

# SYLLABUS

## CHEM 236 Physical Chemistry for Chemical Engineers

Spring 2018

<p><b>Section 002 is TTh Classes:</b>  <b>1/16/18 through 4/26/18*</b>  <b>T: 11:30 am – 2:20 pm</b>  <b>Th: 10 am – 12:05 pm</b>                  Classroom: <b>FMH 205</b></p> <p><b>* Section 002 does not meet on T 3/13/18 and Th 3/15/18</b></p>	<p>Instructor: Kathleen Gilbert, PhD, PE                  Department of Chemistry and                  Environmental Science                  NJIT, Newark, NJ 07102</p> <p>Email: <a href="mailto:gilbert@njit.edu">gilbert@njit.edu</a> (best way to contact)</p> <p><b>See instructor after the first session regarding use of earlier editions of the textbook.</b></p>	<p><b>Section 004 is MTh Classes:</b>  <b>1/18/18 through 4/30/18*</b>  <b>M: 1 pm – 3:50 pm</b>  <b>Th: 2:30 pm – 4:35 pm</b>                  Classroom: <b>FMH 205</b></p> <p><b>* Section 004 does not meet on M 3/12/18 and Th 3/15/18</b></p>
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**TEXTBOOK:** Atkins & dePaula, *Physical Chemistry, 10<sup>th</sup> Edition*.

**eBooks / digital versions of the textbook are NOT recommended – see below.**

**Office hours:** To be determined; email or see the instructor after class to arrange a meeting. TA office hours will be available and are generally after one class per week for each section.

<p><b>Chem 236. Physical Chemistry for Chemical Engineers (5-0-0)</b>                  Prerequisites: (Chem 122 or Chem 126) and Chem 124 and (ChE 230 or ChE 232) with a grade C or better. This course will introduce the chemical engineering students to the concepts of order, disorder, chemical equilibrium, and phase equilibrium. Credit for this course will not be given if credit for Chem 235 has been given.</p>	<p><b>Course Grading:</b></p> <table style="width: 100%; border-collapse: collapse;"> <tr> <td>Worksheets/HW Demo/Signins/Online HW</td> <td style="text-align: right;">8%</td> </tr> <tr> <td>Quizzes</td> <td style="text-align: right;">22%</td> </tr> <tr> <td>Exam 1</td> <td style="text-align: right;">20%</td> </tr> <tr> <td>Exam 2</td> <td style="text-align: right;">20%</td> </tr> <tr> <td><u>Exam 3/Final</u></td> <td style="text-align: right;"><u>30%</u></td> </tr> <tr> <td><b>Total</b></td> <td style="text-align: right;"><b>100%</b></td> </tr> </table>	Worksheets/HW Demo/Signins/Online HW	8%	Quizzes	22%	Exam 1	20%	Exam 2	20%	<u>Exam 3/Final</u>	<u>30%</u>	<b>Total</b>	<b>100%</b>
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<u>Exam 3/Final</u>	<u>30%</u>												
<b>Total</b>	<b>100%</b>												

The default grading scale is as follows.

Letter Grade	Overall Class Percent
A	90 or above
B+	85 - 89.9
B	80 - 84.9
C+	75 - 79.9
C	70 - 74.9
D	60 - 69.9
F	59.9 or below

Departures from this grading scale will be considered on a class-wide basis for individual semesters, based on final grade calculations and grade distributions. In every case, the increments of the grading scale will remain the same.

Only exact percentages will be considered; example would be an overall class percentage of 79.9% is a C+ not a B using this grading scale.

## Learning outcomes for Chem 236:

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

1. Calculate thermodynamic functions of chemical reactions (enthalpy, entropy, Gibbs energy, heat capacity) based on the tabulated data at the reference and other temperatures.
2. Sketch, interpret, and use phase diagrams for one-component systems.
3. Derive the basic thermodynamic relations and state the approximations and the applicability.
4. Calculate the thermodynamic functions of pure compounds and of components in mixtures.
5. Sketch the phase diagrams for liquid-gas, liquid-liquid, and liquid-solid equilibria for mixtures and to interpret them.
6. Calculate activities and activity coefficients of ions in solutions.
7. Determine equilibrium constants and reaction quotients based on reaction and/or thermodynamic data.
8. Calculate the transfer parameters (diffusion coefficient, viscosity, thermal and electrical conductivity).
9. Determine the Arrhenius parameters of a chemical reaction from the rate constant vs. temperature data.
10. Analyze data for reactions of simple orders.
11. Build up mechanisms of complex chemical reactions, construct corresponding systems of ordinary differential equations, and use the steady-state or pre-equilibrium approximations.
12. Estimate rate constants of elementary chemical reactions using the Simple Collision Theory and the Transition State Theory.

***Any indications of cheating before, during, or after any quiz or exam will be treated seriously according to NJIT policy and procedures, per the NJIT University Policy on Academic Integrity:***

**<https://www.njit.edu/policies/sites/policies/files/academic-integrity-code.pdf>**

***Incidents will be forwarded to the Dean of Students as noted in the Policy.***

## Notes on Worksheets/HW Demo/Signins/Online HW

- Worksheets are required and one or more will be given on days when there is neither a quiz nor an exam. Missed worksheets for any reason will not be made up; they will either be a zero or averaged out, depending on if there is a Dean of Students-approved excuse. Worksheets may be reviewed in class or graded. Signins will be random and part of the 8% grade; they may be handed out to sign or a roll call may be used.
- Handwritten homework assignments must be completed, but will not be collected or graded. Students will be required to demonstrate exercises or problems in front of the class by writing on the board and describing their work step by step, as noted in the first session. **For Spring 2018, students must demonstrate one exercise and one problem each. Sign up for homework demonstrations is only in Moodle.**
- Online homework is required using the Moodle learning management system. Multiple attempts are allowed depending on the assignment. Demonstrated online homework questions will be considered problems.

## Notes on Quizzes and Exams

- There will be three quizzes in class throughout the semester to ensure each student is completing the homework assignments in a timely manner. Quizzes are 40 minutes. The first two exams are 85 minutes; Exam #3 is 150 minutes and held during the final exam period. Exam #2 and Exam #3 are cumulative but weighted towards newer material. This will be discussed in class before each exam.
- Quizzes are on an 11 point basis. 100% on a quiz would be 11 points. The lowest quiz grade is dropped.
- All quizzes and exams are open book only – closed notes and no extra papers allowed in your textbook. Only one print copy of Atkins' Physical Chemistry, any edition, is allowed during the quizzes and exams. No other books or papers. \*Tiny\* bookmarks of size less than 1/2" x 1" are allowed. Writing in the textbook is allowed; renters are advised to use \*tiny\* post-it note pieces.
- No eBooks, or any other electronic devices except for approved calculators are allowed during quizzes and exams. You must use a print copy of the text book, or use no book at all during the quizzes and exams. Books and calculators are checked early in each quiz and exam period.
- Some programmable/graphing calculators are allowed during quizzes and exams, however Texas Instruments TI89, TI92 Plus, NSpire, TI89 Titanium, HP Prime, HP 49g, HP 50g, Voyage 200, and any model of Calctimate are not allowed. Be advised that any calculator that appears to have Internet or file access during the exam will be subject to review by the TA or instructor writing down the make and model, and clarifying that the calculator does not violate the class rules. The TA and instructor reserve the right to take a photo of the calculator in question to verify the make and model of the calculator.
- Note that because certain graphing and programmable calculators are allowed, all work must be shown. This includes the equation with variables and parameters only, and the equation with all numbers. Missing steps will result in lost points. Missing units may result in lost points, depending on the problem. Correct answers without proper work will receive no or minimal credit.
- Extra credit may be included with quizzes and exams; the use of extra points on quizzes and exams makes it much more likely that the grading scale shown (90% = A) will be the final grading schedule for the semester.

### **Notes on Class Attendance:**

- Students who miss class due to a valid personal or medical reason must contact the Dean of Students office with the valid excuse and get the excuse approved. The Dean of Students will then contact me and any other professors whose classes were missed. Missed worksheets, quizzes, or exams without a Dean of Students approved excuse will result in a zero grade. The instructor does not approve excuses of any sort. Very brief occasional absences will be ignored. Students walking out of class early or low attendance early in a class may result in a roll call being taken and loss of points.
- No student will be exempted from demonstrating homework - see me if there is a disability issue. If there is a Dean of Students approved excuse for their homework demonstration date, that student will either demonstrate the same homework question later or sign up for another exercise or problem. Students are advised to do their homework demonstrations early in the semester to avoid any issues due to absences.
- The instructor reserves the right to assign online Moodle assignments, including viewing unnarrated or narrated lectures or taking brief online quizzes (separate from the in-class quizzes), as needed to make up class time missed due to special circumstances. Online quizzes will count as worksheets. Viewing online lectures is the responsibility of the student. Material found only online may be on quizzes and exams.

### **Homework Demonstration Policy:**

Homework demonstrations will be confirmed by students signing the homework demonstration paper the day the demonstration takes place, before they return to their seat. Any exercise or problem demonstrated without written proof on the instructor's documents will be considered not demonstrated.

### **Extra Credit Policy:**

Extra credit opportunities are only given at the instructor's discretion. The chief extra credit opportunity is through the instructor adding points to exam totals, and keeping the exams on a 100 point basis, and similarly add one point to make a quiz 12 points yet still on an 11 point basis. If exam averages are 70% or above, it is likely that no other extra credit opportunities will be provided. All extra credits opportunities will be provided to the entire class, regardless of each student's current grade. Please do not ask for "extra extra credit".

### **Quiz or Exam Grading Error Policy:**

Any errors on a quiz or exam must be brought to the attention of the instructor **via email including a photo or photos** within **24 hours** of the papers being returned to the class, whether or not a student receives their paper that day. The only exception would be Dean of Students-approved excuses. Regrading will be at the instructor's discretion, and the instructor can choose to regrade the entire quiz or exam. It is possible that points may be awarded and/or may be taken away, so students are advised to review their entire quiz or exam before emailing the instructor.

Any modifications to a quiz or exam by a student after grading where the student submits their paper for regrading is considered a violation of the NJIT Academic Integrity Policy and will be dealt with accordingly.

COURSE SCHEDULE – CHEM 236 SPRING 2018 GILBERT (Atkins 10<sup>th</sup> Edition Chapters)

Section 002 TTh		Section 004 MTh
T 1/16, Th 1/18	Intro, Ch. 2 First Law (all; <i>in-person and online</i> )	Th 1/18, M 1/22
T 1/23, Th 1/25	Ch. 3 Second and Third Laws (all)	Th 1/25, M 1/29
T 1/30, <b>Th 2/1*</b>	Ch. 4 Physical transformations of pure substances (4A, 4B.1, 4B.2), <b>*Quiz #1</b>	Th 2/1, <b>M 2/5*</b>
T 2/6, Th 2/8	Ch. 5 Simple mixtures (5A, 5B, 5C, 5E, 5F)	Th 2/8, M 2/12
<b>*EXAM 1*</b> <b>T 2/13/18</b>	<b>EXAM 1 (Ch. 2, 3, 4, 5)</b> First, Second and Third Laws, Physical transformations of pure substances, Simple mixtures - <i>Sections noted above</i>	<b>*EXAM 1*</b> <b>Th 2/15/18</b>
Th 2/15, T 2/20	Ch. 5 (continued)	M 2/19, Th 2/22
Th 2/22, <b>T 2/27*</b> , Th 3/1	Ch. 6 Chemical equilibrium (6A, 6B), <b>*Quiz #2</b>	M 2/26, <b>Th 3/1*</b> , M 3/5
T 3/6, Th 3/8, T 3/20	Ch. 19 Molecules in motion (1B, 19A, 19B, 19C.1)	Th 3/8, M 3/19
<b>**EXAM 2**</b> <b>Th 3/22/18</b>	<b>EXAM 2</b> (focusing on Ch. 6 & Ch. 19 (with 1B) - Chemical equilibria and Molecules in motion – <i>Sections noted above</i> )	<b>**EXAM 2**</b> <b>Th 3/22/18</b>

\*\*\*\*\***Monday April 2<sup>nd</sup>, 2018 is last day to withdraw**\*\*\*\*\*

T 3/27, Th 3/29, T 4/3, <b>Th 4/5*</b>	Ch. 20 Chemical kinetics (all), <b>*Quiz #3</b>	M 3/26, Th 3/29, M 4/9, Th 4/5, <b>M 4/9*</b>
T 4/10, Th 4/12, T 4/17	Ch. 20 (continued)	Th 4/12, M 4/16, Th 4/19
Th 4/19, T 4/24, Th 4/26	Ch. 21 Reaction dynamics (21A, 21C)	M 4/23, Th 4/26, M 4/30
<b>FINAL EXAM</b> <i>F 5/4/18 - Th 5/10/18</i>	<b>EXAM 3</b> (focusing on Ch. 20 & 21– The rates of chemical reactions and Reaction dynamics - <i>Sections noted above</i> )	<b>FINAL EXAM</b> <i>F 5/4/18 - Th 5/10/18</i>

**This syllabus may change based on material covered and other factors.**

**Assigned Homework questions. "OH" in a problem number means it is online in Moodle.** Please complete the assigned homework questions listed below before the in-class homework demonstration session to ensure maximum benefit. Homework demonstrations will be assigned in the order indicated, but chapters may have multiple homework demonstration days.

Problem numbers are for the 10th edition of Atkins and dePaula, which is ordered by a lettered section within a numbered chapter; the homework is ordered the same way. Homework is found at the very end of each chapter, after the text of all sections.

Students have to demonstrate one exercise and one problem to receive full credit for that portion of their grade. Not all homework will be demonstrated in class; students are expected to attend teaching assistant or professor office hours to get help on homework not reviewed in class.

P2OH-1	P2OH-2	P2OH-3	P2OH-4	P2OH-5
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E3A.9a	P3A.9	E3B.2a	P3B.1	E3C.4a	E3C.5a	E3D.2a	P3D.5
P3OH-1	P3OH-2	P3OH-3	P3OH-4	P3OH-5			

E4A.2a	E4B.6a	E4B.13a	P4B.8	P4OH-4	P4OH-5	P4OH-6
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E5A.7a	E5A.9a	E5A.11a	P5A.3	E5B.3a	E5B.8a	E5B.10a	E5B.11a
E5B.12a	E5B.13a	E5C.1a	E5C.7a	E5C.3a	E5C.10a	P5C.1	P5C.2
E5C.2a	P5C.4	P5C.6	E5E.1a	I.A.5.1	I.A.5.4		

E6A.4a	E6A.5a	E6A.6a	E6A.9a	E6A.11a	P6A.1	P6A.2	P6A.3
E6B.2a	E6B.4a	P6B.3	6OH #1	6OH #2	6OH #3		

E1B.5a	E1B.6a	E19A.1a	E19A.2a	E19A.4a	E19A.7a	E19A.9a	E19A.10a
E19B.2a	E19B.4a	E19B.5a	E19B.6a	E19B.7a	E19B.4	E19B.6	
P19OH-1	P19OH-2	P19OH-3					

E20A.2a	E20A.4a	E20A.2	E20A.4	E20B.1a	E20B.2a	P20B.3	P20B.13
P20B.17	E20C.1a	E20D.1a	P20D.2	P20D.3	P20D.4	E20E.1a	E20E.2a
E20F.1a	P20G.1	E20H.1a	E20H.2a	P20OH-1			

**Ch. 5 Section C has three sets of homework due to the organization of that section. Homework is due by the day it will be demonstrated, which will be noted in class.**

**Homework demonstration sign up is online in Moodle.**