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OFFICE OF THE SENATE COUNCIL

APPLICATION FOR NEW COURSE

1. Submitted by College of Arts & Sciences Date August 29, 2006

Department/Division offering course Chemistry

2. Proposed designation and Bulletin description of this course

a. Prefix and Number CHE 525 b. Title* Bioanalytical Sensors

*NOTE: If the title is longer than 24 characters (including spaces), write A sensible title (not exceeding 24 characters) for use on transcripts

c. Lecture/Discussion hours per week 3 d. Laboratory hours per week 0

e. Studio hours per week 0 f. Credits 3

g. Course description

Theory, principles, and applications of bioanalytical sensors and sensing systems, including transducers, molecular recognition, and microfabrication

h. Prerequisites (if any)

CHE 440G or by consent of instructor

i. May be repeated to a maximum of N/A (if applicable)

4. To be cross-listed as

Prefix and Number

Signature, Chairman, cross-listing department

5. Effective Date Fall 2007 (semester and year)

6. Course to be offered ☒ Fall ☐ Spring ☐ Summer

7. Will the course be offered each year? ☐ Yes ☒ No
(Explain if not annually)

The course will be offered every other year. This schedule is common among advanced courses in Chemistry.

8. Why is this course needed?

To introduce graduate and undergraduate students to the interdisciplinary field of sensors.

9. a. By whom will the course be taught? Drs. Sylvia Daunert or Leonidas Bachas, Chemistry

b. Are facilities for teaching the course now available? ☒ Yes ☐ No
If not, what plans have been made for providing them?

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10. What enrollment may be reasonably anticipated? 10-12

11. Will this course serve students in the Department primarily? ☒ Yes ☐ No

Will it be of service to a significant number of students outside the Department? ☒ Yes ☐ No
If so, explain.

Will the course serve as a University Studies Program course? ☐ Yes ☒ No

If yes, under what Area?

12. Check the category most applicable to this course

☐ traditional; offered in corresponding departments elsewhere;

☐ relatively new, now being widely established

☒ not yet to be found in many (or any) other universities

13. Is this course applicable to the requirements for at least one degree or certificate at the University of Kentucky? ☒ Yes ☐ No

14. Is this course part of a proposed new program: ☐ Yes ☒ No
If yes, which?

15. Will adding this course change the degree requirements in one or more programs?* ☐ Yes ☒ No
If yes, explain the change(s) below

16. Attach a list of the major teaching objectives of the proposed course and outline and/or reference list to be used.

17. If the course is a 100-200 level course, please submit evidence (e.g., correspondence) that the Community College System has been consulted. ☐ Check here if 100-200.

18. If the course is 400G or 500 level, include syllabi or course statement showing differentiation for undergraduate and graduate students in assignments, grading criteria, and grading scales. ☒ Check here if 400G-500.

19. Within the Department, who should be contacted for further information about the proposed course?

Name Leonidas Bachas Phone Extension 7-6350

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

APPLICATION FOR NEW COURSE

Signatures of Approval:

Department Chair	8/29/06 Date
Dean of the College	12/5/06 Date
	9/21/06 Date of Notice to the Faculty
*Undergraduate Council	2/6/07 Date
*University Studies	Date
Approved by Graduate Council *Graduate Council	1/23/07 Date
*Academic Council for the Medical Center	Date
*Senate Council (Chair)	Date of Notice to University Senate

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

ACTION OTHER THAN APPROVAL

Rev 3/04

Department of Chemistry - University of Kentucky

CHE 525

Bioanalytical Sensors

Fall 200X

Lectures:	9:30 a.m.-10:45 a.m., Tuesday and Thursday, CP-208
Credits:	3
Instructional Material:	Brian Eggins, "Chemical Sensors and Biosensors", Wiley, 2002 Books on reserve Research and review articles
Instructor:	Leonidas G. Bachas Office: CP-207; e-mail: bachas@uky.edu
Office Hours:	11:00-12:00, Tuesday, Wednesday and Thursday, or by appointment
Grading Procedure:	Two Midterm Exams Final Exam (comprehensive Presentation of a sensor topic (graduate students only): last 2 weeks Term paper

	Graduate Students	Undergraduate Students
Midterm Exams	40%	40%
Term Paper	15%	20%
Presentation	10%	
Final Exam	35%	40%

Grades: Usually, "A" corresponds to >90%, "B" to 80-89.9%, etc.

Academic Dishonesty

Academic dishonesty or cheating of any kind will not be tolerated. This is a serious offense and the instructor will make every effort to ensure that the punishment is immediate and severe. This is also the official policy of the Department of Chemistry.

Absence Policy

Students are expected to attend all classes, but there is no penalty for absences. Only when there is an excused absence, a student is allowed to make up missed exams and assignments.

Major Course Objectives

To introduce the basic biomolecular recognition elements (DNA and proteins) and their design and structure/function optimization through protein engineering

To provide the students with an overview of the most important techniques to protein immobilization, especially as it relates to sensors

To explain the integration of biomolecules with transducers in the design of electrochemical and optical biosensors.

To compare and contrast catalytic and affinity based biosensors and relate the corresponding response characteristics to biomolecular properties and transduction function.

In the later part of the course, it will be demonstrated how integration of the basic principles learned could be accomplished in the design of microfabricated sensing systems.

Student Learning Outcomes

Upon completion of this course, a student should be able to:

- Explain the function and principles of operation of bioanalytical sensors
- Understand how to design chemical sensors and biosensors by integrating concepts of molecular recognition, transduction, biomaterials and microfabrication.
- Apply the information to identify the proper sensing system to be used in the determination of chemical components in biological and environmental samples.

Books on Reserve

(Chemistry-Physics Library)

1. D. Diamond, "Principles of Chemical and Biological Sensors", Wiley, 1998
   Call Number: TP159.C46 P75

2. R. F. Taylor and J. S. Schultz, "Handbook of Chemical and Biological Sensors", Institute of Physics Publishing, 1996
   Call Number: TP159.C46 H36

3. U. E. Spichiger-Keller, "Chemical Sensors and Biosensors for Medical and Biological Applications", Wiley, 1998
   Call Number: TP159.C46 S67

Course Schedule		
Tuesday	Thursday	Topic
	Week 1	Syllabus, Introduction to Sensors
Week 2		Introduction to Sensors
	Week 2	Introduction to Sensors; Protein Engineering
Week 3		Protein Engineering
	Week 3	Protein Engineering
Week 4		Protein Engineering; Protein Immobilization
	Week 4	Protein Immobilization
Week 5		Protein Immobilization
	Week 5	Potentiometric Biosensors
Week 6		Potentiometric Biosensors
	Week 6	Potentiometric Biosensors
Week 7		Potentiometric Biosensors
	Week 7	*Exam I*
Week 8		Amperometric Biosensors
	Week 8	Amperometric Biosensors
Week 9		Amperometric Biosensors
	Week 9	Amperometric Biosensors; Optical Biosensors
Week 10		Optical Biosensors
	Week 10	Optical Biosensors; NIR
Week 11		Affinity Biosensors
	Week 12	Affinity Biosensors
Week 13		Microfabrication
	Week 13	Microfabrication
Week 14		Microfabrication
	Week 14	Piezoelectric
Week 15		*Exam II*
	Week 15	Thanksgiving Day
Week 16		Student Presentations
	Week 16	Student Presentations
Week 17		Student Presentations
	Week 17	Student Presentations

Outline for Bioanalytical Sensors Course

I. Introduction to Sensors
   A. Chemical Sensors
   B. General Applications
   C. Biosensor Types
   D. Challenges/Trends in Sensor Research
   E. Sensor Specifications

II. Protein Engineering
   A. DNA Structure
   B. Proteins in Biosensors
   C. Recombinant DNA Technology
   D. Enzymes and Enzymatic Kinetics
   E. Antibodies
   F. Protein Modification Reactions
   G. Synthetic Receptors through Molecular Imprinting

III. Protein Immobilization
   A. Requirements
   B. Immobilization Procedures
   C. Oriented Immobilization
   D. Enzyme Amplification
   E. Effect of Immobilization on Activity

IV. Potentiometric Biosensors
   A. Terminology
   B. Electrochemical Cell
   C. Types of ISEs
   D. ISEs in Clinical Chemistry
   E. Biocatalytic Potentiometric Sensors
   F. Biosensors Based on Microorganisms and Tissues

V. Amperometric Biosensors
   A. Principles
   B. Electrode Reaction
   C. Voltammograms
   D. Microelectrodes
   E. Redox Enzyme Biosensors
   F. Glucose Biosensors
   G. Other Electrochemical Biosensors

VI. Optical Biosensors
   A. Optical Fibers
   B. Instrumentation
   C. Measurement Principles
   D. Ion Optodes
   E. Oxygen Optode

F. Direct Optodes
G. Biocatalytic Optical Sensors

VII. Near-Infrared Sensing
A. Introduction
B. Methodology
C. Glucose Determination
D. Mid-Infrared Determination of Glucose
E. Pulse Oximetry
F. Direct IR Sensors
G. Limitations

VIII. Affinity Biosensors
A. Affinity Interactions
B. Intrinsic Fluorescence Based Sensors
C. Fluorescence Energy Transfer (Immuno)sensors
D. Displacement-Type Biosensors
E. Evanescent Wave Sensors
F. Surface Plasmon Resonance
G. Chemoreceptor Based Sensors

IX. Microfabrication
A. Why Miniaturization?
B. Scaling Laws
C. Mass Production Technologies
D. Thick-Film Sensors
E. Ink-Jet Printing
F. Capillary Filled Devices
G. Thin-Film Technology
H. Soft Lithography
I. Machining Tools
J. Biomimetic Fabrication
K. Lab-on-a-Chip
L. LabCD
M. i-Stat

Grading Scale for Graduate Students

100 – 90% = A
89.9 – 80% = B
79.9 – 70% = C
< 69.9% = E

ARTS AND SCIENCES
EDUCATIONAL POLICY COMMITTEE
INVESTIGATOR REPORT

INVESTIGATING AREA: Natural & Math. Sci. COURSE, MAJOR, DEGREE or PROGRAM: *CHE 525*

DATE FOR EPC REVIEW: *9/21/06* 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 **Leonidas Bachas Associate Dean, 275 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. *None*

2. If no modifications were made, review considerations that arose during the investigation and the resolutions. ***The Natural Sciences subcommittee discussed the course proposal and decided it is a welcome addition to the Chemistry curriculum, a course in an important new area of interest to many.***

3. List contacts with program units on the proposal and the considerations discussed therein. *None*

4. Additional information as needed. *None*

5. A&S **Area Coordinator** Recommendation:

   APPROVE, APPROVE WITH RESERVATION, OR DISAPPROVE

6. A&S **Education Policy Committee** Recommendation:

   APPROVE, APPROVE WITH RESERVATION, OR DISAPPROVE

7. _____ Date: *12/05/06*
   A&S Educational Policy Committee, **Phil Bonner**

File: \InvestigatorRpt