

Fall 2018

CHEM 231-001 Physical Chemistry I

Lev Krasnoperov

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Chemistry: *Fall 2018 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	Lev Krasnoperov

Office Hours for All Chemistry & Environmental Science Instructors: [Fall 2018 Office Hours and Emails](#)

Required Textbook:

Title	Physical Chemistry
Author(s)	Peter Atkins and Julio De Paula
Edition	10 th Edition
Publisher	Freeman & Co.
ISBN #	2014, ISBN-13:978-1-4292-9019-7
Chapters to be covered	1, 2, 3, 4, 5A, 5B, 5E

University-wide Withdrawal Date: The last day to withdraw with a **W** is Monday, November 12, 2018. 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.

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
Attendance	80

^{a)}Homework grades will be given based on **THREE** quizzes 110 pts each, 35 min, two 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 normally result in F. Scores larger than 85% of total always 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. The homework problems set by the instructor are to be handed in for grading and will be used in the determination of the final letter grade as described above.

Exams: There will be two midterm exams held in class 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 - 9 (after the material from lectures 9 -16 is completely covered)
Final Exam Period	December 15 - 21, 2018

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.

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 [here](#).

Accommodation of Disabilities: Office of Accessibility Resources and Services (*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 2018 Academic Calendar, Registrar](#))

Date	Day	Event
September 4, 2018	T	First Day of Classes
September 10, 2018	M	Last Day to Add/Drop Classes
November 12, 2018	M	Last Day to Withdraw
November 20, 2018	T	Thursday Classes Meet
November 21, 2018	W	Friday Classes Meet
November 22 - 25, 2018	R - Su	Thanksgiving Break - University Closed
December 12, 2018	W	Last Day of Classes
December 14, 2018	F	Reading Day
December 15 - 21, 2018	F - R	Final Exam Period

Course Outline

Lecture	Section	Topic	Assignment ^(c)
1, 2	001	Thermodynamic System. Equilibrium. State of Thermodynamic System. Zeroth Law of Thermodynamics. Ideal Gas. Boyle's Law. Charles Law. Temperature. Equation of State.	Homework #1 Exercises: 1A.1(a), 1A.2(a), 1A.3(a), 1A.7(a), 1A.12(a) Problems: 1A.1, 1A.3
3, 4	001	Importance of Boyle Temperature. Van der Waals Equation of State. Van der Waals Parameters. Critical Constants. Principle of Corresponding States. Maxwell Construction. Real Gas.	Homework #2 Exercises: 1C.4(b), 1C.7(a) Problems: 1C.2, 1C.3, 1C.7
5, 6	001	Energy, Work, Heat, and Internal Energy. Thermodynamics. First Law. Expansion Work. Reversible Expansion. Heat and Enthalpy. Heat Capacity.	Homework #3 Exercises: 2A.6(a), 2B.2(a), 2B.3(a), 2C.5(a) Problem: 2B.3
7	001	Enthalpy. Standard Enthalpy. Standard State. Enthalpy of Chemical Reaction. Standard Enthalpy of Solution, Ionization, Bond Dissociation, etc.	Homework #4 Exercises: 2A.5(a), 2C.3(b), 2C.4(a), 2C.9(a), 2C.10(a) Problems: 2A.2, 2C.7
8	001	Thermochemistry. Reference States of Elements. Standard Enthalpies of Formation. Standard Enthalpy of Formation of Ions. Temperature Dependence of Reaction Enthalpies.	Homework #5 Exercises: 2D.2(a), 2D.3(a) Problems: 2D.3, 2D.4
FIRST MIDTERM EXAM			
9, 10	001	Thermodynamic Relations. Joule Experiment. Coefficient of Thermal Expansion. Relation between C_p and C_v . Reversibility. Entropy. Second Law of Thermodynamics. Entropy of Chemical Reaction.	Homework #6 Exercises: 3A.11(a), 3B.2(a), 3C.2(a), 3C.3(a) Problems: 3A.7, 3A.9
11	001	Adiabatic Expansion or Compression. Ideal Gas.	Homework #7 Exercises: 3D.2(a), 3D.3(a), 3D.4(a) Problems: 3D.1, 3D.3
12	001	Heat Engines. Carnot Cycle. Reversion of Heat Engines. Efficiency. Clausius Theorem.	

13,14	001	Entropy of Phase Transitions. Entropy of Ideal Gas. Measurements of Entropy. Third Law of Thermodynamics. Third Law Entropies of Chemical Substances. Efficiencies of Thermal Processes.	
15	001	Helmholtz Free Energy. Gibbs Free Energy. Fuel Cell.	
16	001	Fundamental Equation. Maxwell Relations. Variation of Internal Energy with Volume. Properties of Gibbs Energy. Temperature Dependence of Gibbs Energy. Gibbs – Helmholtz Equation. Pressure Dependence of Gibbs Energy	
		SECOND MIDTERM EXAM	
17	001	Open Systems. Chemical Potential. Pure Substances and Mixtures. Chemical Potential of Real Gases. Fugacity.	Homework #8 Exercises: 4A.1(a), 4B.5(a), 4B.6(a), 4B.7(a) Problems: 4B.2, 4B.3
18, 19, 20	001	Phase Transitions in Pure Compounds. Phases. Phase Diagrams. Pressure Dependence. First and Second Order Transitions. Clausius- Clapeyron Equation.	Homework #9 Exercises: 4B.8(a), 4B.13(a) Problems: 4B.4, 4B.5
21, 22	001	Properties of Simple Mixtures. Mole Fractions. Partial Molar Volume. Gibbs- Duhem Relations. Thermodynamics of Simple Mixtures. Thermodynamics of Mixing. Ideal Gas Mixture. Solutions. Colligative Properties.	Homework #10 Exercises: 5A.7(a), 5A.9(a), 5B.3(a), 5B.5(a), 5B.7(a)
23	001	Binary Liquid Mixtures. Partial Vapor Pressure. Ideal Solutions. Raoult's Law. Real Solutions. Ideal Dilute Solutions. Henry's Law. Solubility of Gases.	Homework #11 Exercises: 5E.1(a), 5E.2(a), 5F.1(a), 5F.3(a) Problems: Integrated activities 5.1

^{c)} Eleven weekly homeworks. The position in the table is tentative.

*Updated by Prof. L. Krasnoperov - 2018
Department of Chemistry & Environmental Sciences
Course Syllabus, Fall 2018*