DEPARTMENT OF CHEMISTRY
CHEM-UA 129
Accelerated General Chemistry
Fall 2018

Course Description: This course is a single-semester accelerated course, taught at an advanced level, for first-year students with a strong interest in majoring in the sciences, including Chemistry, and who have completed advanced high school courses in the subject areas of chemistry, math, and physics. The course serves as a one-semester substitute for the two-semester General Chemistry I and II course (Chem-UA 125 and Chem-UA 126). The course addresses quantum mechanics in the context of atomic structure, thermodynamics in the context of properties of matter and chemical transformations, and reaction kinetics. The course aims to bolster understanding of the various aspects of chemistry through explorations at a deeper level than in a standard general chemistry course. Topics include quantum mechanics related to atomic structure and the chemical bond, laws of thermodynamics related to the properties of matter and chemical transformations, and chemical kinetics. The course is built around foundational concepts and their application to understanding chemistry broadly, and it is accompanied by an associated laboratory designed to reinforce lecture topics.

Course Web Site: See NYU Classes (classes.nyu.edu)
Lecture times: Monday and Wednesday (MW) 8:00 AM - 9:15 AM
Location: 25W4_C-13
Lecture Instructor: Michael D. Ward (MDI laboratories, Brown 554, mdw3@nyu.edu)
Office Hours: TW 3:00 PM – 4:00 PM, and by appointment
Recitation: Friday (F) 9:30 - 10:45 AM
Laboratory: Thursday (R) 2:30 PM – 6:45 PM; Brown 455
Recitation Instructor: Malgorzata Mandziuk (1001W Silver, margaret.mandziuk@nyu.edu)
Lab Instructor: Malgorzata Mandziuk (1001W Silver, margaret.mandziuk@nyu.edu)
Office Hours: TBA

Textbook
Atkins and Jones: Chemical Principles: The Quest for Insight, W.H. Freeman and Co., 7th Edition. Older editions will suffice, although there may be some differences between editions. An online Sapling Learning package can be purchased as a package with a new text or separately (if you buy a used text) at www.saplinglearning.com. The Sapling Learning package is not required, but you may find it useful as a study tool. You can purchase the textbook in hardcopy or E-copy format (the latter is much less expensive). Either version is available directly from the publisher (MacMillan) or the NYU Bookstore:

https://www.macmillanlearning.com/Catalog/product/chemicalprinciples-seventhedition-atkins/valueoptions#tab
https://www.bkstr.com/nyustore/home

Supplemental Material
The textbook is only a subset of what will be covered by the course. Supplemental reading and exploration will be assigned occasionally and posted on the NYU Classes course website.
These readings will provide you with exposure to the historical development of key concepts to examination of certain topics beyond the scope of the textbook to areas of contemporary and emerging chemistry research. Some lectures may be accompanied by notes and outlines that will be available on the NYU Classes website at least one day ahead of the lecture so that you can download them for annotation in class, thus allowing you to pay closer attention to the lecture. Please note that topics often will not be covered fully in lecture and there may be material you will need to master on your own or with your peers.

**Prerequisites**

Department permission required for all students. Prior course prerequisites include Calculus I or equivalent; AP scores of 5 in Chemistry and Math (Calculus AB at a minimum) required; AP Physics score of 4 preferred. In the absence of AP courses and scores, the Department will evaluate alternative qualifications when considering admission to the course. All students must demonstrate proficiency, as defined by the Department, in a placement examination administered prior to the beginning of the semester.

**Course Objectives**

Learn the physical principles and foundational concepts underlying the behavior of matter and chemical processes, including (i) quantum mechanics at the atomic level, chemical bonding, molecular structure, (ii) properties of gases, liquids and solids, materials and their properties, (iii) the first, second and third law of thermodynamics, and (iv) chemical kinetics. Students will be prompted to explore topics independently in order to expand their understanding of core principles beyond the scope in the textbook, using any available resources. The course aims to equip students with analytical and critical thinking skills so they are prepared for subsequent advanced courses in chemistry and allied disciplines, while providing more flexibility when choosing electives in chemistry.

**Exams**

- **Exam 1:** Friday, October 19, 2018 Location: TBA
- **Exam 2:** Friday, November 16, 2018 Location: TBA
- **Final:** TBA

Exam questions will be drawn from material covered prior to the lecture immediately preceding the exam, although in the case of the second exam and final exam these questions will build on concepts taught earlier in the course. Make-up exams will be allowed only in the event of a DOCUMENTED illness of family emergency. If you become aware that you cannot be present for an exam and you have a legitimate excuse, notify the instructor immediately. Students who miss an exam (i) will have the option of folding the weighting of the missed exam evenly into the other two exams or (ii) can choose a standing oral exam given jointly by the lecture and recitation instructors. 

**Problem Sets**

Problem sets will be available for download on the NYU Classes course site (classes.nyu.edu) each Monday, beginning in Week 2. Completed problem sets will be due the following Monday, submitted PRIOR to the beginning of the lecture – NO EXCEPTIONS. Each problem set will consist of ten questions, weighted equally. No partial credit will be considered for problems with numerical solutions for which there is only one correct answer. Answers with missing units will be considered incorrect. Points will be deducted for answers with an incorrect number of significant figures. No more than twelve problem sets will be assigned; the lowest two grades will be dropped. In cases of a DOCUMENTED illness or family emergency, a missed problem set(s) will not be used in evaluating the student’s grade. The combined problems sets constitute 10% of the grade. Collaboration with others in the class is permitted, but the names of your collaborators must be included on your problem set. If you collaborate, however, be sure
you understand the solutions to the problem sets, otherwise you will not be well prepared for the exams and your grade will suffer accordingly. Questions about problem sets and course material must be addressed during office hours, not by Email. The only exception: if you find a mistake or typographical error in a problem set question (this can happen!), feel free to send an Email to the instructors.

*Student-generated problem sets.* On occasion, you will be asked to construct a challenging problem and supply a complete solution, with all steps included, on each problem set. This question should be submitted to the instructors by Email as a Microsoft Word document. The problem should be challenging, but at appropriate level of difficulty. The question should be clear and unambiguous. One question will then be drawn at random for a subsequent recitation session, and the student who authored the question will be asked to lead the class through the problem using a Socratic approach. These questions also will be compiled into a problem set that will be the final assignment of the semester. As a form of explanatory learning, this is intended to give you an opportunity to learn by doing.

**Quizzes**
Short quizzes may be given occasionally at the beginning of class. Each quiz will consist of a short question pertaining to material covered in previous lectures and/or in assigned readings. Quizzes will begin promptly at 08:00 and will be collected at 08:10.

**Exams**
Exams will be closed book, in class. It is crucial you arrive 10 minutes prior to the beginning of the class period when exams are given. You will be allowed one 3 x 5 in. index card, a calculator, and writing instruments for the exam.

**Recitations**
Recitations will be formatted as problem-solving sessions. Attendance is required. See list of recitation topics on the following pages. See the attached syllabus.

**Laboratory**
Laboratory sessions will meet weekly in Brown 455. See the attached syllabus.

**Grading (Lecture):**
The final lecture grade will be based on the following distribution:

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Problem Sets</td>
<td>10%</td>
</tr>
<tr>
<td>Quizzes</td>
<td>10%</td>
</tr>
<tr>
<td>Exam 1</td>
<td>20%</td>
</tr>
<tr>
<td>Exam 2</td>
<td>20%</td>
</tr>
<tr>
<td>Final</td>
<td>40%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100%</strong></td>
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**Grading (Laboratory):**
See the laboratory syllabus for details.

**Final Total Grade:**
Final Grade: *Lecture:* 75% *Laboratory:* 25%

**Grade Appeals**
If you have a concern about a grade, or a concern about how a particular problem(s) was graded, you should contact the instructor who graded the problem set/quiz/exam or the specific question in the
problem set/quiz/exam. The instructor who graded a particular problem set/quiz/exam or a specific question usually will be identified by their initials on the assignment or next to the specific question. Please be aware that an appeal of a grade opens the entire assignment or exam to review. If the instructor finds a problem that has been graded as correct is actually incorrect, your grade may be lowered.

Schedule of Topics

<table>
<thead>
<tr>
<th>Week</th>
<th>Topic</th>
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</table>
| 1    | Focus 1: Quantum World  
        Lab 1: Orientation and Lab Safety; Error analysis |
| 2    | Focus 1: Quantum mechanics: Atoms  
        Lab 2: Atomic Spectra |
| 3    | Focus 2: Quantum mechanics: Chemical Bonds  
        Lab 3: Light & Color: Application of Beer’s Law; Job Method |
| 4    | Focus 2: Molecular Shape and Structure  
        Lab 4: VESPR with Cambridge Crystallographic Data Centre |
| 5    | Focus 2: Molecular Orbitals  
        Lab 5: Spartan: MO of Diatomic and Polyatomic Species / MOs of Ferrocene |
| 6    | Focus 3: States of Matter - Gases, Liquids and Solids  
        Lab 6: Gas Chromatography |
| 7    | Focus 3: Gases, Liquids and Solids  
        Lab 7: Vapor Pressure of Water; Enthalpy of Vaporization |
| 8    | Focus 4: First Law of Thermodynamics  
        Lab 8: Determination of the Enthalpy of Formation |
| 9    | Focus 4: Second and Third Law  
        Lab 9: Evaluating Equilibrium Constant for Complex Formation |
| 10   | Focus 5: Equilibria and free energy  
        Lab 10: Effect of ionic strength on an Equilibrium Constant |
| 11   | Focus 5-6: Solutions (colligative properties, acids & bases)  
        Lab 11: Preparation of a Buffer of a Specific Strength |
| 12   | Focus 6: Electrochemistry and free energy  
        Lab 12: Non-Ideality in Freezing Point Depression |
| 13   | Focus 7: Kinetics and rate laws  
        Lab 13: Iodine Clock Reaction/Kinetics |
| 14   | Focus 7: Kinetics and rate laws  
        Lab 14: Checkout |

Academic Dishonesty

Academic dishonesty is incompatible with the practice of science or any profession. If evidence of dishonesty is found, the policy of the College of Arts and Sciences will be followed [http://cas.nyu.edu/object/bulletin1012.ug.academicpolicies]. This includes any form of plagiarism, copying, collusion or cheating during an examination of any kind. All such cases are reported to the Director of Undergraduate Studies. University policy states: “Students who engage in such behavior will
be subject to review and the possible imposition of penalties in accordance with the standards, practices, and procedures of NYU and its colleges and schools. Violations may result in failure on a particular assignment, failure in a course, suspension or expulsion from the University, or other penalties.” If suspended or expelled from the University, a notation will be made on your record as to the cause. A notation is very SERIOUS, as it could translate to a barring of entry to a professional school of any kind, e.g. medical school, graduate school and, possibly, difficulty in landing a job.

Excellent students such as you are probably offended at even the mention of cheating. But temptation can arise even among the accomplished. If you are having difficulties, then see Professors Ward or Mandziuk immediately. If you believe you would rather seek assistance from someone outside the course, you may want to consider the Student Services Section of the CAS Dean’s Office on the 9th floor of the Main Building. Read and understand the above before you consider compromising your integrity - and your future.

Disabilities
Students with Disabilities are encouraged to contact the instructor for a confidential discussion of their individual needs for academic accommodation. It is the policy of NYU to provide flexible and individualized accommodation to students with documented disabilities that may affect their ability to fully participate in course activities or to meet course requirements. To receive accommodation services, students must be registered with the Center for Students with Disabilities (CSD) (mosescsd@nyu.edu) as soon as possible. Any student who needs a reasonable accommodation based on a qualified disability is required to register with the CSD for assistance. CSD will send the course instructors official notification of your accommodation needs. Please make an appointment with the instructor to discuss the accommodations and how course requirements and activities may impact your ability to fully participate.

Classroom Etiquette
Courteous and civil behavior is expected and anything apart from that will not be condoned. A university exists for the free but critical exploration of ideas and developing understanding of a myriad of topics. This can only be achieved through respect for the institution itself and among the scholars that comprise it. Anything other than polite (which does not exclude passionate or spirited debate) behavior is inexcusable. The fundamental rule is simple: Be considerate of others in the classroom. In order to prevent distractions, to allow others to concentrate on proceedings, and to make learning as efficient and facile as possible, certain proscriptions are necessary:

• During exams, the use of DVD, mp3, mp4, etc. players; netbook, tablet, laptop, PDA, tablet computers or any other personal, portable electronic device other than a calculator is prohibited, unless expressly allowed by the instructor. Only students approved by the CSD may have personal electronic devices in the classroom or laboratory.
• No foods, soft drinks (water is OK), etc. are allowed in the classroom. No food or water is allowed in the laboratory (see the laboratory syllabus for more details).
• Gum and (need I say this) tobacco chewing is prohibited.
• Any distraction to others, such as conversation, electronic devices, smoke signals, etc. is not acceptable.
• Silence cell phones before class. If your cell phone makes a disturbance, you will be asked to leave the class. You may be asked to look up material on your cell phone or tablet
• If you need to leave the class, avoid disruption as much as possible. If you suspect or know you may have to leave class early or otherwise, sit at the desk nearest an exit door to keep disruption at a minimum.
<table>
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<th>Week</th>
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| 1    | **Focus 1:** Quantum World  
*Recitation 1:* Review of calculus and other basic math techniques needed for understanding the solutions of a particle in a box problem. Kinetic and electrostatic potential energy expressions for a system of charged particles.  
*Lab 1:* Orientation and Lab Safety; Error analysis |
| 2    | **Focus 1:** Quantum mechanics: Atoms  
*Recitation 2:* Modeling shapes of hydrogen atom orbitals.  
*Lab 2:* Atomic Spectra. Measuring line spectra of gases, including hydrogen. Analysis of the helium spectrum with an emphasis on whether or not it contains lines from a He⁺ ion? |
| 3    | **Focus 2:** Quantum mechanics: Chemical Bonds  
*Recitation 3:* Modeling formation of hybrid orbitals.  
| 4    | **Focus 2:** Molecular Shape and Structure  
*Recitation 4:* Predicting shapes of small molecules and ions. Comparing predictions with the experimentally determined shapes in the Cambridge Crystallographic Data Centre.  
*Lab 4:* Molecular Structure: Polarimetry - Stereoisomers and Diastereomers, mutarotation |
| 5    | **Focus 2:** Molecular Orbitals  
*Lab 5:* Spartan: Molecular Orbitals of Polyatomic Species |
| 6    | **Focus 3:** States of Matter - Gases, Liquids and Solids  
*Recitation 6:* Demo of the simulation of Gas Laws, Maxwell-Boltzmann distribution, and intermolecular forces needed for condensation.  
*Lab 6:* Gas Chromatography. Effect of different conditions on the retention time. Identification of unknown compounds in a mixture. |
| 7    | **Focus 3:** Gases, Liquids and Solids  
*Recitation 7:* Matter and light: Principles of X-ray diffraction  
*Lab 7:* Vapor Pressure of Water; Enthalpy of Vaporization |
| 8    | **Focus 4:** First Law of Thermodynamics  
*Recitation 8:* Solutions of thermochemistry problems  
*Lab 8:* Determination of the Enthalpy of Formation |
9  **Focus 4:** Second and Third Law  
**Recitation 9:** Problem solving? Partition function? Contributions to specific heat capacity?  
**Lab 9:** Evaluating Equilibrium Constant for Complex Formation

10  **Focus 5:** Equilibria and free energy  
**Recitation 10:** Problems illustrating the Le Chatelier’s principle  
**Lab 10:** Effect of ionic strength on an Equilibrium Constant

11  **Focus 5-6:** Solutions (colligative properties, acids & bases)  
**Recitation 11:** pH of solutions, titration, solubility equilibria practice problems  
**Lab 11:** Preparation of a Buffer of a Specific Strength

12  **Focus 6:** Electrochemistry and free energy  
**Recitation 12:** Problem solving  
**Lab 12:** Non-Ideality in Freezing Point Depression

13  **Focus 7:** Kinetics and rate laws  
**Recitation 13:** Oscillating reaction demonstration. Stripping a bi-exponential decay curve.  
**Lab 13:** Iodine Clock Reaction

14  **Focus 7:** Kinetics and rate laws  
**Recitation 14:** Review  
**Lab 14:** Checkout