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Fall 2021

CHEM 231-001: Physical Chemistry I

Elena Avzianova

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Chemistry:
Fall 2021 Course Syllabus

NJIT Academic Integrity Code: All Students should be aware that the Department of Chemistry & Environmental Science (CES) takes the University Code on Academic Integrity at NJIT very seriously and enforces it strictly. This means that there must not be any forms of plagiarism, i.e., copying of homework, class projects, or lab assignments, or any form of cheating in quizzes and exams. Under the University Code on Academic Integrity, students are obligated to report any such activities to the Instructor.

COURSE INFORMATION

Course Description:

CHEM 231 Physical Chemistry I

> Basic principles of thermodynamics, Ideal and non-ideal systems, Closed and open systems, Chemical potential, Equilibrium, Phase transitions, Simple mixtures.
> Prerequisites: Basic chemical principles, Functions of two and several variables, Partial derivatives, Integrals.

Number of Credits:
> 3

Prerequisites:
> **Chem 126 or 123, Phys 111**
Co requisite:
> **Math 211**

Course-Section and Instructors

Course-Section	Instructor
CHEM 231-001	Elena Avzianova

Required Textbook:

Title	**Physical Chemistry**
Author(s)	**Peter Atkins, Julio De Paula and James Keeler**
Edition	**11th Edition**
Publisher	**Oxford University Press**
ISBN #	**2018, ISBN-13: 9780198769866**
Chapters to be covered	**1A, 1C, 2, 3, 4, 5A, 5B**

University-wide Withdrawal Date: The last day to withdraw with a **W** is Monday, November 11, 2021. It will be strictly enforced.

Learning Outcomes:

By the end of the course, students should be able to do the following:

1. Calculate pressure and molar volumes of ideal as well as real gases.
2. Determine the efficiency of heat engines.
3. Derive the basic thermodynamic relations and to state the approximations and the applicability.
4. Calculate the thermodynamic functions of components in pure compounds and simple mixtures.
5. Calculate thermodynamic functions of chemical reactions at reference as well as arbitrary temperatures.
6. Calculate the location of phase boundaries for pure substances.
7. Calculate properties of simple mixtures.

POLICIES

All CES students must familiarize themselves with, and adhere to, all official university-wide student policies. CES takes these policies very seriously and enforces them strictly.

The shift to remote and converged teaching due to the COVID-19 pandemic has required that both instructors and students make changes to their normal working protocols for courses. Students are asked to practice extra care and attention in regard to academic honesty, with the understanding that all cases of plagiarism, cheating, multiple submission, and unauthorized collaboration are subject to penalty.

Students must properly cite and attribute all sources used for papers and assignments.

Students may not collaborate on exams or assignments, directly or through virtual consultation, unless the instructor gives specific permission to do so. Posting an exam, assignment, or answers to them on an online forum (before, during, or after the due date), in addition to consulting posted materials, constitutes a violation of the university's Honesty policy. Likewise, unauthorized use of live assistance websites, including seeking "expert" help for specific questions during an exam, can be construed as a violation of the honesty policy. All students should be familiar with the NJIT Academic Integrity Code.

Grading Policy: The final grade in this course will be determined as follows:

Homework	220[a]
Quizzes	[a]
Midterm Exam I	200
Midterm Exam II	200
Final Exam	300
Participation	80

[a]**Homework grades will be given based on THREE quizzes 110 pts each, 45 min, problems similar to those from the homework assignments, with different numerical data, TWO BEST quizzes will be taken into account (homework grades will be assigned contingent submission of all homework assignments). The quizzes are POP UP (i.e., are NOT announced in advance). No requests whether a quiz would appear on a specific date must be made. NO make-up quizzes will be offered.**

Your final letter grade in this course will be based on the following **tentative** curve:[b]

A	>850	C	500 - 600
B+	750 – 850	D	450 - 500
B	650 – 750	F	<450

C+	600-650		

[b]Scores less than 45% of the total <u>normally</u> result in F. Scores larger than 85% of total <u>always</u> result in A. The distribution of the grades between these benchmarks as well as the F and A boundaries depend on the overall performance of the class.**

Attendance Policy: Attendance at classes will be recorded and is **mandatory**. Each class is a learning experience that cannot be replicated through simply "getting the notes."

Homework Policy: Homework is an expectation of the course and is **mandatory**.

Exams: There will be two midterm exams held in **regular class hours** during the semester and one comprehensive final exam. The following exam periods are tentative and therefore possibly subject to change:

Midterm Exam I	October 1 – 5 (after the material from lectures 1 -8 is completely covered)
Midterm Exam II	November 5 – 12 (after the material from lectures 9 -16 is completely covered)
Final Exam Period	December 15 - 21, 2021

The final exam will test your knowledge of all the course material taught in the entire course.

Makeup Exam Policy: There will normally be NO MAKE-UP QUIZZES OR EXAMS during the semester. In the event that a student has a legitimate reason for missing a quiz or exam, the student should contact the Dean of Students office and present written verifiable proof of the reason for missing the exam, e.g., a doctor's note, police report, court notice, etc. clearly stating the date AND time of the mitigating problem. The student must also notify the CES Department Office/Instructor that the exam will be missed so that appropriate steps can be taken to make up the grade.
If you miss the final exam, excuses must be approved by the Dean of Students office. In this case, you will get an *I* grade in most circumstances and will have to make up the final exam in the next semester.

Cellular Phones: All cellular phones and other electronic devices must be switched off during all class times. Such devices must be stowed in bags during exams or quizzes.

ADDITIONAL RESOURCES

Chemistry Tutoring Center: Located in the Central King Building, Lower Level, Rm. G12. Hours of operation are Monday – Friday 10:00 am - 6:00 pm. For further information please click <u>here</u>.

Accommodation of Disabilities: **O**ffice of **A**ccessibility **R**esources and **S**ervices (*formerly known as Disability Support Services*) offers long term and temporary accommodations for undergraduate, graduate and visiting students at NJIT.

If you are in need of accommodations due to a disability please contact Chantonette Lyles, Associate Director at the Office of Accessibility Resources and Services at 973-596-5417 or via email at lyles@njit.edu. The office is located in Fenster Hall Room 260. A Letter of Accommodation Eligibility from the Office of Accessibility Resources Services office authorizing your accommodations will be required.

For further information regarding self-identification, the submission of medical documentation and additional support services provided please visit the Accessibility Resources and Services (OARS) website at:

- http://www5.njit.edu/studentsuccess/disability-support-services/

Important Dates (See: Fall 2021 Academic Calendar, Registrar)

Date	Day	Event
September 1, 2021	W	First Day of Classes

September 6 , 2021	M	Labor Day
September 8 2021	W	Monday Classes Meet
September 8, 2021	W	Last Day to Add/Drop Classes
November 10, 2021	W	Last Day to Withdraw
November 25 - 28, 2021	Th - Su	Thanksgiving Break - University Closed
December 10, 2021	F	Last Day of Classes
December 11, 2021	F	Reading Day
December 15 - 21, 2021	W- T	Final Exam Period
December 23, 2021	Th	Final Grades Due

Course Outline

Lecture	Week	Topic	Assignment[c)
1, 2	1	**Thermodynamic System. Equilibrium. State of Thermodynamic System. Zeroth Law of Thermodynamics. Ideal Gas. Boyle's Law. Charles Law. Temperature. Equation of State.**	All HW's assignments see on Canvas
3, 4	2	**Real Gas. Virial equation. Importance of Boyle Temperature. Van der Waals Equation of State. Critical Constants. Principle of Corresponding States. Maxwell Construction.**	
5, 6	3	**Energy, Work, Heat, and Internal Energy. First Law of Thermodynamics. Expansion Work. Reversibility. Reversible Expansion. Heat and Enthalpy. Heat Capacity at constant volume and at constant pressure.**	
7	4	**Standard Enthalpy changes. Standard State. Standard Enthalpies of Physical and Chemical Changes. Hess's Law. Standard Enthalpies of Formation. Temperature Dependence of Reaction Enthalpies. Kirchhoff's Law.**	
8	5	**Exact and inexact differential. Changes in Internal Energy. Joule Experiment. Changes in Internal Energy at Constant Pressure. Coefficient of Thermal Expansion. Coefficient of Thermal Compressibility.**	
		FIRST MIDTERM EXAM	
9, 10	6	**Relation between C_p and C_v. Joule-Thomson coefficient. Thermodynamic Relations. Adiabatic changes. Adiabatic reversible expansion.**	
11	7	**Entropy. Second Law of Thermodynamics. Heat Engines. Carnot Cycle. Reversion of Heat Engines. Efficiency. Clausius Theorem.**	

12	8	Entropy Changes at specific Processes. Entropy of Phase Transitions. Entropy of Ideal Gas. Measurements of Entropy.	
13,14	9	The Nernst heat theorem. Third Law of Thermodynamics. Third Law Entropies of Chemical Substances. Helmholtz Free Energy. Gibbs Free Energy. Maximum work.	
15	10	Fuel Cell. Fundamental Equation. Maxwell Relations. The thermodynamics potentials. Variation of Internal Energy with Volume.	
16	11	Properties of Gibbs Energy. Temperature Dependence of Gibbs Energy. Gibbs – Helmholtz Equation. Pressure Dependence of Gibbs Energy	
		SECOND MIDTERM EXAM – 11 week	
17	12	Material equilibrium. Chemical Potential. Phases. Phase Diagrams. Phase equilibrium. Chemical Potential of Real Gases. Fugacity.	
18, 19	13	Phase rule. Phase Transitions in Pure Compounds. Temperature and Pressure Dependence. Clapeyron equation. Clausius-Clapeyron Equation. First and Second Order Transitions.	
20, 21	14	Properties of Simple Mixtures. Partial Molar Quantities. Partial Molar Volume. Gibbs - Duhem Equation. Thermodynamics of Mixing. Ideal Gas Mixture.	
22	15	Binary Liquid Mixtures. Partial Vapor Pressure. Raoult's Law. Henry's Law. Ideal solutions. Ideal Dilute Solutions. Real Solutions. Excess functions. Colligative Properties.	

The position in the table is tentative.