properties from pressure/volume/temperature (PVT) relations.
2. 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.
3. Develop generalized correlations, which provide estimates of property values in the absence of complete experimental information.
4. Apply solution thermodynamics fundamentals to solve VLE problems including bubble point, dew point, and flash calculations using ideal gas and ideal solution models.
5. Understand the fundamental concepts of solution thermodynamics including chemical potential, fugacity, activity, partial molar properties, ideal/real solutions, and excess properties.
6. Choose appropriate models for calculating real phase equilibrium.
7. Use simulation and computational tools to estimate phase equilibria.

B- Intended Learning Outcomes (ILOs):

After the completion of this course, the students are expected to have achieved the following learning outcomes (ILOs):

1. Evaluate thermodynamic properties from pressure/volume/temperature (PVT) relations. [1]
2. Predict the (PVT) behavior of real fluids using equations of state (EOS) and generalized correlations. [1]
3. Develop generalized correlations, which provide estimates of property values in the absence of complete experimental information. [1, 3]
4. Apply solution thermodynamics fundamentals to solve VLE problems including bubble point, dew point, and flash calculations using ideal gas and ideal solution models. [1]
5. Understand the fundamental concepts of solution thermodynamics including chemical potential, fugacity, activity, partial molar properties, ideal/real solutions, and excess properties. [1]
6. Choose appropriate models for calculating real phase equilibrium. [1, 3]
7. Use simulation and computational tools to estimate phase equilibria. And work in teams to submit a project.[3]

22. Topic Outline and Schedule:

Week	Lecture	Topic	Teaching Methods*/platform	Evaluation Methods**	Referer
1-3	8	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.	Synchronous (MS Teams)	Assignment	Textbook Other referen
4-8	11	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.	Synchronous (MS Teams) Asynchronous (PDF)	Assignment + Mini-project	Textbook Other referen
9-11	8	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.	Synchronous (MS Teams) Asynchronous (PDF)	Projects Assignment	Textbook Other referen
12-13	5	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.	Synchronous (MS Teams) Asynchronous (PDF)	Projects Assignment	Textbook and
14-15	5	Special topics and student presentations.	Synchronous (MS Teams) Asynchronous (PDF)	Project Group discussion Presentations by students	Papers Student work

- Teaching methods include synchronous lecturing/meeting; asynchronous lecturing/meeting, reading assignments, and/or research as necessary.
- Evaluation methods include: Homework, Quiz, Exam, pre-lab quiz…etc

23 Evaluation Methods:

Opportunities to demonstrate achievement of the ILOs are provided through the following assessment methods and requirements: Assignments, Midterm and final exams, presentations, and project(s).

24 Course Requirements (e.g: students should have a computer, internet connection, webcam, account on a specific software/platform … etc.):

Students should have a computer, internet connection, webcam and account on specific software. Also, their JU email accounts must be activated.
It is an added value to have knowledge in Matlab, Excel, and a process simulator e.g., HYSYS, ChemCAD or ASPEN Plus.

25 Course Policies:

A- Attendance policies:

- Students are expected to attend 100% of their lectures.
- Only excused absences are allowed within the limit set by University of Jordan's regulations.
- Absence without explanation is subject to university regulation.

B- Absences from exams and submitting assignments on time:

- Absences without written explanation are deemed unexcused and subjected to university regulation.
- Late assignment/project submission will not be accepted.

C- Health and safety procedures:

D- Honesty policy regarding cheating, plagiarism, misbehavior: Cheating is not allowed and is punishable by the bylaw specific to student misconduct.

E- Grading policy:

Evaluation Tool	Weight	Date
Midterm Exam	20	TBA
Projects (include presentation)	15	TBA
HW and Quizzes	10	Expect 3-4 quizzes
Instructor evaluation	5	Depends on your participation and added-value to the course
Final Exam	50	Will be announced by the Registrar

F- Available university services that support achievement in the course: electronic platforms and licensed software.

26 References:

A- Required book(s), assigned reading and audio-visuals:

1. (**Textbook)** Matsoukas, Themis. Fundamentals of chemical engineering thermodynamics. Pearson Education, 2013.

B- Recommended books, materials and media:

1. Sandler, S. I., Chemical, biochemical and engineering thermodynamics, John Wiley and Sons, Fourth Edition, New York, 2006.
2. Winnick, J., Chemical engineering thermodynamics, John Wiley and Sons, New York, 1998.
3. De Nevers, N., Physical and Chemical Equilibria for Chemical Engineers, John Wiley and Sons, Second Edition, New York, 2012.
4. Smith, J. M.; Van Ness, H. C.; and Abbott, N.M., Introduction to chemical engineering thermodynamics, 7th Edition, McGraw-Hill, New York, 1999.
5. Koretsky, Milo D. Engineering and chemical thermodynamics. John Wiley & Sons, 2012.

C- Journals

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

D- Internet links

Dr. Ali Al-Matar YouTube channel https://www.youtube.com/channel/UC2aLJ_dDpSM-pQjuOh1R9cw

27 Additional information:

Name of Course Coordinator: -Dr. Ali Al-matar----------Signature: ----------
Date: 21/2/2021

Head of Curriculum Committee/Department: ---------- Signature: ----------

Head of Department: ---------- Signature: ----------

Head of Curriculum Committee/Faculty: ---------- Signature: ----------

Dean: ---------- Signature: ----------