CGS Agenda Item:	09-13
Proposal Effective Date:	Fall 2010

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 5420
2. **Title (may not exceed 30 characters, including spaces):** Modern Organic Chemistry
3. **Long title, if any (may not exceed 100 characters, including spaces):** Modern Organic Chemistry
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 Even-numbered years
6. **Initial term of offering:** ☒ Fall ☐ Spring ☐ Summer **Year:** Fall 2010
7. **Course description (not to exceed four lines):** The course introduces a collective view of both synthetic and physical topics in modern organic chemistry and related cross-disciplinary areas. An advanced study of chemical bonding and structure with emphasis on molecular orbital theory, conformational analysis, mechanisms, pericyclic reactions, enolate chemistry, and retrosynthetic/multistep synthesis.
8. **Registration restrictions:**

   a. **Identify any equivalent courses** (e.g., cross-listed course, non-honors version of an honors course). There are no equivalent courses.

   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 2840 Organic Chemistry II lecture 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): None

   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: Restricted to graduate level chemistry majors

   g. **Degree, college, major(s), level, or class** to be excluded from the course, if any: None
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. Student learning objectives

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

It is anticipated that students in this course will:

a. demonstrate an understanding of the important concepts of advanced organic chemistry, as listed in Part III. (**depth of content knowledge, critical thinking/problem solving**)

b. demonstrate and hone the ability to critically analyze and discuss current literature articles in prominent organic chemistry journals. (**critical thinking, effective oral communication**)

c. demonstrate effective problem solving and propose syntheses for complicated organic molecules. **(critical thinking, advanced scholarship**)

d. effectively present a short recent synthesis of an interesting compound from the current literature. **(depth of content knowledge, effective oral communication, effective written communication, advanced scholarship)**

2. Identify the assignments/activities the instructor will use to determine how well students attained the learning objectives:

The students will:

- complete several short drills given throughout the semester. Drills will consist of 1-2 practical questions to be answered on the board and will emphasize key points from the recent lectures. As examples, a drill question could involve drawing a particular MO (say the HOMO or LUMO) of a conjugated molecule, identifying the pK_a's of two different hydrogens in a given molecule and whether or not they could be deprotonated with a given base, or predicting the stereochemistry by drawing and evaluating the two possible Zimmerman-Traxler transition states in an Aldol reaction.
- discuss recent journal articles on selected Fridays.
- complete a homework assignments after each topic to reinforce the concepts. Each assignment will have two or more questions based on literature articles.
- complete two or three written in-class exams.

- write a critical paper of a multistep synthesis from the chemical literature.
- give an in-class oral presentation of their critical paper, with a question and answer session following.
- pose questions, either verbally or in writing, for oral presentations by their peers.

Item	Percent Composition of Total Grade	Learning Objective
Drills	12%	a
Journal Article Discussions	10%	a, b, c
Homework Assignments	18%	a, b, c
Exams	40%	a, b
Written Multistep Synthesis Report	10%	a, b
Oral Presentation	8%	d
Questions for Q/A Session of Presentations	2%	a, b

3. Explain how the instructor will determine students' grades for the course:
Grades will be determined based on the items identified in Part II.2, with the following relative weight:

Drills	12%
Journal Article Discussions	10%
Homework assignments	18%
Exams	40%
Written multistep synthesis report	10%
Oral presentation	8%
Questions for presentations	2%

4. Not applicable.
5. Not applicable.
6. Not applicable.

PART III: OUTLINE OF THE COURSE

Weeks 1 & 2 – Review of Atomic and Molecular Orbital Theory (including discussion of bonding/antibonding orbitals, conjugated systems and Hückel theory, aromaticity)
Drill 1

Week 3 – Oxidation and Reduction (including oxidation states, changes in oxidation states during reactions, typical reagents for oxidation and reductions)
Journal Article Discussion I

Week 4 – Acid Base Chemistry (including Brønsted and Lewis theories, acid-base equilibria, structural and electronic effects on acidity, pKa's)
Drill 2

Week 5 – Conformation Analysis (including Newman projections of alkanes, alkenes, and carbonyls, chair conformations of cyclohexanes, the anomeric effect, Baldwin's ring closure rules, and torsional & stereoelectronic effects on reactivity)
Drill 3
Journal Article Discussion 2
Exam I

Weeks 6 & 7 – Stereochemistry and stereocontrol (including enantiomeric and diastereomeric relationships, stereochemical effects on reactivity, Cram and Felkin-Anh models)
Drill 4
Journal Article Discussion 3

Week 8 & 9– Mechanisms (including mechanisms involving additions, eliminations, carbenes, and radicals; methods of determining mechanism such as kinetic isotope effects, Hammett plots, rate laws and data; transition state and activated complex theory)
Drill 5
Journal Article Discussion 4

Week 10 – Enolate reactions (including *E* vs *Z* enolate formation, Zimmerman-Traxler model, Aldol and Henry reactions)
Journal Article Discussion 5
Exam II

Weeks 11 & 12 – Pericyclic reactions (including Diels-Alder reactions, FMO approach, orbital correlation diagrams, Claisen rearrangements, sigmatropic shifts)
Drill 6
Journal Article Discussion 6

Week 13 & 14 – Multistep synthesis (including protecting groups, retrosynthetic strategies, example syntheses)
Drill 7

Week 15, 16 – Special topics, student presentations

PART IV: PURPOSE AND NEED

1. Explain the department's rationale for developing and proposing the course.

The Chemistry Department has historically offered two graduate courses in organic chemistry, CHM 5400 Physical Organic Chemistry, and CHM 5410, Organic Reactions and Mechanisms. The first course emphasized the structure and bonding of compounds, conformational analysis, pericyclic reactions, and determination of mechanism, while the second course was primarily focused on exposing students to synthetic reactions, protecting groups, and multi-step synthesis. While these courses afforded graduate students additional exposure to organic chemistry beyond the undergraduate level, the

frequency of their offering (once every four years) meant that any given graduate student would only be able to take one of these courses. With the Chemistry Department's goal of redesigning the graduate curriculum to provide comprehensive foundation graduate courses in the various subdisciplines, this new course is designed to take the most important concepts from each of the aforementioned courses (CHM 5400 and 5410) and combine them into a single course. This will ensure our graduate students leave with a good knowledge base both in the physical and synthetic aspects of organic chemistry beyond the baccalaureate level. Additionally, this graduate course will seek to present reactions and techniques that have been developed and extensively applied in the field over the past two decades. These reactions and techniques are more sophisticated than those typically encountered in an undergraduate course, and this course will serve to bridge the gap between the organic chemistry seen at the undergraduate level and the organic chemistry currently employed in industry and academia. Recent topics such as atom-economy reactions, multicomponent reactions, and avoidance of protecting groups (all issues dealing with "green" or "environmentally friendly" chemistry) will be illustrated in the journal readings. Indeed, all the journal articles discussed, as well as the multistep synthesis article, will be from the past decade.

2. Justify the level of the course and any course prerequisites, co-requisites, or registration restrictions.

As this course builds on the knowledge of organic chemistry at the undergraduate level, exposure to and mastery of the concepts in CHM 2840 (Organic Chemistry II lecture) is mandatory to begin discussions at the graduate level.

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.

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.

CHM 5400 Physical Organic Chemistry. CHM 5410 Organic Mechanisms and Synthesis will be retained in order to cover the less fundamental aspects/more specialized reactions that cannot be covered in the new, combined course.

4. Impact on Program(s):

c. For undergraduate programs, specify whether this course will be required for a major or minor or used as an approved elective.

d. 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 serve as one of the core classes in the Masters in Chemistry program.

PART V: IMPLEMENTATION

1. **Faculty member(s) to whom the course may be assigned:** Drs. Treadwell, Wheeler, and Yan

2. **Additional costs to students:** None

Include those for supplemental packets, hardware/software, or any other additional instructional, technical, or technological requirements. (Course fees must be approved by the President's Council.)

3. **Text and supplementary materials to be used (Include publication dates):** *March's Advanced Organic Chemistry* (6th edition), Micheal B. Smith, Jerry March, Wiley & Sons, 2007.
   Advanced Organic Chemistry, Reactions and Mechanisms (2nd edition), Robert V. Hoffman, Wiley & Sons, 2004. Additionally, extensive use of published research articles from journals prominent in the field (such as *J. Org. Chem., J. Am. Chem. Soc., Eur. J. Org. Chem., Org. Biomolec. Chem., Org. Lett., Angew. Chem. Intl. Ed. Engl., Phys. Org. Chem.*) will be made, with Booth library providing access to these journals.

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: April 21, 2009