C087

UNIVERSITY OF KENTUCKY
APPLICATION FOR CHANGE IN EXISTING COURSE: MAJOR & MINOR

1. Submitted by **College of Arts and Sciences** Date **March 14, 2003**

   Department/Division offering course **Chemistry**

2. Changes proposed:

   (a) Present prefix & number **CHE 559** Proposed prefix & number _____

   (b) Present Title **Intermolecular Forces: From Molecules to Materials**

   New Title **Molecular Biophysics**

   (c) If course title is changed and exceeds 24 characters (including spaces), include a sensible title (not to exceed 24 characters) for use on transcripts:

   (d) Present credits: **3** Proposed credits: _____

   (e) Current lecture:laboratory ratio **3:0** Proposed: _____

   (f) Effective Date of Change: (Semester & Year) **Fall 2003**

3. To be Cross-listed as: _____ _____
   (Prefix & Number) (Signature: Dept. Chair)

4. Proposed change in Bulletin description:
   (a) Present description (including prerequisite(s): **Overview of intermolecular forces responsible and the processes of formulation tertiary structure, complexes, assemblies separate phases and materials, including electrostatics, the hydrophobic effect, linked equilibria. Prerequisite: CHE 440G and CHE 442G.**

   (b) New description: **Overview of intermolecular forces responsible for formation of tertiary structure and macromolecular assemblies, as well as linked equilibria, allostery and propagation of signals. Extension of these principles to explain macromolecular machines, complex molecular behavior and, ultimately, processes of life. Prerequisite: CHE 442G or equivalent or permission of instructor.**

   (c) Prerequisite(s) for course as changed: **CHE 442G or equivalent or permission of instructor**

5. What has prompted this proposal? **Improve attractiveness of course and better represent topic.**

6. If there are to be significant changes in the content or teaching objectives of this course, indicate changes:
   Cut out three lectures on solid-state theory to allow more time or other objectives.

7. What other departments could be affected by the proposed change? **None**

8. Is this course applicable to the requirements for a least one degree or certificate at the _____ Yes **X** No
   University of Kentucky?

9. Will changing this course change the degree requirements in one or more programs? *_____ Yes **X** No
   If yes, attach an explanation of the change.*

10. Is this course currently included in the University Studies Program? _____ Yes **X** No
    If yes, please attach correspondence indicating concurrence of the University Studies Committee.

11. If the course is a 100-200 level course, please submit evidence (e.g., correspondence) that the Community College System has been consulted. **N/A**

*NOTE: Approval of this change will constitute approval of the program change unless other program modifications are proposed.

ORIGINAL

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12. Is this a minor change? ____ Yes __X__ No
(NOTE: See the description on this form of what constitutes a minor change. Minor changes are sent directly from the Dean of the College to the Chair of the Senate Council. If the latter deems the change not to be minor, it will be sent to the appropriate Council for normal processing.)

13. Within the Department, who should be consulted for further information on the proposed course change?

Name/e-mail: **Anne-Frances Miller afm@uky.edu** Phone Extension: **7-9349**

Signatures of Approval:

Boyd E Haley Department Chair	3/14/03 Date
David Leep Dean of the College	DEC 09 2003 Date
	NOV 03 2003 Date of Notice to the Faculty
*Undergraduate Council	Date
*University Studies	Date
J Blackwell *Graduate Council	3-19-04 Date
*Academic Council for the Medical Center	Date
*Senate Council	Date of Notice to Univ. Senate

*If applicable, as provided by the Rules of the University Senate

ACTION OTHER THAN APPROVAL

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The Minor Change route for courses is provided as a mechanism to make changes in existing courses and is limited to one or more of the following:

a. change in number within the same hundred series;
b. editorial change in description which does not imply change in content or emphasis;
c. editorial change in title which does not imply change in content or emphasis;
d. change in prerequisite which does not imply change in content or emphasis;
e. cross-listing of courses under conditions set forth in item 3.0;
f. correction of typographical errors. [University Senate Rules, Section III - 3.1]

Rev 8/02

Hanson, Roxie

From: Thomas H. Troland [troland@pa.uky.edu]
Sent: Thursday, December 11, 2003 3:51 PM
To: Hanson, Roxie
Subject: CHE 559

Roxie,

Regarding CHE 559, here are the two relevant items:

(1) LEARNING OBJECTIVES

Student Learning Outcomes

Upon completion of the course the student should be able to:

Understand the simple physical interactions that underlie the folded structures and behaviors of common biomolecules,

Describe such various phenomena as signalling, energy transduction and regulation in terms of simple coupled equilibria,

Understand how the complex behavior of biomolecules can be derived from the combination of multiple non-covalent interactions although these are individually weak,

Understand how the function of such remarkable molecular machines as the ribosome, ion-selective channels, photosynthesis and even primitive life originate from, and could be redesigned from, a relatively small number of kinds of simple non-covalent interactions.

(2) PRE-REQUISITES

Ann-Frances Miller says that the pre-requisites should be "~~PHY~~ CHE 442G or equivalent or instructor's permission"

Tom

ARTS AND SCIENCES COLLEGE COUNCIL/CURRICULUM COMMITTEE

INVESTIGATOR REPORT

INVESTIGATING BODY **Nat. & Math Sci.** (Area) COURSE, MAJOR, DEGREE or PROGRAM CHE 559 (department or college)

DATE FOR COUNCIL REVIEW **Dec. 9, 2003** CATEGORY: (NEW) CHANGE, DROP

INSTRUCTIONS: This completed form will accompany the course application to the Graduate/Undergraduate Council(s) in order to avoid needless repetition of investigation. The following questions are included as an outline only. Be as specific and as brief as possible. If the investigation was routine, please indicate this. The term "course" is used to indicate one course, a series of courses or a program, whichever is in order. Return the form to **David Leep Associate Dean, 231 Patterson Office Tower** for forwarding to the Council(s). ATTACH SUPPLEMENT IF NEEDED.

1. List any modifications made in the course proposal as submitted originally and why.
Request made for learning objectives and for clarification of pre-requisites. This request was handled by Anne Frances Miller, Prof. of Chemistry
2. If no modifications were made, review considerations that arose during the investigation and the resolutions.

3. List contacts with program units on the proposal and the considerations discussed therein.
Anne-Frances Miller, Chair. Dept

4. Additional information as needed.

5. A&S **Area** A **Curriculum Committee** Recommendation:

(APPROVE) APPROVE WITH RESERVATION, OR DISAPPROVE

6. A&S **Council** Recommendation:

(APPROVE) APPROVE WITH RESERVATION, OR DISAPPROVE

7. T A Troland Date: 09-Dec-03

A&S Council Investigator, Tom Troland

File: \InvestigatorRpt

Current Syllabus

Intermolecular Forces: From Molecules to Materials

CHE 559
Intermolecular Forces
(from molecules to materials and machines)

Lectures: M,W,F 9-9:50 CP-208

Instructor: A.-F. Miller, CP113, afm@uky.edu

Lectures and Exam

27 Aug. to 12 Dec., No class 3 Oct., 27 Oct., 7 Nov., 12 Nov., 28 Nov. I would like to negotiate a few additional lectures to make up for those I have to miss due to travel. Final Exam Mon Dec 15 at 10:30 am.

Teaching Outcomes:

Students will learn how the collective behaviours of the large numbers of molecules we encounter in practice can be understood in terms of the properties and interactions between individual molecules. Thus, the course provides a bridge between the foundation provided by the chemistry of individual molecules, the collective properties that characterize materials, and the diverse and complex behaviours of macromolecular machines and even whole organisms addressed by biophysics and cell biology. Specific types of systems students will learn to address include phase equilibria, two and three component solutions, binding and oligomerization, elaboration of repetitive higher-order structures (order in space), linked equilibria, regulation, energy transduction in various guises, rhythmical behaviour (order in time), molecular machines, origin of life.

This course is aimed at graduate students and senior undergraduates who have had the following prerequisites: a course in statistical physics or thermodynamics (for example CHE 440), basic physics such as PHY232 or PHY 213 and biological chemistry, such as CHE 550.

I Grading

Problem sets	4 offered on biweekly basis	25%
Quizzes	Offered without warning at the beginning of lectures	10%
Literature Research Paper	Based on recent papers in the primary literature	20%
Participation / Discussion	Includes finding papers on topics of interest, and leading the discussion on a selected topic in section 3.	20 %
Final Exam	Covers everything, will include a short essay.	25%

Literature Research Paper, Due Nov. 21 (Friday) ≤ 5 pm.

Each student, alone, must identify a lead article that appeared in the primary literature in 2002 or 2003 and use this as the basis of a 10 page paper (all inclusive, single spaced). The paper should provide a balanced (though brief) review of the topic chosen, refer to **at least 6** published articles and not be on the student's group's immediate area of research. The topic must be an assembly of molecules and how its behaviour / activity / physical properties stem from the component molecules. Be as rigorous as possible and **incorporate quantitative data and a discussion of how some intermolecular forces or principles of thermodynamics are important**. The subject and lead article must be approved by Dr. Miller by Oct 31 at 5 pm (for 20% of the paper grade, or 4% of the course grade). Since Dr. Miller may not approve your first choice, do not wait until 4:45 pm on the 31st to submit your lead article. Write the paper in the format of *Current Opinion in Structural Biology*, including references.

Leading a Discusison, (dates to be scheduled)

Each student will present one class, in which that student is responsible for informing the class in advance of 2-4 papers on which the discussion will be based, introducing the topic and covering the main points and then stimulating discussion. The student can chose one of the topics in section 3, or a topic not listed, subject to prior approval by Dr. Miller (before Oct 15). The topic CAN be drawn from the student's research interests.

Current Syllabus

Outline (approximate)

Section 1 Intermolecular Forces, in single then multiple component systems

Lect 1-2	Types of non-covalent interactions (Refer to Atkins Ch 1.4, 22, Logan Ch5, van Holde Ch 1.2, 3.2 or Nossal Lecar Ch2, Richards Ch 2)
Lect 3	Enthalpy <-> entropy
Lect 4-5	States of matter, phase changes, phase diagrams Ch 9 Ellis, Atkins Ch 6, Ch 7 Bergethon (also Ch 7 of Logan)
Lect 6	Partitioning, Micelle formation, Lipid bilayers (phase diagrams II) Ch 7 Hall

Section 2 Molecules and Intermolecular Forces in Aqueous Solutions

Lect 7	Molecular Forces in Biological media, overview Ch 2 Nossal and LeCar (refer to Ch2 Richards)	
Lect 8	Water	Ch 9 Bergethon
Lect 9-11	Electrolytic solns	Ch 10 Bergethon, Logan Chp 9 Bokris and Reddy
Lect 12-13	Ion-Solvent int, Ion-Ion	Ch 11-12 Bergethon
Lect 14	Macromolecules-Counterions	Ch 13-14 Bergethon
Lect 15-16	Gels (an alternative point of view)	Pollack

Section 3: Interactions Within Molecules Leading to Complex Behaviour

Lect 16-17	Electrostatics in Proteins (coupled pKs)	Tanford Ch. 7
Lect 18-19	Ligand binding interactions, coupled equilibria	Cantor and Schimmel III Ch 15
Lect 20-21	Cooperativity and order - disorder transitions van Holde Ch 4, Cantor and Schimmel III Ch 17, 20	
Lect 22	Determinants of protein structure (hydrophobic interaction) van Holde Ch 3.2, Creighton Ch 4	
Lect 23	Folding and stability, 'sequential' orders of structure van Holde Ch 1, Creighton Ch 5,6	
Lect 24	Self-assembly of supramolecular complexes (ribosome) Ch 5 of Nossal Lecar	
Lect 25	Filamentous proteins, viruses	(Nossal Lecar)
Lect 26-27	Energy transduction (Htet), bacteriorhodopsin, and ion channels	
Lect 28	Molecular motors: flagellae and ATP synthase	Nossal Lecar, Pollack
Lect 29	Origin of life.	Literature

Presentations by class members

References:

We will refer to a variety of books and primary literature in the course of the semester. Some of the suggested references are: (list is alphabetical by author).
Binders of suggested reading from the primary literature will be placed on reserve in the CP library.

'Physical Chemistry' 6th ed. P. Atkins, 1998, Freeman ISBN 0-7167-2871-0

'Biophysical Chemistry, Molecules to membranes', P. R. Bergethon and E. R. Simons, 1989, Springer Verlag ISBN 0-387-97053-3

'Biophysical Chemistry I: The conformation of biological macromolecules', C. R. Cantor and P. R. Schimmel, 1980, Freeman ISBN 0-7167-1188-5, 'III: The Behaviour of biological macromolecules' ISBN 0-7167-1192-3

'Proteins', T. E. Creighton, 1993, Freeman ISBN 0-7167-7030-X

'Teaching General Chemistry', A. B. Ellis, M. J. Geselbracht, B. J. Johnson, G. C. Lisensky, W. R. Robinson, 1993 A. C. S. ISBN 0-8412-2725-X

'Molecular Solid State Physics', G. G. Hall, 1991, Springer Verlag, ISBN 3-540-53792-9

'Physical Chemistry for the Biomedical Sciences', S. R. Logan 1998, Taylor & Francis ISBN 0-7484-0710-3

'Molecular and Cell Biophysics', R. Nossal and H. Lecar, 1991, Addison-Wesley ISBN 0-201-19560-7

'Cells, Gels and the Engines of Life', G. H. Pollack 2001, Ebner and Sons ISBN 0-9626895-2-1

'Physical Chemistry of Macromolecules: Basic Principles and Issues', Sun.

'Physical Chemistry of Macromolecules', C. Tanford 1961 Wiley and Sons, ISBN 0-471-84447-0

'Physical Biochemistry', K. E. van Holde, W. C. Johnson, P. S. Ho, 1998, Prentice Hall, 0-13-720459-0

Molecular Biophysics: From Molecules to Machines and Complex Behaviour

CHE 559

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(signaling), energy transduction in various guises, mechanisms and costs of specificity, rhythmical behaviour (order in time), molecular machines, origin of life. Thus, while we will start with nuts and bolts and a fairly physical discussion of individual interactions, we then open up discussions and engage in a grand tour of some of the most remarkable supramolecular behaviours observed, and how they can be explained by, and designed from, fundamental interactions.

This course is aimed at graduate students and senior undergraduates who have had a course in statistical physics or thermodynamics (for example CHE 440), basic physics such as PHY232 or PHY 213 and biological chemistry, such as CHE 550.

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Lect 6 Partitioning, Micelle formation, Lipid bilayers (phase diagrams II)
Ch 7 Hall

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Lect 8-11	Electrolytic solns	Ch 10 Bergethon, Logan Chp 9 Bokris and Reddy,
Lect 12-14	Ion-Solvent int, Ion-Ion	Bokris & Reddy Ch. 2,3
Lect 15-16	Macromolecules-Counterions	Tanford Ch. 7
Lect 17	Gels (an alternative point of view)	Pollack

Section 3: Interactions Within Molecules Leading to Complex Behaviour

Lect 18-19 Two-state structural transition (±coorperativity)
van Holde Ch 4, Cantor and Schimmel III Ch 17, 20

Lect 20 Determinants of protein structure (hydrophobic interaction)
van Holde Ch 3.2, Creighton Ch 4

Lect 21-22 Folding and stability, 'sequential' orders of structure
van Holde Ch 1, Creighton Ch 5,6

Lect 23-24 Ligand binding interactions, coupled equilibria Cantor and Schimmel III Ch 15

Lect 25 Self-assembly of supramolecular complexes (ribosome)
Ch 5 of Nossal Lecar

Lect 26 Filamentous proteins, viruses (Nossal Lecar)

Lect 27-28 Energy transduction (Htet), bacteriorhodopsin, and ion channels

Lect 29 Molecular motors: flagellae and ATP synthase Nossal Lecar, Pollack

Lect 30 Origin of life. Literature

Presentations by class members

Primary Literature Suggestions (Please add your own suggestions too)

Basic Forces

Hydrogen Bonds

Water

Hydrophobic effects

Forces and model systems for Protein Folding

Protein Folding

Protein Stability and Structure

Pre and Pro-Proteins

Binding

Linked Equilibria and Cooperativity

Fibers and Materials

Catalysis

Enzyme Engineering

Redox

Electron transfer <-> Conformation, Electron transfer <-> Proton transfer

Photosynthesis

Energy Transduction I: Cytochrome C oxidase and F1-ATPase

Channels and Pores

Ribosomes

Motors and Machines

Immune System

Virus Assembly

Origin of Life

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