Physical Chemistry II CHEM 4424
Physical & Environmental Sciences
Spring 2017

A. COURSE INFORMATION

Course number/section: CHEM 4424.001 and CHEM4424.101
Class meeting time: Lecture MWF 10:00 – 10:50 a.m.; Lab M 11:00 – 1:50
Class location: Lecture CS 103; Lab CS 221
Course Website: https://bb9.tamucc.edu/

B. INSTRUCTOR INFORMATION

Instructor: Timothy P. Causgrove
Office location: CS 202
Office hours: T & Th 9:00-10:00 a.m., W & F 8:00 – 9:30 a.m.
Telephone: 825-2399
e-mail: tim.causgrove@tamucc.edu
Appointments: Additional appointments available by e-mail request

C. COURSE DESCRIPTION

Catalog Course Description
A continuation of CHEM 4423, including the study of chemical kinetics, electrochemistry, molecular structure, and quantum mechanics. Prerequisite: CHEM 4423. Safety training given during a laboratory meeting early in the semester is required for continued participation in this course.

Extended Course Description
This course is the second semester of the two-semester physical chemistry sequence. It combines a lecture portion and a laboratory portion. The lecture portion of the course consists primarily of introductory quantum mechanics and its relation to spectroscopic observations. The course will also include reaction kinetics and kinetic mechanisms. The laboratory portion of the course will contain a mixture of traditional laboratory experiments, dry lab experiments and computer exercises.

D. PREREQUISITES AND COREQUISITES

Prerequisites
CHEM 4423

Corequisites
SMTE 0093

E. REQUIRED TEXTBOOK(S), READINGS AND SUPPLIES

Required Textbook(s)
Physical Chemistry, 10th ed. by Atkins & dePaula ISBN 9781429290197 OR Physical Chemistry

Optional Textbook(s) or Other References
None

Supplies
Scientific calculator, lab coat, goggles

F. STUDENT LEARNING OUTCOMES AND ASSESSMENT

Assessment is a process used by instructors to help improve learning. Assessment is essential for effective learning because it provides feedback to both students and instructors. A critical step in this process is making clear the course’s student learning outcomes that describe what students are expected to learn to be successful in the course. The student learning outcomes for this course are listed below. By collecting data and sharing it with students on how well they are accomplishing these learning outcomes students can more efficiently and effectively focus their learning efforts. This information can also help instructors identify challenging areas for students and adjust their teaching approach to facilitate learning.

By the end of this course, students should be able to:
1. Identify the solutions to the Schrödinger equation
2. Extract physical quantities from wavefunctions
3. Calculate the allowed energy levels for molecules and atoms
4. Do calculations involving chemical kinetic equations

G. INSTRUCTIONAL METHODS AND ACTIVITIES

The laboratory grade will be based on laboratory assignments submitted for each experiment. It is expected that there will be nine laboratory assignments, with each weighted equally. Each laboratory assignment, which will vary depending on the lab activity, will be graded based on a maximum of 20 points. Laboratory experiments will be done in groups of two, and group may turn in one common assignment, or the students may turn in materials independently. Laboratory reports are generally due one week after the experiment. For non-laboratory (mostly computer) assignments, the work will be turned in individually and will generally be due during the lab period. Make-up lab attendance is intended only for those absent during a regular lab session.

H. MAJOR COURSE REQUIREMENTS AND GRADING

Your grade in this course will be based on both lecture and laboratory, broken down as follows:

<table>
<thead>
<tr>
<th>ACTIVITY</th>
<th>% of FINAL GRADE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Exams (3) | 45
---|---
Problem Sets | 10
Lab Average | 25
Final Exam | 20

Overall grades for the course (four hours credit) will be assigned according to a ten-point scale: A for >90%, B for 80-89%, C for 70-79%, D for 60-69%, and F for <60%. Rounding is at the discretion of the instructor.

**I. COURSE CONTENT/SCHEDULE**

**Lecture Schedule:**

<table>
<thead>
<tr>
<th>DATE</th>
<th>TOPIC</th>
<th>CHAPTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/18</td>
<td>Introduction to Physical Chemistry II</td>
<td></td>
</tr>
<tr>
<td>1/20</td>
<td>Failure of classical mechanics</td>
<td>7A</td>
</tr>
<tr>
<td>1/23</td>
<td>Schrödinger equation</td>
<td>7B</td>
</tr>
<tr>
<td>1/25</td>
<td>Operators and eigenvalues</td>
<td>7C</td>
</tr>
<tr>
<td>1/27</td>
<td>Orthogonality and uncertainty principle</td>
<td>7C</td>
</tr>
<tr>
<td>1/30</td>
<td>Translation – the particle in a box</td>
<td>8A</td>
</tr>
<tr>
<td>2/1</td>
<td>Translation – multi-dimensional boxes</td>
<td>8A</td>
</tr>
<tr>
<td>2/3</td>
<td>Vibration – the harmonic oscillator</td>
<td>8B</td>
</tr>
<tr>
<td>2/6</td>
<td>Rotation in two dimensions (one variable)</td>
<td>8C</td>
</tr>
<tr>
<td>2/8</td>
<td>Rotation in three dimensions (two variables)</td>
<td>8C</td>
</tr>
<tr>
<td>2/10</td>
<td>Hydrogenic atoms</td>
<td>9A</td>
</tr>
<tr>
<td>2/13</td>
<td>Review for Exam #1</td>
<td></td>
</tr>
<tr>
<td>2/15</td>
<td>Properties of orbitals</td>
<td>9A</td>
</tr>
<tr>
<td>2/17</td>
<td>Many-electron atoms and spin</td>
<td>9B</td>
</tr>
<tr>
<td>2/20</td>
<td>Self-consistent field orbitals</td>
<td>9B</td>
</tr>
<tr>
<td>2/22</td>
<td>Atomic spectra and selection rules</td>
<td>9C</td>
</tr>
<tr>
<td>2/24</td>
<td>Spin-orbit coupling and term symbols</td>
<td>9C</td>
</tr>
<tr>
<td>2/27</td>
<td>Valence bond theory and hybrid orbitals</td>
<td>10A</td>
</tr>
<tr>
<td>3/1</td>
<td>Molecular orbital theory</td>
<td>10B</td>
</tr>
<tr>
<td>3/3</td>
<td>Molecular orbitals of homonuclear diatomics</td>
<td>10C</td>
</tr>
<tr>
<td>3/6</td>
<td>Molecular orbitals of heteronuclear diatomics</td>
<td>10D</td>
</tr>
<tr>
<td>3/8</td>
<td>The Hückel approximation</td>
<td>10E</td>
</tr>
</tbody>
</table>
3/10  Semi-empirical and *ab initio* methods  10E
3/20  Symmetry elements  11A
3/22  Symmetry groups  11A
3/24  Group theory  11B
3/27  **Review for Exam #2**
3/29  Character tables  11B
3/31  Basics of molecular spectroscopy  12A
4/3  Rotational and vibrational spectra  12B
4/5  Vibrations in polyatomic molecules  12E
4/7  The rates of chemical reactions  20A
4/10  Integrated rate laws  20B
4/12  Reactions approaching equilibrium  20C
4/14  The Arrhenius equation  20D
4/17  Reaction mechanisms  20E
4/19  Examples of reaction mechanisms  20F
4/21  Photochemistry  20G
4/24  **Review for Exam #3**
4/26  Enzymes  20H
4/28  Collision theory  21A
5/1  Transition-state theory  21C
5/8  Final Exam, 8:00 – 10:30 a.m.

Note: Changes in this course schedule may be necessary and will be announced to the class by the Instructor. The assignments and exams shown are directly related to the Student Learning Outcomes described in Section F.

**Laboratory Schedule:**

<table>
<thead>
<tr>
<th>DATE</th>
<th>EXPERIMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/23</td>
<td>Math Review</td>
</tr>
<tr>
<td>1/30</td>
<td>Numerical Solution of the Schrödinger Equation (applet)</td>
</tr>
<tr>
<td>2/6</td>
<td>Absorption Spectra of Conjugated Dyes</td>
</tr>
<tr>
<td>2/13</td>
<td><strong>Exam #1</strong></td>
</tr>
<tr>
<td>2/20</td>
<td>The Interpretation of the Emission Spectrum of Lithium (Excel)</td>
</tr>
<tr>
<td>2/27</td>
<td>Simple and Extended Hückel Molecular Orbitals (applet)</td>
</tr>
</tbody>
</table>
J. COURSE POLICIES

• Attendance/Tardiness
  The student is expected to be on time and attend every class. If absent, it is the responsibility of the student to obtain any information that was missed from a classmate. Missed information includes not only lecture notes, but also any possible information regarding syllabus changes.

• Late Work and Make-up Exams
  There will be no make-up exams except as detailed below. Late laboratory assignments will be assessed a penalty of 2 points in the first week after the due date and 10 points thereafter. In-class activities cannot be made up. Make-up laboratory session is exclusively for those who miss a lab. No assignments are accepted after the start of the final exam.

• Extra Credit
  There will be no extra credit assignments.

• Cell Phone Use
  Don’t let that thing distract you.

• Laptop Use
  Any use of an electronic device (cell phone, tablet, laptop, etc.) during an exam is strictly prohibited. Any use of such a device will be considered an attempt to cheat on the exam and will result in a score of zero on the exam although more severe actions may be considered.

• Missed Exam
  Missing an exam does not entitle you to a make-up exam. Students with a university approved absence (athletics, university field trips, etc.) MUST contact the instructor well in advance of the scheduled absence to arrange for an early exam. A written excuse from the university department involved is required. Students who miss an
exam without meeting the above requirements may be given a written exam that may be more difficult than the regular exam.

K. COLLEGE AND UNIVERSITY POLICIES

• Academic Integrity (University)
University students are expected to conduct themselves in accordance with the highest standards of academic honesty. Academic misconduct for which a student is subject to penalty includes all forms of cheating, such as illicit possession of examinations or examination materials, falsification, forgery, complicity or plagiarism. (Plagiarism is the presentation of the work of another as one’s own work.) In this class, academic misconduct or complicity in an act of academic misconduct on an assignment or test will result in a failing grade.

• Classroom/Professional Behavior
Texas A&M University-Corpus Christi, as an academic community, requires that each individual respect the needs of others to study and learn in a peaceful atmosphere. Under Article III of the Student Code of Conduct, classroom behavior that interferes with either (a) the instructor’s ability to conduct the class or (b) the ability of other students to profit from the instructional program may be considered a breach of the peace and is subject to disciplinary sanction outlined in article VII of the Student Code of Conduct. Students engaging in unacceptable behavior may be instructed to leave the classroom. This prohibition applies to all instructional forums, including classrooms, electronic classrooms, labs, discussion groups, field trips, etc.

• Statement of Civility
Texas A&M University-Corpus Christi has a diverse student population that represents the population of the state. Our goal is to provide you with a high quality educational experience that is free from repression. You are responsible for following the rules of the University, city, state and federal government. We expect that you will behave in a manner that is dignified, respectful and courteous to all people, regardless of sex, ethnic/racial origin, religious background, sexual orientation or disability. Behaviors that infringe on the rights of another individual will not be tolerated.

• Deadline for Dropping a Course with a Grade of W (University)
The grade of W will be assigned to any student officially dropping a course. Please consult with the instructor before you decide to drop to be sure it is the best thing to do. Just stopping attendance and participation WILL NOT automatically result in your being dropped from the class. Should dropping the course be the best course of action, visit the Office of the University Registrar for the Course Drop Form that must submitted. No student is eligible to receive a W without completing the official drop process by this deadline. Please consult the Academic Calendar (http://www.tamucc.edu/academics/calendar/) for the last day to drop a course.
• **Grade Appeals (College of Science and Engineering)**
  As stated in University Procedure 13.02.99.C2.01, Student Grade Appeal Procedures, a student who believes that he or she has not been held to appropriate academic standards as outlined in the class syllabus, equitable evaluation procedures, or appropriate grading, may appeal the final grade given in the course. The burden of proof is upon the student to demonstrate the appropriateness of the appeal. A student with a complaint about a grade is encouraged to first discuss the matter with the instructor. For complete details, including the responsibilities of the parties involved in the process and the number of days allowed for completing the steps in the process, see University Procedure 13.02.99.C2.01, Student Grade Appeal Procedures. These documents are accessible through the University Rules website at [http://www.tamucc.edu/provost/university_rules/index.html](http://www.tamucc.edu/provost/university_rules/index.html), and the College of Science and Engineering Grade Appeals webpage at [http://sci.tamucc.edu/students/GradeAppeal.html](http://sci.tamucc.edu/students/GradeAppeal.html). For assistance and/or guidance in the grade appeal process, students may contact the chair or director of the appropriate department or school, the Office of the College of Science and Engineering Dean, or the Office of the Provost.

• **Disability Services**
  The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please call (361) 825-5816 or visit Disability Services in Corpus Christi Hall 116.

  If you are a returning veteran and are experiencing cognitive and/or physical access issues in the classroom or on campus, please contact the Disability Services office for assistance at (361) 825-5816.

  [http://disabilityservices.tamucc.edu/](http://disabilityservices.tamucc.edu/)

• **Statement of Academic Continuity**
  In the event of an unforeseen adverse event, such as a major hurricane and classes could not be held on the campus of Texas A&M University–Corpus Christi; this course would continue through the use of Blackboard and/or email. In addition, the syllabus and class activities may be modified to allow continuation of the course. Ideally, University facilities (i.e., emails, web sites, and Blackboard) will be operational within two days of the closing of the physical campus. However, students need to make certain that the course instructor has a primary and a secondary means of contacting each student.

L. **OTHER INFORMATION**

• **Academic Advising**
The College of Science & Engineering requires that students meet with an Academic Advisor as soon as they are ready to declare a major. The Academic Advisor will set up a degree plan, which must be signed by the student, a faculty mentor, and the department chair. Meetings are by appointment only; advisors do not take walk-ins. Please call or stop by the Advising Center to check availability and schedule an appointment. The College’s Academic Advising Center is located in Center for Instruction 350 or can be reached at (361) 825-3928.

GENERAL DISCLAIMER

I reserve the right to modify the information, schedule, assignments, deadlines, and course policies in this syllabus if and when necessary. I will announce such changes in a timely manner during regularly scheduled lecture periods.