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| **CGS Agenda Item:** | 09-12 |
| **Proposal Effective Date:** | Spring 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 5360
2. **Title (may not exceed 30 characters, including spaces):** Supramol Chem and Nanotech
3. **Long title, if any (may not exceed 100 characters, including spaces):** Supramolecular Chemistry and Nanotechnology: Principles, Applications and Ethical Aspects
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):** Basic inorganic chemical principles related to non-covalent interactions (hydrogen bonds, $\pi$-$\pi$ stacking, and C-H···$\pi$ interactions) will be outlined, as well as their use in the design of supramolecular systems, molecular devices and machines, and other nanoscale systems. Physical methods used to characterize these systems will also be presented.
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 2310 or equivalent and CHM 3910 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**

During this course, the students will demonstrate:

i) a comprehensive understanding of principles and concepts related to non-covalent interactions such as hydrogen bonds, $\pi$-$\pi$ stacking, and C-H···$\pi$ interactions. **(depth of content knowledge; effective critical thinking and problem solving)**

ii) an understanding of fundamental principles of supramolecular chemistry, and their applications to create devices and machines at the molecular level. **(depth of content knowledge; effective critical thinking and problem solving)**

iii) the capability to handle some of the modern software used to analyze and characterize these devices and machines at the molecular level. **(depth of content knowledge; effective critical thinking and problem solving)**

iv) the ability to search for and find significant articles related to this research field and to prepare a critical paper discussing a specific topic related to the course content. **(depth of content knowledge; effective critical thinking and problem solving; effective oral and written communication; advanced scholarship through research or creative activity)**

v) the ability to present the above scientific concepts by preparing and presenting a 10-15 minute talk summarizing the topics discussed in their research paper. **(depth of content knowledge; effective critical thinking and problem solving; effective oral and written communication; advanced scholarship through research or creative activity)**

vi) the ability to work on individual assignments that are part of a common project related to the critical analysis of one of the topics treated in the course. **(depth of content knowledge; effective critical thinking and problem solving; effective oral and written communication; advanced scholarship through research or creative activity)**

vii) teamwork skills integrating their individual assignments into the common project related to the critical analysis of one of the topics treated in the course. Such a project might consist of analyzing, through various different methods, a common complex chemical system, in which each characterization method supports the results obtained through the other methods – their combination offering the complete picture of the system. **(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 show their understanding of the topics covered in the course by completing weekly assignments consisting of literature analysis and questions designed to deepen and reinforce the concepts treated in class; one of these individual assignments will be part of a common project.
    - They will take two one-hour exams and one final exam (comprehensive); these exams will cover material contained in lectures and textbook readings as well as in recent literature articles.
    - Students will write a paper based on relevant literature data related to the topics covered in class.
    - Students will give a 10-15 minute presentation based on the topics discussed in class.

| Objectives from II.1 above | Weekly assignments 20 % | In class exams 2 x 20 = 40 % | Final exam 20 % | Literature research paper 10 % | Oral presentation 10 % |
|---|---|---|---|---|---|
| II.1.i | x | x | x | x | x |
| II.1.ii | x | x | x | x | |
| II.1.iii | | | x | | |
| II.1.iv | | | | x | |
| II.1.v | | | | | x |
| II.1.vi | x | | | | |
| II.1.viii | x | | | | |

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

    Weekly problem assignments (20 %)
    Two one-hour exams (20 % each = 40 % total)
    Comprehensive final exam (20 %)
    Literature research paper (10 %)
    Oral presentation (10%)

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

5. **This is not a course numbered 4750-4999.**

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 *.) N/A**

## 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 1-3**: *Non-covalent forces in supramolecular chemistry* (dative forces, hydrogen bonds, secondary bonds, $\pi - \pi$ stacking, C-H···$\pi$ interactions)

**Week 4-6**: *Applications of Non-Covalent Interactions in Crystal Engineering* (principles and goals of crystal engineering, analysis of non-covalent interactions, transferability and statistical aspects, software used, design and preparation host-guest species, polynuclear metal complexes and multidimensional architectures)

**Week 7**: *From Macro-World to Micro-World* (general concepts, fundamental principles of electron and energy transfer)

**Week 8-10**: *Devices at the Molecular Level* (wires, light-harvesting antennae, logic gates)

**Week 11-13**: *Machines at the Molecular Level* (basic principles, spontaneous mechanical–like movements, opening, closing and translocation, rotary movements, threading and dethreading processes, linear movements, circumrotational movements)

**Week 14**: *Ethical Aspects of Nanotechnology* (potential benefits, potential dangers, policies to eliminate its damaging effects on society and enhance the beneficial ones)

**Week 15**: *Oral presentation by students* (based on selected scientific articles treating the concepts covered in class)

## PART IV: PURPOSE AND NEED

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

The progress of mankind has always been related to the construction of novel devices and machines. Depending on its purpose a device or a machine can be very big or very small. In the last years, progressive miniaturization of the components employed for the construction of devices and machines has resulted in outstanding technological achievements, particularly in the field of information processing. A common prediction is that further progress in miniaturization will not only reduce the size and increase the power of computers, but also will open the way to new technologies in the fields of medicine, environment, energy, and materials.

In view of the rapidly growing interest of the scientific community in molecular level devices and machines, we feel that a graduate level course is needed to cover the background underlying this field and to present a unifying, critical, and stimulating overview of this new frontier of chemical research. Throughout the course, emphasis is placed on fundamental inorganic concepts that are then illustrated with examples of the various kinds of artificial devices or machines. Selected examples of natural and biomimetic molecular-level systems will also be presented, not so much for the purpose of comparison with artificial systems, but rather to give the student a flavor of the beauty and complexity of the chemical mechanisms responsible for the material aspects of life.

Manipulation and control of non-covalent interactions in crystal engineering will be discussed. Software necessary to visualize and analyze these systems will be introduced. Basic understanding acquired will allow the introduction of contemporary topics as outlined above (Part III). As this course proceeds, students will gain a deeper understanding of fundamental inorganic principles: acid-base chemistry, dynamic equilibria, symmetry, metal-ligand interactions, solid-state geometry, and cluster chemistry. While retaining the perspective of inorganic chemistry, the course will also have an interdisciplinary nature. For example, host-guest species are usually considered a topic of organic chemistry; polynuclear metal complexes are almost exclusively associated with inorganic chemistry classes, while electrochemistry and flash photolysis belong to the realm of physical chemistry. This strengthens the course and allows students to get a glimpse of the interdisciplinary environment they will face after graduation.

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

Being a graduate level course, its content is built on topics and fundamentals covered in the undergraduate level course CHM 2310. CHM 3910 provides the physical-chemistry background needed to understand the course material.

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.** N/A
   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 5120

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

   a. **For undergraduate programs, specify whether this course will be required for a major or minor or used as an approved elective.**
   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 MS 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. Mark McGuire, Dan Sheeran, Radu Semeniuc. In addition, other qualified chemistry faculty could also be assigned to teach this course.

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

3. **Text and supplementary materials to be used (Include publication dates):**

V. Balzani, M. Venturi, A. Credi "Molecular Devices and Machines – A Journey into the Nanoworld"
Wiley-VCH, 2003; C. Housecroft, A. Sharpe "Inorganic Chemistry" third edition, Pearson Ed. Ltd, 2008; Additional materials are based on published scholarly articles in top scientific journals between 2000 and 2008 – all of them available online or in print at Booth Library.

## PART VI: COMMUNITY COLLEGE TRANSFER

**NA**

## PART VII: APPROVALS

**Date approved by the department or school: Thursday, 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).