

CURRICULUM PROPOSAL FORM 1999-2000

NON-GENERAL EDUCATION PROCESS A

***DEADLINES:** Deadline dates for 1999/2000 submissions: Regular proposals: October 22, 1999 to be implemented in Fall 2000; Short-Term proposals: December 10, 1999 to be implemented in Fall, 2000; Regular proposals February 18, 2000 to be implemented in Spring, 2001; March 24, 2000 for short-term courses to be implemented in Spring 2001.

1907.558

PROPOSAL TITLE: Advanced Biochemistry

SPONSOR(S): Cathy Yang, Dept. of Chem/Phys

DEPARTMENT:

COLLEGE: LAS

IF LAS CHECK ONE: History/Humanities Math/Sciences Social/Behavioral Sciences

Check one: Undergraduate Graduate

THE ATTACHED *NON-GEN-ED* PROPOSAL IS BEST DESCRIBED BY THE ITEM(S) CHECKED.

New non-gen-ed course

Short-term non-gen-ed course

Minor curricular changes (fewer than three) to:

- existing non-gen-ed course
- non-gen-ed degree requirements
- major
- minor, specialization, concentration, track, certificate program

DEPARTMENT
(Signature indicates approval)

Charles W. Schultz

Dept. Curriculum Chair / Date 3/6/00

Dept. Chairperson / Date 3/6/00

ACADEMIC DEAN

Approved Not Approved Comments:

Dean's Signature/Date Joy King 3-25-00

COLLEGE CURRICULUM COMMITTEE

Date of open hearing (if necessary) 11/30/99 Approved Not Approved

Comments:

Signature of College Chair/Date: [Signature]

UNIVERSITY CURRICULUM COMMITTEE

Date Received/Processed 4/17/00

Comments:

Curriculum Chair Signature [Signature]

Date Announced At Senate 4/18/00

EXECUTIVE VICE PRESIDENT/PROVOST

Approved Not Approved If no, reasons are as follows:

Student Credit Hours _____ Faculty Load Hours _____ Equalized Credit Hours _____

Official Copy & Approval Sheet Filed (Date): _____ Executive VP/Provost Signature/Date [Signature] 4/26/00

REGISTRAR

Date Approved Course Description Received _____ Hegis Taxonomy & Course Number Assigned 1907. 558

Registrar Signature/Date [Signature] 4/27/00

NOTIFICATION FORWARD

_____ Senate Curriculum Committee Chairperson _____ Academic Dean(s)
_____ Department Chairpersons _____ Registrar _____ Sponsor(s)

Rowan University
Department of Chemistry and Physics

Request for cross-listed 400& 500 level HEGIS numbers:
Advanced Biochemistry
as Graduate Course

1. Details

1a. Course Title: Advanced Biochemistry *1907. 558*

1b. Sponsors: Cathy F. Yang, Associate Professor
Department of Chemistry and Physics

1c. Credit Hours: 4 s.h.

1d. Course Level: 500-level HEGIS numbered requested for graduate standing

1e. Curricular Effect: Elective (will be the required course for evolving Biochemistry Major)

1f. Prerequisites: Chemistry I, Chemistry II, Organic Chemistry I, Organic Chemistry II and Biochemistry I (~~1907348/548~~).

1g. Suggested Time of Implementation: Spring, 2000 *0414.440*

1h. Adequacy of Resources: adequate

*4/27/00
Per Bd Newland will only include
0414.440 or 0414.548 as prerequisites
RAK*

2. Rationale

Scientific understanding of the molecular nature of life is growing at an astounding rate. Naturally, society is the prime beneficiary of this increased understanding. Cures for diseases, better public health, remediations for environmental pollution, and the development of cheaper and safer natural products are just a few practical results of this knowledge.

As biochemistry increases in prominence among the natural sciences, its inclusion at an advanced level in undergraduate curricula becomes imperative. This expansion of our knowledge has been marked by new paradigms and also an enormous enrichment of almost every facet in the field. In past five years, the number of known protein and nucleic acid structures as determined by X-ray and NMR techniques has increased by over fivefold and, moreover, many of these structures have led to seminal advances in our

understanding of a particular subfield. Likewise, the state of knowledge has exploded in such subdisciplines as eukaryotic and prokaryotic molecular biology, metabolic control, protein folding, electron transport, membrane transport, immunology, signal transduction, and etc.

The increased scope of this knowledge allows scientists to make generalizations, validated by repetitive examples that emerge in time as principles of biochemistry; principles that are useful in discerning and describing new relationships between diverse bio-molecular functions and in predicting the mechanisms underlying newly discovered biomolecular phenomena. A National survey by American Chemical Survey shows high percentage of colleges and universities offering this course, eg. Brandeis University, Boston College, California State University, Fullerton, Bucknell University, Bates College and Gustavus Adolphus College. We thus propose this course be added to the chemistry curriculum.

3. Essence of the Course

a. Objectives:

1. Students will gain an overview of the bio-chemical structures and reactions that occur in living systems, particularly, in perspective of mechanisms.
2. Students will learn to describe metabolism with special emphasis on how the pathways are organized and more importantly how they are regulated.
3. Students will understand the biomedical significance of the defects in metabolism.
4. Students will learn the process of scientific research in light of how some major bio-chemical discoveries were made.
5. Students will be exposed to the state-of-the-art experiments and learn hands-on techniques.
6. Students will be required to conduct an in-depth review of the literature regarding a topic within the areas described above.

However, the existing Biochemistry I course primarily emphasizes basic chemical reactions that take place in biological systems. This proposed course will focus on various topics in biophysical chemistry in depth and is designed to build on the fundamental aspects of the structure of biochemical systems. Detailed examination of

advanced aspects of protein structure and function, including the determination of primary, secondary, tertiary and quaternary structures, are integrated with molecular modeling concepts. Nucleic acid chemistry and its application in pharmacology will also be emphasized.

b. Topical Outline:

Possible texts: L. Stryer. **Biochemistry**, D. Voet and J. Voet. **Biochemistry**, G. Zubay. **Principles of Biochemistry**. Higher level texts include: T. Creighton. **Proteins** and Y. Mizuno. **The Organic Chemistry of Nucleic Acids**. In addition, the best source of up to date material are the journals of *Science*; *Nature*; *Proceedings of National Academy Sciences, USA.*; *Journal of Biological Chemistry* and *Biochemistry*.

Topical Outline of Lecture:

I. Introduction and Background

(Prokaryotes, eukaryotes and thermodynamic principles)

II. Proteins

(Three-dimensional structures, folding and dynamics)

III. Mechanisms of Enzyme Action

(Enzymes, kinetics and enzymatic catalysis)

IV. Metabolism and Its Regulation

(Metabolic integration and the unidirectionality of pathways)

V. Genetic Information

(Nucleic acid structures and manipulation; transcription, translation, replication, repair and gene expression)

VI. Molecular Basis of Macromolecular Complexes

(Membrane transport; muscle contraction; hormone action; neurotransmission; carcinogenesis and sensory systems)

VII. Biotransformation

(Biosynthesis of proteins, vitamins, lipids, nucleotides and drugs; photosynthesis)

Topical Outline of Lab:

I. Introduction of Bio-Instrumental Analysis

II. Protein Quantification

III. Purification of Amine Oxidases

- IV. Fluorescence Spectrum of Monoamine Oxidase
- V. Kinetic Characteristics of Wheat Germ Acid Phosphatase
- VI. DNA Sequencing(conditional)
- VII. Characterization of Nucleic Acids by Chemical and Physical Methods
- VIII. DNA Amplification Using the Polymerase Chain Reaction (PCR)
- IX. Digestion of DNA with Restriction Endonucleases

Although fairly detailed lab outlines are provided, in most cases, parts of the experiment are left to the design of the student.

c. Evaluation Procedures:

Students will be evaluated by class participation, exams, oral presentation of a research paper, lab reports and a final exam. In-depth expectation will be needed compared to undergraduate students. The research paper will be on a topic relevant to the course selected by the student and approved by the instructor.

d. Course Evaluations:

The departmental course evaluation form will be used at the end of the course.

4. Consultations:

Chemistry Faculty

Biology Faculty

Dr. Stew Slater, Chemical Engineering

Dr. Ralph Dusseau, Civil Engineering

Catalog Description:

Advanced Biochemistry (1907.5⁵⁰~~xx~~)

(Prerequisite: 0414.440/548)

Intro to Biochemistry / Biochemistry I
0414, 440 *0414, 540*

4 s.h.

This course provides an in-depth study of the principles involved in biological processes. It emphasizes the significance of biochemical reactions and regulations as well as mechanisms. A thorough elucidation of structure, function and mechanism will be presented. The overall strategy of living systems will be illustrated. Laboratory experiments will provide exposure to representative procedures and some important modern techniques. Students are encouraged to design their own molecular biology experiments using the facilities provided. A term project is incorporated into this course. Students are required to conduct an in-depth review of the literature regarding a topic.

15001E

OCT 23

CURRICULUM PROPOSAL FORM 1999-2000

RECEIVED NON-GENERAL EDUCATION PROCESS A

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1998.305

PROPOSAL TITLE: Biophysical Chemistry

SPONSOR(S): Lee A. Dinsmore and The Faculty of the Department of Chemistry and Physics

DEPARTMENT: Chemistry and Physics

COLLEGE:

IF LAS CHECK ONE: History/Humanities Math/Sciences Social/Behavioral Sciences

Check one: Undergraduate Graduate

THE ATTACHED NON-GEN-ED PROPOSAL IS BEST DESCRIBED BY THE ITEM(S) CHECKED.

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Minor curricular changes (fewer than three) to:

existing non-gen-ed course

non-gen-ed degree requirements

major

minor, specialization, concentration, track, certificate program

DEPARTMENT

(Signature indicates approval)

Charles W. Schultz 10/19/99

Dept. Curriculum Chair / Date

Robert Dinsmore 10/19/99

Dept. Chairperson / Date

ACADEMIC DEAN

Approved Not Approved Comments:

Dean's Signature/Date *Joey Han* 11/2/99

COLLEGE CURRICULUM COMMITTEE

Date of open hearing 1/27/00 Approved X Not Approved _____

Comments: - course description & Hegis # included
- attach consultation

Signature of College Chair/Date: [Signature]

UNIVERSITY CURRICULUM COMMITTEE

Date Received/Processed _____

Comments:

Curriculum Chair Signature [Signature] Date announced at Senate 2/28/00

EXECUTIVE VICE PRESIDENT/PROVOST

Approved ✓ Not Approved _____ If no, reasons are as follows:

Student Credit Hours _____ Faculty Load Hours _____ Equalized Credit Hours _____

Official Copy & Approval Sheet Filed (Date): _____ Executive VP/Provost Signature/Date [Signature] 3/2/00

REGISTRAR

Date Approved Course Description Received _____ Hegis Taxonomy & Course Number Assigned 1908 305

Registrar Signature/Date [Signature] 3/21/00

NOTIFICATION FORWARD

____ Senate Curriculum Committee Chairperson _____ Academic Dean(s)
____ Department Chairpersons _____ Registrar _____ Sponsor(s)

Course Proposal

5/21/00
Spoke to Bd Newland.
① will use 1909.350 instead
of 1909.352 - not approved yet
② Use current actual numbers
only. 1907.201 & not 1907.301

1. Details

- a. Course Title: **Biophysical Chemistry** AKK
- b. Sponsors: Lee A. Dinsmore and The Faculty of the Department of Chemistry and Physics
- c. Credit Hours: 4 S.H.
- d. Course Level: Junior level
- e. Curricular Effect: Required course for proposed B.S. in Biochemistry, elective for a minor in chemistry.
- f. Prerequisites: 1907.201 (formerly 1907.301), 1701.131, 1902.201, 1909.250 (formerly 1909.350), 0401.101.
- g. Suggested time and scale of implementation: One section with maximum 24 students in Fall, 1999
- h. Adequacy of present staff, resources, space needs, and other additional resources needed for implementation: Present staff resources are adequate, but we will hire another physical chemist this year. Lab, classroom, and library resources are also adequate.
- i. Recommended Library Resources: This course is physical chemistry applied to biochemistry. The existing library resources in physical chemistry and in biochemistry are adequate to serve the needs of this course.
- j. Short Term Evaluations: Not applicable.

2. Rationale:

This proposed course is new to this institution, but is a standard required course across the Country in all institutions that offer a B.S. in Biochemistry. The rationale for this course includes all those for implementation of the Biochemistry B.S program. The course will also be available as an elective for students earning a minor in chemistry. Biology majors may also select this course as a free elective. Physical chemistry involves the interface between chemistry and physics, biochemistry between chemistry and biology. This course is therefore highly interdisciplinary. Rowan students can expect to be involved in interdisciplinary research as they continue their scientific careers.

3. Essence of the Course:

a. Objectives of the course in relation to student outcomes: The main physical chemistry topics included in this course are thermodynamics, kinetics, and spectroscopy. These topics are fundamental to every field of science, but this course will emphasize their importance to and their utilization in biochemistry. Thus it is expected that the student will:

- become familiar with concepts of thermodynamics and will be able to define and apply the notion of a thermodynamic system to biochemical problems.
- Understand the first law variables and be able to calculate their magnitude under a variety of conditions.
- Understand the second law quantities with particular emphasis on the Gibbs free energy and be able to calculate their magnitude under a variety of conditions
- Understand the utility to biochemistry of applications of thermodynamics such as phase diagrams, colligative properties, equilibria in physical and chemical systems, electrochemistry, and surface phenomena and be able to calculate their magnitude under a variety of conditions.
- Understand the principles of kinetics of reactions, including photochemical reactions, and apply them to the calculation of a variety of reactions rates of biochemical interest.
- Understand the principles of spectroscopy and be able to utilize appropriate methods to gain an understanding of molecular systems and processes.
- Learn the use of a variety of instruments and techniques in the laboratory to measure the concepts of thermodynamics, kinetics, and spectroscopy as presented in the course outline.

b. Lecture Topical Outline

I Thermodynamics

A. Systems

1. Ideal gas
2. non ideal gases

B. The First Law of Thermodynamics

1. Energy, Work, and Heat
2. The First Law
3. Enthalpy
 - a.. Enthalpy and Chemical Reactions
 - b. Standard Enthalpies of Formation
 - c. Enthalpy and Extent of Reaction

4. Heat Capacities

- a. Equipartition Principle
- b. Temperature Dependence of Heat Capacities
- c. Temperature Dependence of Enthalpy

C. The Second and Third Laws of Thermodynamics

1. Entropy

- a. Heat Engines
- b. Entropy Changes
- c. Entropy and Spontaneity
- d. Entropy and Probability
- e. Entropy and Chemical changes

2. Free Energy

- a. Standard Free Energies of Formation
- b. Pressure and Temperature dependence of free energy
- c. Free Energy and spontaneity
- d. Free Energy and Equilibria
- e. Phase Diagrams

D. Thermodynamics of Solutions

- 1. Solvents and Solutes
- 2. Equilibria in Solutions
- 3. Colligative Properties

E. Phase Equilibria

- 1. The Phase Rule
- 2. Phase Diagrams
- 3. Surface Phenomena

F. Electrochemistry

II Kinetics

A. Rate Equations and Rate Constants

- 1. First Order
- 2. Second Order
- 3. Reaction Rates and Equilibrium

B. Mechanisms

- 1. Complex Rate Equations
- 2. Enzyme Catalyzed Reactions
- 3. Photochemical Reactions

III Spectroscopy

A. Molecular Spectroscopy

1. Rotational Spectra
2. Vibrational Spectra
3. Electronic Spectra

B. Nuclear Spectroscopy

1. Nuclear Spin States
2. Nuclear Magnetic Resonance Spectra

b. Lab Topical Outline

I Thermochemistry

- A. Solution Calorimetry
- B. Bomb Calorimetry

2. Heat Capacity Ratio for Gases

3. Solutions

- A. Cryoscopic Determination of Molecular Weight
- B. Chemical Equilibrium in Solution

4. Phase Equilibria of a Pure Liquid

5. Kinetics

- A. Kinetics of a Hydrolysis Reaction
- B. Kinetics of an Inversion Reaction
- C. Kinetics of an Enzyme Mediated Reaction

6. Helix-Coil Transition in Polypeptides

7. Absorption Spectrum of a Conjugated Dye

c. Evaluation and grading procedure of students: The students will be evaluated through homework assignments, two hour long exams, a comprehensive final exam, and formal lab reports.

d. Course evaluation: The course will be evaluated in all the usual ways, including student and alumni evaluations, departmental review, and program review

4. Results of Consultations: Consultation has been requested of Drs. Andrew Prieto, Chair and Gregory Hecht, Department of Biological Sciences. The proposal has been modified in accord with suggestions by Dr. Hecht.

Prerequisites:
1907.201, 1701.131, 1902.201, 1909.250, 0401.101

5. Catalog description: *1908 305*

This course covers the topics of physical chemistry and their applications in biochemistry. Topics include thermodynamics, kinetics and spectroscopy. This course also provides laboratory experience in physical methods that apply to biological systems.



TO: Dr. Robert Newland, Chairperson, Chemistry & Physics

FROM: Andy Prieto, Chair, Biological Science

RE: Biophysical Chemistry Course

DATE: February 4, 2000

The Biological Sciences department fully endorses the Biophysical Chemistry course as proposed by the Chemistry department.