CGS Agenda Item: 09-11
Proposal Effective Date: Fall 2011

Eastern Illinois University

NEW COURSE PROPOSAL

Please check one: ☒ New course ☐ Revised course

PART I: CATALOG DESCRIPTION

1. **Course prefix and number, such as ART 1000:** CHM 5210
2. **Title (may not exceed 30 characters, including spaces):** Bonding and Reactivity
3. **Long title, if any (may not exceed 100 characters, including spaces):** Bonding and Reactivity
4. **Class hours per week, lab hours per week, and credit [e.g., (3-0-3)]:** 3-0-3
5. **Term(s) to be offered:** ☒ Fall ☐ Spring ☐ Summer ☐ On demand odd numbered years
6. **Initial term of offering:** ☒ Fall ☐ Spring ☐ Summer **Year:** 2011
7. **Course description (not to exceed four lines):** A study of theoretical descriptions of molecular bonding and dynamics combined with theoretical and experimental applications of these concepts to specific chemical systems.
8. **Registration restrictions:**
   a. **Identify any equivalent courses** (e.g., cross-listed course, non-honors version of an honors course).
      None
   b. **Prerequisite(s),** including required test scores, courses, grades in courses, and technical skills. Indicate whether any prerequisite course(s) MAY be taken concurrently with the proposed/revised course. CHM 3910 and CHM 3920 or equivalent
   c. **Who can waive the prerequisite(s)?**
      ☐ No one ☒ Chair ☐ Instructor ☐ Advisor ☐ Other (Please specify)
   d. **Co-requisites** (course(s) which MUST be taken concurrently with this one):
   e. **Repeat status:** ☒ Course may not be repeated.
      ☐ Course may be repeated to a maximum of hours or times.
   f. **Degree, college, major(s), level, or class** to which registration in the course is restricted, if any: graduate standing
   g. **Degree, college, major(s), level, or class** to be excluded from the course, if any:
9. **Special course attributes** [cultural diversity, general education (indicate component), honors, remedial, writing centered or writing intensive] none
10. **Grading methods** (check all that apply): ☒ Standard letter ☐ C/NC ☐ Audit ☐ ABC/NC ("Standard letter"—i.e., ABCDF--is assumed to be the default grading method unless the course description indicates otherwise.)

11. Instructional delivery method: ☒ lecture ☐ lab ☐ lecture/lab combined ☐ independent study/research ☐ internship ☐ performance ☐ practicum or clinical ☐ study abroad ☐ other

PART II: ASSURANCE OF STUDENT LEARNING

1. **List the student learning objectives of this course:**

   a. **This is not a general education course.**

   b. **If this is a graduate-level course, indicate which objectives are designed to help students achieve established goals for learning at the graduate level:**
      - **Depth of content knowledge**
      - **Effective critical thinking and problem solving**
      - **Effective oral and written communication**
      - **Advanced scholarship through research or creative activity**

Students will demonstrate:

1. a thorough understanding of concepts in chemical bonding, kinetics, and reaction dynamics including:
   - molecular bonding theories including Molecular Orbital Theory and Valence Bond Theory and the quantum mechanical foundations of these theories
   - applications of bonding theories as applied to specific systems such as conjugated molecules, charge transfer complexes, solids and polymers
   - potential energy surfaces that serve as a link between a description of bonding in individual molecules and a description of chemical reactions (i.e., the transformation of chemical bonds over time)
   - chemical kinetics of simple and complex reactions
   - chemical reaction dynamics, collision theory and transition state theory
   - traditional and state-of-the-art experimental methods used to study chemical reactions, bonding and potential energy surfaces
   - applications of the concepts described in this course to real-world problems such as combustion, atmospheric chemistry, and the design of novel materials

   (Goals addressed: depth of content knowledge; effective critical thinking and problem solving)

2. the ability to integrate the concepts listed in Objective 1 sufficiently to use the current literature to prepare a research paper on a specific experimental method that has been used to study chemical bonding, chemical kinetics or reaction dynamics.
   (Goals addressed: depth of content knowledge; effective critical thinking and problem solving; effective oral and written communication; advanced scholarship through research or creative activity)

3. the ability to effectively communicate their understanding of the concepts developed in Objectives 1 and 2 by preparing and presenting a brief (10-15 minute) talk summarizing the topics discussed in their research paper.
   (Goals addressed: depth of content knowledge; effective critical thinking and problem solving; effective oral and written communication; advanced scholarship through research or creative activity)

2. **Identify the assignments/activities the instructor will use to determine how well students attained the learning objectives:**
   - Students will complete weekly assignments designed to elucidate concepts developed in lectures and in the texts. Assignments will include discussion and literature questions aimed to develop conceptual comprehension, short reports based on in-class exercises using molecular modeling software and modern experimental instrumentation as well as numerical problems.
   - Two hourly exams and one comprehensive final exam will be given which will cover material contained in lectures and textbook readings and covered by the problem assignments.
   - Students will write a research paper based on relevant techniques used to study chemical systems as applied to the topics discussed in the course.
   - Students will give a brief presentation based on the topics discussed in their written papers.

	Objective 1	Objective 2	Objective 3
Weekly assignments (20%)	x		
Hourly Exams (35%)	x		
Final exam (25%)	x		
Research paper (15%)		x	
Oral presentation (5%)			x

3. **Explain how the instructor will determine students' grades for the course:**

   Weekly problem assignments (20%)
   Two hourly exams (35%)
   Comprehensive final exam (25%)
   Literature research paper (15%)
   Oral presentation (5%)

4. **This is not a technology-delivered course**

5. **For courses numbered 4750-4999, specify additional or more stringent requirements for students enrolling for graduate credit. NA**

6. **If applicable, indicate whether this course is writing-active, writing-intensive, or writing-centered, and describe how the course satisfies the criteria for the type of writing course identified. (See Appendix *.) NA**

PART III: OUTLINE OF THE COURSE

Provide a week-by-week outline of the course's content. Specify units of time (e.g., for a 3-0-3 course, 45 fifty-minute class periods over 15 weeks) for each major topic in the outline. Provide clear and sufficient details about content and procedures so that possible questions of overlap with other courses can be addressed. For technology-delivered or other nontraditional-delivered courses/sections, explain how the course content "units" are sufficiently equivalent to the traditional on-campus semester hour units of time described above.

Week	Topic
1-3	Overview of quantum mechanics
4-5	Molecular orbital and valence bond theories; *Molecular modeling exercise*
6-7	Applications of bonding theories (Huckel method, charge-transfer complexes, solids, polymers, etc.); *Exam on bonding theories*
8-9	Connection between molecular bonding and reactivity: potential energy surfaces
9-10	Basic concepts in chemical kinetics: simple and complex reactions
10-11	Reaction dynamics/ collision theory/ transition state theory
12	Special topics in bonding and reactivity (e.g. atmospheric chemistry, combustion chemistry); *Exam on application of bonding theories, kinetics and reaction dynamics.*
13-14	Experimental methods; *Lectures and in-class experimental exercises*
15	Student presentations in-class; *Literature research paper due*

PART IV: PURPOSE AND NEED

1. **Explain the department's rationale for developing and proposing the course.**
   Physical chemistry provides the theoretical foundation for all of the other subdisciplines in chemistry. The topics covered in this course are topics that are integral to modern chemical sciences but are not usually covered in detail in the undergraduate curriculum. Practical applications of current interest will be emphasized. Some of the more introductory topics are covered in CHM 3910 (Chemical Thermodynamics and Kinetics) and CHM 3920 (Quantum Chemistry) but not in the depth to be covered in this course, which will focus on recent developments in physical chemistry.

2. **Justify the level of the course and any course prerequisites, co-requisites, or registration restrictions.**
   This course is a graduate course and assumes knowledge of material covered in previous undergraduate courses such as CHM 3910 and CHM 3920.

3. **If the course is similar to an existing course or courses, justify its development and offering.**

   a. **If the contents substantially duplicate those of an existing course, the new proposal should be discussed with the appropriate chairpersons, deans, or curriculum committees and their responses noted in the proposal.** NA

   b. **Cite course(s) to be deleted if the new course is approved. If no deletions are planned, note the exceptional need to be met or the curricular gap to be filled.**
      This course is not similar to an existing course.

4. **Impact on Program(s):**

   a. **NA**
   b. **For graduate programs, specify whether this course will be a core requirement for all candidates in a degree or certificate program or an approved elective.**
      This course will be a core requirement for all candidates in the M.S. in Chemistry program.

If the proposed course changes a major, minor, or certificate program in or outside of the department, you must submit a separate proposal requesting that change along with the course proposal. Provide a copy of the existing program in the current catalog with the requested changes noted.

PART V: IMPLEMENTATION

1. **Faculty member(s) to whom the course may be assigned:** Drs. Rebecca A. Peebles, Sean A. Peebles and Barbara A. Lawrence are qualified to teach this course

2. **Additional costs to students:**

   none

3. **Text and supplementary materials to be used (Include publication dates):** *Molecular Quantum Mechanics*, P.W. Atkins and R. Friedman (2005); *Chemical Kinetics and Dynamics*, J.I. Steinfeld, J.S. Francisco, and W. L. Hase (1999)

PART VI: COMMUNITY COLLEGE TRANSFER

NA

PART VII: APPROVALS

Date approved by the department or school: April 2, 2009

Date approved by the college curriculum committee:

Date approved by CGS:

*In **writing-active courses**, frequent, brief writing activities and assignments are required. Such activities -- some of which are to be graded – might include five-minute in-class writing assignments, journal keeping, lab reports, essay examinations, short papers, longer papers, or a variety of other writing-to-learn activities of the instructor's invention. Writing assignments and activities in writing-active courses are designed primarily to assist students in mastering course content, secondarily to strengthen students' writing skills. In **writing-intensive courses**, several writing assignments and writing activities are required. These assignments and activities, which are to be spread over the course of the semester, serve the dual purpose of strengthening writing skills and deepening understanding of course content. At least one writing assignment is to be revised by the student after it has been read and commented on by the instructor. In writing-intensive courses, students' writing should constitute no less than 35% of the final course grade. In **writing-centered courses** (English 1001G, English 1002G, and their honors equivalents), students learn the principles and the process of writing in all of its stages, from inception to completion. The quality of students' writing is the principal determinant of the course grade. The minimum writing requirement is 20 pages (5,000 words).