APPROVED BY SENATE
11/18/2013

EP.14.13

ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Proposal to the Senate Educational Policy Committee

PROPOSAL TITLE:
Revision to the Bachelor of Science in Bioengineering, Department of Bioengineering, College of Engineering

SPONSOR:
Brad Sutton, Associate Professor and Associate Head, Department of Bioengineering
217-244-5154, bsutton@illinois.edu

COLLEGE CONTACT:

Umberto Ravaioli, Interim Associate Dean, College of Engineering, 217-333-2280,
ravaioli@illinois.edu

BRIEF DESCRIPTION:
The Bioengineering Department continues to develop its core engineering courses with strong biology and physiology integration, demonstrating for students the application of engineering principles to biological systems. In line with that curriculum goal, the Department of Bioengineering requests a revision to the Bioengineering Technical Core section of the curriculum for the Bachelor of Science in Bioengineering as follows:

Further development of fundamentals of systems engineering throughout curriculum

- Revise BIOE 205—Circuits & Systems in Bioengrg (4 hours) to BIOE 205—Signals & Systems in Bioengrg (3 hours)
- Replace MCB 404—Sys & Integrative Physiol Lab (2 hours) with BIOE 303—Quantitative Physiology Lab (2 hours)
- Introduce a new course BIOE 420—Intro Bio Control Systems (3 hours).

Replacing fluid mechanics with transport and fluids in biological systems

- Replace TAM 335—Fluid Mechanics (4 hours) with a new course BIOE 360—Transport & Flow in Bioengrg (3 hours).

Replacing separate quantum mechanics and thermodynamics courses with an integrated course in bioenergetics

- Replace ME 300—Thermodynamics (3 hours) and PHYS 214—Univ Physics: Quantum Physics (2 hours) with a new course BIOE 220—Bioenergetics (4 hours).

Applying statistics to large biological data sets and genomics

- Replace IE 300—Analysis of Data (3 hours) with a new course BIOE 310—Comp Tools Bio Data (3 hours).

A Course Revision form for BIOE 205 and New Course Outline forms for BIOE 220, BIOE 310, BIOE 360, and BIOE 420 can be found in Appendix B.

Net hour change in curriculum: 0 hours added, 4 hours of engineering added. Total hours changed: 14 hours of BIOE courses added; 12 hours of Engineering and 2 hours of MCB deleted.

JUSTIFICATION:

Bioengineering incorporates a thorough understating of biology with a breadth of engineering knowledge across multiple engineering disciplines. Bioengineering undergraduate curriculums are significantly challenged to cover the large amount of material that bioengineers need to master within the allotted degree program hours and with sufficient engineering hours for ABET. The ABET standard for any engineering program is 48 hours of engineering content (referred to as engineering hours below), as defined by the ABET a-k outcomes for engineering graduates (ABET.org). The B.S. degree curriculum in Bioengineering, as currently approved by the Illinois Board of Higher Education, is 128 hours with 50 engineering hours. The curriculum as it was originally proposed included foundational mathematics, physical and life science courses; a large component of courses from affiliated engineering disciplines, and a small proposed core of bioengineering courses integrating biology with principles of engineering from these affiliated disciplines. As the department faculty have increased in number, the Bioengineering Department has had the ability to further develop courses that provide a strong integration of engineering and biology in a string of courses that prepare students for the challenges in field of Bioengineering. The current changes proposed would increase our ABET engineering hours from 50 to 54 engineering hours due to replacing basic science courses, PHYS 214 and IE 300, increasing thermodynamics content, BIOE 220, and adding in a course with heavy design content, BIOE 420.

This proposal adds five courses to the curriculum; largely replacing courses focused on fundamental science concepts, such as statistics, fluids, and thermodynamics, with courses that integrate biological examples and specific technical topics into the treatment of the basics. This provides students with domain-specific treatment and focus on the areas that are most likely to impact their future careers. Three of these five courses have been piloted several times with success.

<u>Further development of fundamentals of systems engineering throughout curriculum</u>

- Revise BIOE 205—Circuits & Systems in Bioengrg (4 hours) BIOE 205—Signals & Systems in Bioengrg (3 hours).
- Replace MCB 404—Sys & Integrative Physiol Lab (2 hours) with BIOE 303—Quantitative Physiology Lab (2 hours)
- Introduce BIOE 420—Intro Bio Control Systems (3 hours).

The first step in this curriculum revision is a further development of our systems engineering approach to biology. Along these lines, we are revising our core introductory course, BIOE 205—Circuits & Systems in Bioengrg, to focus more specifically on linear systems theory while reducing the emphasis on circuit analysis. Currently, BIOE 205 is 50% circuit analysis and 50% systems, but does not include Laplace transform theory and biological applications. The department proposes to revise BIOE 205 to include Laplace transforms and a better introduction to system analysis concepts; moving the circuit analysis content to another course, BIOE 414. To reflect the change in content, we are requesting (via a course revision form) a change in course title to BIOE 205 Signals & Systems in Bioengrg. Overall, the revisions to BIOE 205 will cover less content than it currently does and so the credit hours will be reduced from 4 hours to 3 hours.

BIOE 303—Quantitative Physiology Lab was recently approved by the campus for the Bioengineering curriculum. This course expands upon physiology taught in BIOE 302—Modeling Human Physiology, allowing students to see how parameters in models of various body systems (cardiovascular, neurophysiology, muscle, respiratory, and endocrine systems) are measured, how they change, and allowing them to validate the model's ability to describe real human physiology behaviors. When simulating physiology, students can perform many virtual experiments very quickly to get a quantitative feel for how the systems perform. However, while they are learning the models, they need to have hands-on experience with one or two experiments to validate the model and understand the inputs. This combination of computer simulations coupled with hands-on experiments has been shown to be a powerful learning model and addresses teaching to a variety of learning styles. Additionally, a significant proportion of the proposed course (50 %) is devoted to measurements associated with the mathematical and computer modeling of the systems, so information and experiments are presented as a means to create context for the mathematical models, calibrating and validating their behavior. This approach allows for engineering content in the course that was not offered in MCB 404.

In order to provide a stronger integration of engineering systems and biology, we are introducing a new course BIOE 420—Intro Bio Control Systems as a capstone course for seniors in the department. This course will require integration of the physiological models and linear systems theory to analyze and design control systems for biomedical applications. The course will cover fundamentals of control while working up to a project that allows students to design a measurement and control system for a physiological signal of interest using microcontrollers and biosensors.

<u>Replacing fluid mechanics with transport and fluids in biological systems</u>

- Replace TAM 335—Fluid Mechanics (4 hours) with a new course BIOE 360—Transport Phenomena in Bioengineering (3 hours).

We have developed a course to provide a deeper treatment of transport in biological systems. Currently students are required to take TAM 335—Fluid Mechanics. This course teaches fundamentals of fluids, however, in an industrial flow context. In contrast, our proposed course, BIOE 360—Transport Phenomena in Bioengineering, will focus on fundamental flow concepts in microfluidics, biological flows, blood flow, drug delivery, and biomedical devices. Biological fluids behave very differently than industrial fluids, and our proposed course will prepare Bioengineering students for dealing with these challenging flow systems. In addition, the course will cover transport processes for topics such as drug delivery and incorporate imaging techniques used in industry and medical applications by addressing design and use of contrast agents, phase contrast imaging and flow Doppler instrumentation. This comprehensive list of topics will strengthen the applied knowledge for bioengineering graduates who choose to pursue careers involving imaging, diagnostics, and medical devices – a trend that is increasingly seen in bioengineering job placements.

<u>Replacing separate quantum mechanics and thermodynamics with bioenergetics</u>

- Replace ME 300—Fluid Mechanics (3 hours) and PHYS 214—Univ Physics: Quantum Physics (2 hours) with a new course BIOE 220—Bioenergetics (4 hours).

Currently Bioengineering students experience thermodynamics in two contexts, once in PHYS 214 and once in ME 300. These two courses cover quantum mechanics up to systems-level thermodynamics, however, they do not have coverage of biological systems. We have partnered with mechanical engineering faculty to develop BIOE 220—Bioenergetics to include coverage of quantum, sub-molecular, molecular, up to cell-level thermodynamics. Thermodynamics,

energetics, and metabolism are fundamental to life processes and coverage in a biological context, with the specific topics that Bioengineers will need in research and industry, is absolutely essential to prepare our students. This course has been offered as a pilot twice previously through mechanical engineering, once in Spring 2007 and once in Spring 2012 when it was updated, co-taught by a bioengineering faculty member and tailored for the bioengineering curriculum in preparation for approval as a permanent course.

Introducing statistics through large biological data sets and genomics

- Replace IE 300—Analysis of Data (3 hours) with a new course BIOE 310—Comp Tools Bio Data (3 hours).

We are proposing to replace a general statistics course with one focused on large biological data and computational tools. Currently Bioengineering students take IE 300—Analysis of Data, which provides coverage of probability and statistics in a general context. We are proposing to update this with BIOE 310—Comp Tools Bio Data. The course will focus on statistics of large biological data sets from genomics, including access to genomic datasets from the NCBI genomics database. In addition to the use of genomics data, students are taught the tools needed to analyze such large data sets, using both R and Matlab. The proposed course provides the tools and context that students need to form hypotheses about genomics problems and analyze and test them with real data and real computational tools. This skill is critical for industrial and research jobs that many Bioengineering students pursue after graduation.

BUDGETARY AND STAFF IMPLICATIONS:

a. Additional staff and dollars needed – No additional staff or budget is required to implement the changes outlined in this proposal. Enrollment in new BIOE courses can be managed with existing instructional resources. Four new faculty have been hired and they have been assigned these courses as part of their teaching load. We have increased capacity and are able to accommodate these new courses with our current staffing.
b. Internal reallocations – No change in class size, teaching load, or student-faculty ratio is indicated by the changes outlined in this proposal.
c. Effect on course enrollment in other units and explanations of discussions with representatives of those departments – Our students will no longer take Physics 214. A letter is attached in the appendix from Physics indicating that this will not have an impact on the course. Other course changes are courses that are being replaced with new Bioengineering courses with integrated biological topics. Letters of support from the affected departments are included in Appendix B associated with each proposed new course.
d. Impact on the University Library – No impact to the University Library is indicated by the changes outlined in this proposal. A letter from the library is attached.
e. Impact on computer use, laboratory use, equipment, etc. – No additional impact to computer use, laboratory use, or equipment is anticipated with the changes outlined in this proposal.

DESIRED EFFECTIVE DATE: Spring 2014

STATEMENT FOR PROGRAMS OF STUDY CATALOG: Appendix A

CLEARANCES:

Signatures:

Unit Representative: Date: 1/24/13

College Representative: Date: 9/27/2013

Graduate College Representative: Date:

Provost Representative: Date:

Educational Policy Committee Representative: Date:

Appendix A: Statement for Programs of Study

Bioengineering

bioengineering.illinois.edu

Department Head: Michael F. Insana
Department Office: 1270 Digital Computer Lab, 1304 West Springfield Avenue, (217) 333-1867

Curriculum in Bioengineering

bioengineering.illinois.edu

For the Degree of Bachelor of Science in Bioengineering

Bioengineers use tools from biology, chemistry, physics and math to solve engineering problems that arise in biological systems related to biomaterials, biomechanics and prosthetics, cell and tissue engineering, molecular modeling, imaging, bioinformatics, nanomedicine, synthetic biology, and drug delivery. The goal of research and education in bioengineering is to advance fundamental understanding of how human biological systems function, and to develop effective technology-based solutions to the wide spectrum of societal needs in human development and disease diagnosis, treatment, and prevention.

Bioengineering graduates work in such fields as healthcare, pharmaceuticals, medical devices, consumer products, hospitals and clinics, government regulatory agencies, patent law, academia, laboratory and research facilities, product and process development, quality and regulatory services, and operations and manufacturing.

The curriculum includes integration of principles of biology and engineering in coursework such as biomechanics, modeling of human physiology, bioinstrumentation, and cell and tissue engineering. The curriculum is project based and has a strong emphasis on systems-thinking as an approach to large-scale bioengineering problems. During the first and second year, students take fundamental courses introducing them to bioengineering as a field and introducing clinically relevant projects as learning experiences. The program also features hands-on labs for real-world experience throughout the curriculum. The final two years allow students to focus on a particular track of Bioengineering for further study. A year-long senior capstone design course provides experience in applying engineering fundamentals to biological problems submitted by faculty, clinicians, and industrial firms.

Overview of Curricular Requirements

The curriculum requires 128 hours for graduation and is organized as shown below.

Technical grade point average requirements for graduation and advanced-level course registration apply to students in this curriculum. These rules are summarized at the College of Engineering's undergraduate advising Web site

Orientation and Professional Development

These courses introduce the opportunities and resources your college, department, and curriculum can offer you as you work to achieve your career goals. They also provide the skills to work effectively and successfully in the engineering profession.

Hours	Requirements
1	BIOE 120—Introduction to Bioengineering

0	ENG 100—Engineering Orientation
1	Total

Foundational Mathematics and Science

These courses stress the basic mathematical and scientific principles upon which the engineering discipline is based.

Hours	Requirements
3	CHEM 102—General Chemistry I
1	CHEM 103—General Chemistry Lab I
3	CHEM 104—General Chemistry II
1	CHEM 105—General Chemistry Lab II
4	MATH 221—Calculus I[1]
3	MATH 231—Calculus II
4	MATH 241—Calculus III
3	MATH 285—Intro Differential Equations
4	PHYS 211—University Physics: Mechanics
4	PHYS 212—University Physics: Elec & Mag
~~2~~	~~PHYS 214—Univ Physics: Quantum Physics~~
~~32~~30	Total

1. MATH 220—Calculus may be substituted, with four of the five credit hours applying toward the degree. MATH 220 is appropriate for students with no background in calculus.

Bioengineering Technical Core

These courses stress fundamental concepts and basic laboratory techniques that comprise the common intellectual understanding of bioengineering.

Hours	Requirements
3	BIOE 201—Conservation Principles Bioeng
2	BIOE 202—Cell & Tissue Engineering Lab
43	BIOE 205—~~Circuits~~ Signals & Systems in Bioengrg
3	BIOE 206—Cellular Bioengineering

4	BIOE 220—Bioenergetics
3	BIOE 301—Introductory Biomechanics
3	BIOE 302—Modeling Human Physiology
2	BIOE 303—Quantitative Physiology Lab
3	BIOE 310—Comp Tools Bio Data
3	BIOE 360—Transport & Flow in Bioengrg
3	BIOE 414—Biomedical Instrumentation
2	BIOE 415—Biomedical Instrumentation Lab
3	BIOE 420—Intro Bio Control Systems
2	BIOE 435—Senior Design I
2	BIOE 436—Senior Design II
3	BIOE 476—Tissue Engineering
3	CHEM 232—Elementary Organic Chemistry I[1]
3	CS 101—Intro Computing: Engrg & Sci
~~3~~	~~IE 300—Analysis of Data~~
4	MCB 150—Molec & Cellular Basis of Life
~~2~~	~~MCB 404—Sys & Integrative Physiol Lab~~
~~3~~	~~ME 300—Thermodynamics~~
4	~~TAM 335—Fluid Mechanics~~
~~52~~54	Total

1. May be taken for 4 credit hours; the extra hour may be used to help meet free elective requirements.

Track Electives

Students must complete 15 hours of study which show coherence, focus, and purpose within a bioengineering context. Students may choose from among the following pre-approved tracks:

- Biomechanics
- Cell and Tissue Engineering
- Computational and Systems Biology ~~(under review, consult department chief advisor)~~
- Imaging and Sensing

- Therapeutics Engineering

Alternately a student may devise a special track and set of courses which must be approved by the Bioengineering Department. In either case, overage hours in required courses may be counted toward the 15-hour minimum.

Hours	Requirements
15	Track electives selected from a departmentally approved list of track elective courses.

Liberal Education

The liberal education courses develop students' understanding of human culture and society, build skills of inquiry and critical thinking, and lay a foundation for civic engagement and lifelong learning.

Hours	Requirements
6	Electives from the campus General Education social & behavioral sciences list.
6	Electives from the campus General Education humanities & the arts list.
6	Electives either from a list approved by the college, or from the campus General Education lists for social & behavioral sciences or humanities & the arts.
18	Total

Students must also complete the campus cultural studies requirement by completing (i) one western/comparative culture(s) course and (ii) one non-western/U.S. minority culture(s) course from the General Education cultural studies lists. Most students select liberal education courses that simultaneously satisfy these cultural studies requirements. Courses from the western and non-western lists that fall into free electives or other categories may also be used satisfy the cultural studies requirements.

Composition

These courses teach fundamentals of expository writing.

Hours	Requirements
4	RHET 105—Principles of Composition
	Advanced Composition. May be satisfied by completing a course in either the liberal education or free elective categories which has the Advanced Composition designation.
4	Total

Free Electives

These unrestricted electives, subject to certain exceptions as noted at the College of Engineering advising Web site, give the student the opportunity to explore any intellectual area of unique interest. This freedom plays a critical role in helping students to define research specialties or to complete minors.

Hours	Requirements

6	Free electives. Additional unrestricted course work, subject to certain exceptions as noted at the College of Engineering advising Web site, so that there are at least 128 credit hours earned toward the degree.

Suggested Sequence

The schedule that follows is illustrative, showing the typical sequence in which courses would be taken by a student with no college course credit already earned and who intends to graduate in four years. Each individual's case may vary, but the position of required named courses is generally indicative of the order in which they should be taken.

First Year

Hours	First Semester
1	BIOE 120—Introduction to Bioengineering
3	CHEM 102—General Chemistry I
1	CHEM 103—General Chemistry Lab I
0	ENG 100—Engineering Orientation
4	MATH 221—Calculus I[1]
4	RHET 105—Principles of Composition **or** MCB 150—Molec & Cellular Basis of Life[2]
3	Liberal education elective[3]
16	Total

Hours	Second Semester
3	CHEM 104—General Chemistry II
1	CHEM 105—General Chemistry Lab II
3	MATH 231—Calculus II
4	MCB 150—Molec & Cellular Basis of Life **or** RHET 105—Principles of Composition[2]
4	PHYS 211—University Physics: Mechanics
3	Liberal education elective[3]
18	Total

Second Year

Hours	First Semester

3	BIOE 201—Conservation Principles Bioeng
3	BIOE 206—Cellular Bioengineering
3	CS 101—Intro Computing: Engrg & Sci
4	MATH 241—Calculus III
4	PHYS 212—University Physics: Elec & Mag
17	Total

Hours	Second Semester
2	BIOE 202—Cell &Tissue Engineering Lab
43	BIOE 205—~~Circuits~~ Signals & Systems in Bioengrg
3	CHEM 232—Elementary Organic Chemistry I[4]
3	MATH 285—Intro Differential Equations
~~34~~	~~Liberal education elective~~[3]BIOE 220—Bioenergetics
15	Total

Third Year

Hours	First Semester
3	BIOE 301—Introductory Biomechanics
3	BIOE 414—Biomedical Instrumentation
2	BIOE 415—Biomedical Instrumentation Lab
3	~~ME 300—Thermodynamics~~BIOE 360—Transport & Flow in Bioengrg
~~2~~3	Track elective[5]~~PHYS 214—Univ Physics: Quantum Physics~~
3	Liberal education elective[3]~~Track elective[5]~~
~~16~~17	Total

Hours	Second Semester
3	BIOE 302—Modeling Human Physiology

2	BIOE 303—Quantitative Physiology Lab
3	BIOE 310—Comp Tools Bio Data
3	BIOE 476—Tissue Engineering
~~3~~	~~IE 300—Analysis of Data~~
~~2~~	~~MCB 404—Sys & Integrative Physiol Lab~~
3	Track elective[5]
3	Liberal education elective[3]
17	Total

Fourth Year

Hours	First Semester
3	BIOE 420—Intro Bio Control Systems
2	BIOE 435—Senior Design I
~~4~~	~~TAM 335—Fluid Mechanics~~
6	Track electives[5]
3	Liberal education elective[3]
~~15~~14	Total

Hours	Second Semester
2	BIOE 436—Senior Design II
3	Track elective[5]
3	Liberal education elective[3]
6	Free electives
14	Total

1. MATH 220—Calculus may be substituted, with four of the five credit hours applying toward the degree. MATH 220 is appropriate for students with no background in calculus.
2. RHET 105 may be taken in the first or second semester of the first year as authorized. The alternative is MCB 150.
3. Liberal education electives must include 6 hours of social & behavioral sciences and 6 hours of humanities & the arts course work from the campus General Education lists. The remaining 6 hours may be selected from a list maintained by the college, or additional course work from the campus General Education lists for social & behavioral sciences or humanities & the arts. Students must also complete the campus cultural studies requirement by completing (i) one western/comparative culture(s) course and (ii) one non-western/U.S. minority culture(s) course

from the General Education cultural studies lists. Most students select liberal education courses that simultaneously satisfy these cultural studies requirements. Courses from the western and non-western lists that fall into free electives or other categories may also be used satisfy the cultural studies requirements.
4. May be taken for 4 credit hours; the extra hour may be used to help meet free elective requirements.
5. To be selected from a departmentally approved list of track elective courses if a pre-approved track is chosen. Alternately a student may devise a special track which must be approved by the Bioengineering Department.

"Pitts, Kevin T" <kpitts@illinois.edu> January 13, 2013 8:53 AM
To: Brad Sutton <bsutton@illinois.edu>
RE: Bioengineering Curriculum Update

Brad,

The annual enrollment (Fall + Spring + Summer) in PHYS 214 is approximately 1400 students. Over the last several years, the number of Bioengineering students enrolled in PHYS 214 (Fall + Spring + Summer) has averaged 25. If PHYS 214 is dropped from the Bioengineering curriculum, the 2% reduction in enrollment in PHYS 214 will not affect the implementation or quality of instruction in PHYS 214.

I would be happy to provide additional information if needed.

Regards,
Kevin Pitts
Associate Head, Physics

Kevin T. Pitts
Dept. of Physics
University of Illinois
Tel. (217) 333-3946
Fax (217) 333-4990

-----Original Message-----
From: Sutton, Brad
Sent: Saturday, January 12, 2013 4:49 PM
To: Pitts, Kevin T
Subject: Bioengineering Curriculum Update

Kevin,

Bioengineering is undergoing a revision to the undergraduate curriculum in order to further the integration of coverage of engineering fundamentals and biology. As part of this, we will be introducing a course on Bioenergetics that includes coverage of quantum, sub-molecular, molecular, up to cell-level thermodynamics. With inclusion of this new course (BIOE 220), we will be dropping the inclusion of PHYS 214 and ME 300 from our required curriculum.

We would like to include a letter from Physics (an email is fine) indicating that the loss of Bioengineering students from PHYS 214 will not create any issues for the course. If there are any concerns, I would be glad to discuss them. Thanks for your support.

Brad

Brad Sutton
Associate Head, Bioengineering
bsutton@illinois.edu

Appendix B: Course Revision Form and New Course Outlines

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COURSE REVISION FORM

Departments/units should complete this form, obtain all necessary approvals and submit to their College Office to revise a course. The form will be reviewed by the College and forwarded to appropriate campus offices for additional approval.

All gray boxes on this form, except gray check boxes, are expandable text fields. Place your cursor in the box and start typing.

Instructions and guidance to complete certain items in this form are contained in *Revising Existing Courses* (http://provost.illinois.edu/programs/cps/revisingcourses.html)

Department/Unit Name: Bioengineering **Department/Unit ORG Code:** 1343	**Course Subject and Number:** BIOE 205 **Course Title:** Circuits & Systems in Bioengrg **Proposed Effective Term:** ☐ Fall ☒ Spring ☐ Summer - 2014
Please indicate current course cross-listings*:	

☐ **COURSE DISCONTINUANCE (and all cross-lists*, if any); IF CHECKED, SKIP TO #3**

–OR– *(check the box above or below)*

☒ **TYPE OF REVISION(S) (check all that apply)**

☐ Subject	☐ Add	☐ Remove	☐ Revise – Cross-List*
☐ Number	☐ Add	☐ Remove	☐ Revise – Differential Credit
☒ Title	☐ Add	☐ Remove	☐ Revise – Repeatability
☒ Credit Hours	☐ Add	☐ Remove	☐ Revise – Credit Restriction
☒ Description (subject matter)	☐ Add	☐ Remove	☐ Revise – Prerequisite
☐ Grade Mode (e.g., request for use of DFR)			

☐ Other, describe:

1. HOW REVISION(S) INDICATED APPEAR CURRENTLY:

Circuits & Systems in Bioengrg
Credit: 4 hours
Electronic circuits and general linear systems with examples from biology and medicine. Principles of circuit analysis, transient analysis, steady-state analysis, semiconductor devices and op-amps, and network frequency response. Linear systems and mathematical models of systems, including differential equations, convolution. Fourier series and transforms, and power spectral density. Application of general techniques to biological signal analysis through class examples and course work.

2. HOW REVISION(S) INDICATED WOULD APPEAR AFTER CHANGE:

Signals & Systems in Bioengrg
Credit: 3 hours
Introduction to signals and linear systems with examples from biology and medicine. Linear systems and mathematical models of systems, including differential equations, convolution, Laplace transforms, Fourier series and transforms, and discrete representations. Class examples and coursework apply general techniques to problems in biological signal analysis, including circuits, enzyme kinematics, and physiological system analysis. Use of Matlab and Simulink software to understand more complex systems.

3. JUSTIFY REVISION OR REQUEST:

The Bioengineering Department has future plans to introduce a new upper-level course in System Control Theory, which will require students to use the Laplace transform. The current BIOE 205 is 50% circuit analysis and 50% systems, but does not include Laplace. In order to accommodate the introduction of Laplace in preparation for the new course in System Control Theory, we plan to move the circuit analysis portion of BIOE 205 to our instrumentation course BIOE 414 (to be proposed in a follow on course revision form) to make room for the introduction of Laplace and to more explicitly introduce systems analysis concepts. The revised BIOE 205 course will have less material overall, so the number of course hours has been reduced from four to three. To reflect the change in content, we also want to change the course title to Signals & Systems in Bioengr.

Proposed By: Kenneth Gentry **Date:** 12/20/2012

***Note: Additional approvals are required.** An authorized official of each non-controlling, cross-listing department must endorse the revisions(s). In addition, if the cross-listing involves a different college, a dean of that college must also approve. (Letter, e-mail, or note written below the Approvals block are all acceptable methods of approval endorsement.)

COURSE REVISION FORM APPROVALS **Subject and Course Number:** BIOE 205

(Signatures required)

Department/Unit	Date 1/24/13
School (if applicable)	Date
College	Date
Graduate College (Requests for Graduate Credit)	Date
Provost	Date

ADDITIONAL APPROVALS

The space below may be used for additional approvals involving cross-listed courses – cf. footnote * above – in lieu of letters or e-mails. Indicate department or college after signature and provide date.

Revised 6/2010

Course Syllabus

BIOE 205 – Signals and Systems in Bioengr

Required text: *Engineering Signals and Systems*, Fawwaz T. Ulaby and Andrew E. Yagle, National Technology and Science Press, 2013.
The text will be supplemented with notes and slides from the instructor.

Credit: 3 undergraduate hours.

Meeting Schedule/Contact Hours: Three 50-minute lecture-discussions per week; i.e., 3.0 contact hours per week.

Topical Outline:

Topics	Contact Hours
Signal descriptions - Complex, periodic, singularity, exponential, Gaussian functions, causal - Models of drug delivery	5
System properties - Linearity, time-invariance, causality, stability - Examples of linear time-invariant systems in biology represented by differential equations (Enzyme kinetics, Cell growth)	3
Impulse response and convolution - Transfer function from impulse response - Application to biomechanical models of muscle contraction	3
Laplace transform and inverse Laplace transform - Definition and properties - Partial fraction expansion - Bilateral transform - Application to circuit analysis	7
Laplace transfer functions - Input/output relations - Transient and Steady-state responses - Stability	3
Phasor analysis and Fourier series - Exponentials as basis functions - Input/output relations and transfer functions - Examples of Fourier representations of biological signals	5
Fourier transform - Definition and properties - Parseval's theorem - Phasor vs. Laplace vs. Fourier - Example of Fourier analysis: Cardiovascular physiology model	7
Transfer functions and the frequency response - Example analysis of systems: Bode plots - Example transfer functions: Medical imaging systems	3
Filtering using the Fourier transform	2
Discrete signals and the Fast Fourier Transform - Sampling criteria and sampling issues - Example of discrete sampled signal: Spectral analysis of ECG	3
Mid-term tests	2
Total	**43**

Grading: Two mid-term tests 50%, final examination 30%, and assignments (20%). The assignments will include homework problems from the textbook, homework problems provided by the instructor, and Matlab and Simulink problems.

Proposed by: Ken Gentry

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NEW COURSE OUTLINE

Departments/units should complete this form, obtain all necessary approvals and submit to their College Office to establish a new course. The outline will be reviewed by the College and forwarded to appropriate campus offices for additional approval.

All gray boxes on this form, except gray check boxes, are expandable text fields. Place your cursor in the box and start typing.

Instructions and guidance to complete certain numbered items in this form are contained in *Proposing New Courses* (http://provost.illinois.edu/programs/cps/proposingcourses.html) and *Procedures for Presenting New or Revised Graduate Courses* (http://www.grad.illinois.edu/courses-procedures).

Proposed Effective Term: ☐ Fall ☒ Spring ☐ Summer – 2014

Department/Unit Name: BIOE

Department/Unit ORG Code: 1343

1. Course Subject and Number: BIOE 220
2. Course Title (limit to 30 characters): Bioenergetics
3. Course description (Include subject matter, and any special course requirements such as field trips, special equipment, etc. Exclude other course information of any numbered items below; the Office of the Registrar will include it in the *Course Catalog* entry. It should read like a publication abstract and ideally be limited to about 75 words.):
   An integrative view of functional organization and energy transfer in biological systems. Emphasis on dynamics and kinetics of quantum, sub-molecular, and molecular interactions for metabolism. Topics include biomolecules of life, laws of thermodynamics, enzyme kinetics, protein-ligand binding, DNA binding, and modeling of molecular systems.
4. Course prerequisites (prerequisite statements are not enforced through the Banner system):
   BIOE 201 and 206
5. Is there a restricted audience for this course? (Audience restrictions may only be placed in the Class Schedule. Do not include in prerequisite statement.)
   ☒ Yes ☐ No If yes, please specify the restrictions (e.g., "for majors only" or "junior standing required"): Departmental approval required for nonmajors

COURSE JUSTIFICATION

6. **Please attach the course syllabus.** The syllabus should include basic and recommended texts (author, title, year of publication) as well as a list of the principal topics covered in this course, number of examinations, contact hours, work required of students, and basis for determining grade.
7. Justify the course in terms of new subject matter and how the addition of this course relates to the overall pattern of courses in your unit: This course will offer thermodynamics and quatum knowledge in the context of

biological systems. The course will invovle modeling at varying length scales of atomic to molecular for metabolics. Currently, there is no undergraduate course at UIUC that offers this content.

8. Explain the nature and degree of duplication or overlap with existing courses on campus: This course has overlap with PHYS 214, ME 300, and CHBE 321 on campus. The overlap with PHYS 214 is minimal, estimated at 15% in terms of coverage of probability of atomic states and modeling of particle in a box. Overlap with ME 300 is limited roughly 15% involving basic theories of enegry transfer through the law of thermodynamics and entropy calculations. CHBE 321 has the most significant overlap at roughly 30% in coverage of the laws of thermodynamics, chemical potential, and some overlap in applications of molecular modeling. The course differs in presentation of material through the application to sub-molecular and molecular systems as opposed to industrial systems that are presented in the courses with overlapping content. Further, the emphasis on biological systems will set this course apart from the other offerings of thermodynamics and quantum mechanics.

   Note: If the proposed course has significant overlap with an existing course outside your unit, please obtain a letter of comment from that unit's executive officer.

COURSE DETAIL

9. Frequency with which this course will be offered (mark all that apply):

   ☐ Every fall ☒ Every spring ☐ Every summer ☐ Other (describe, e.g. "Spring terms, odd years"):

   _____

10. Duration of course: ☒ Full term ☐ Less than full term (describe) : _____

11. Anticipated enrollment: 70

12. Expected distribution of student registration:

Freshman: ___%	Sophomore: 90%
Junior: 10%	Senior: ___%
Graduate: ___%	Professional: ___%

13. Course credit (The number of class contact hours in organized instruction is one factor affecting the amount of credit earned. It is customary for courses to meet 14 to 20 hours per semester for each hour of credit earned. See *Student Code* Article 3, Part 7, § 3-704 (b) {http://admin.illinois.edu/policy/code/article3_part7_3-704.html} for an explanation of the relationship between course credit and contact hours.):

A. Undergraduate credit only

100- to 300-level: 4* undergraduate hours

400-level: _____* undergraduate hours (no graduate credit available)

B. Both Undergraduate and Graduate credit

400-level: _____* undergraduate hours **and** 400-level: _____* graduate hours

Note: Courses offered for both undergraduate and graduate credit require completion of Item 14.

C. Graduate credit only

500-level: _____* graduate hours

Note: Courses offered for graduate credit require completion of Item 14.

D. Professional credit only

600- and 700-level: _____* professional hours

E. Both Graduate and Professional credit

_____* graduate hours **and** _____* professional hours

Note: Courses offered for both graduate and professional credit require completion of Item 14.

* For A-E, if a course is offered for varying amounts of credit please select one of the two options:

☐ Variable credit: this course is available for a range of credit hours (e.g., 1 to 3 hours)

☐ Differential credit: this course is only available for two distinct credit-hour options (e.g., 1 or 3 hours)

In addition, complete Item 15.

14. For any course awarding graduate credit, please justify why it should, in terms of level of content, previous knowledge required, relevance to current research, methodology, etc. (See *Graduate College Policy for Proposed New and Revised Courses that Carry Graduate Credit* for criteria to judge graduate courses.): _____

15. For any course requesting variable or differential credit, please justify why the amount of credit varies and specify the work required for the additional credit: _____

16. May this course be repeated? (See *Procedures for Presenting New or Revised Graduate Courses* or Provost's *Proposing New Courses* for guidance in completing Parts A - C.)

☐ Yes ☒ No If yes, please fill out A - C below:

A. Course Type

Indicate the **one** type of course the proposed course matches:

☐ Honors ☐ Subject mastery/skill proficiency ☐ Individualized instruction

☐ Research or ongoing study ☐ Special topics, seminars ☐ Applied experiences

B. Repeatable – same term

May students register in this course more than once (duplicate registration) in the same term?

☐ Yes ☐ No If yes, for how many total hours (fill all fields: NA = not applicable; U = unlimited)?

_____ undergraduate; _____ graduate; _____ professional

☐ check if "if topics vary" is an added qualifier

C. Repeatable – separate terms

May this course be repeated in separate terms?

☐ Yes ☐ No If yes, for how many total hours (fill all fields: NA = not applicable; U = unlimited)?

_____ undergraduate; _____ graduate; _____ professional

☐ check if "if topics vary" is an added qualifier

17. Are there credit restrictions?

☒ Yes ☐ No If yes, please specify the restrictions (e.g., for MATH 221: "Credit is not given for both MATH 221 and MATH 220."): Credit is not given for both BIOE 220 and ME 300, PHYS 214, or CHBE 321

18. Grading Type:

☒ Letter grade

☐ S/U (Any course offered for zero hours of graded credit must include S/U grade mode.)

☐ Both If Both is selected, which should be the default mode? ☐ Letter grade ☐ S/U

☐ DFR If DFR is selected, please justify the use of the grade: _____

CROSS-LISTING

19. Is this course to be cross-listed?

☐ Yes ☒ No If yes, please complete A and B and take notice of C:

A. Indicate the subject and course number of the cross-listing(s) (please note, all cross-listed courses must be offered at the same numerical level): _____

B. Please give the justification for establishing the cross-listing: _____

C. **Note: Additional approvals are required to establish a cross-listing.** An authorized official of each non-controlling department must endorse the cross-listing. In addition, if the cross-listing involves a different college, a dean of that college must also approve. (Letter, e-mail, or use of the Additional Approvals signature block at the end of this form are all acceptable methods of endorsement or approval.)

ADDITIONAL COURSE INFORMATION

20. Does this course replace an existing course?

☐ Yes ☒ No If yes, please list the course to be discontinued and note that submission of a Course Revision Form is necessary to remove it from the Course Catalog: _____

21. Does the addition of this course impact other courses (i.e., prerequisite or credit restriction statements)?

☐ Yes ☒ No If yes, please list the course(s) affected, and note that submission of Course Revision Form(s) are necessary to update the impacted course(s): _____

22. Does the addition of this course have any impact on your department's current curriculum (i.e., Programs of Study catalog, concentrations, minors, etc.)?

☒ Yes ☐ No If yes, please specify the curriculum and explain: The course will replace PHYS 214 and ME 300 in the Bioengineering B.S. curriculum

23. Has this course been offered as a special topics or other type of experimental course?

☒ Yes ☐ No If yes, please indicate the Banner subject, course number, section ID, term, and enrollment for each offering: ME 498 Section JG; CRN 47098 (Crosslisted as BIOE 498 JGA CRN 58062); Spring 2012, 5 enrolled; Spring 2007, 7 enrolled

24. Will this course be submitted for General Education credit?

☐ Yes ☒ No

25. Does this course require students to register in multiple schedule components (e.g., lecture and a lab)?

☐ Yes ☒ No

26. Is a special facility needed to effectively teach this class (e.g., lab, studio, or ITS room)?

☐ Yes ☒ No If yes, please describe: _____

27. Will this course be offered on-line?

☐ Yes, online only ☐ Yes, online and traditionally ☒ No

28. Faculty member(s) who will teach this course: Andrew Smith, Jennifer Amos, John Georgiadis

29. Course proposed by: Andrew Smith Date: 12/18/2012

NEW COURSE OUTLINE APPROVALS **Course Subject and Number:** BIOE 220

(Signatures required)

Department/Unit	Date 1/29/13
School (if applicable)	Date
College	Date
Graduate College (Requests for Graduate Credit)	Date
Provost	Date

ADDITIONAL APPROVAL(S)

The space below may be used for additional approvals involving cross-listed courses. – see Section 19.C; – in lieu of letters or e-mails. Indicate department or college after signature and provide date.

Revised 8/2012

Course Syllabus

BIOE 220 – Bioenergetics

Reference texts: Bioenergetics, DG Nicholls and SJ Ferguson, Academic Press 2011 (3rd edition)
Physical Chemistry for the Life Sciences, P Atkins and J De Paula, W H Freeman & Co, 2011 (2nd edition)
The text will be supplemented with notes and slides from the instructor regarding traditional thermodynamics principles and research papers from journals.

Credit: 4 undergraduate hours

Meeting Schedule/Contact Hours: Two 80-minute lectures per week and one 110 minute lecture-discussion per week; i.e., 4.0 contact hours per week.

Topical Outline:

Topic	Contact Hours
Overview of Cellular energetics	2
- Review of Atomic structure and Introduction to quantum physics Plank, quantum chemistry, wave functions	2
Energy balances involving biomolecules of life	
- ATP as a motor	2
Gibbs free energy minimization principles for Biomolecules of life	4
- Boltzmann Distribution principles for biomolecules of life	4
Laws of Thermodynamics	
- Entropy, enthalpy, equilibrium and non-equilibrium systems, electrochemistry of the cell	8
- Maxwell Relations	4
- Chemical Potential	4
Kinetics and metabolism of biomolecules	2
- Protein ligand binding	2
Modeling methodologies	
- Monte Carlo	2
Finite Element	2
- Advanced modeling considering quantum chemistry	2
Applications of bioenergetics in systems	
- Lactic acid cycle	2
- Glucose use in the brain	2
Midterms	4
Project	8
TOTAL	56

Grading: Two mid-term tests 30%, final examination 35%, assignments (20%) and project (15%) will make up the grades. The assignments will include homework problems and simulation exercises as well as quizzes or in-class activities. The project will consist of modeling a biomolecular system using any of the presented techniques and a report in journal format.

Prepared by: Andrew Smith

"Henderson, Jerrod Antwone" <jahender@illinois.edu> January 11, 2013 5:12 PM
To: "Sutton, Brad" <bsutton@illinois.edu>
Cc: "Amos, Jennifer" <jamos@illinois.edu>
RE: Two BIOE course proposals

Hi Brad,

After reviewing the proposals for BIOE 220 and BIOE 360, I have determined that although there is some overlap with ChBE 321 and ChBE 421 respectively. This overlap is not significant and there is very little overlap in application areas for the basic engineering principles.

Please let me know if you need something on a formal letter head. I noticed that your note said that email was fine.

Cheers,
Jerrod

Jerrod A. Henderson, Ph.D.
Department of Chemical & Biomolecular Engineering
118 Roger Adams Laboratory, MC-712
600 S. Mathews Ave.
Urbana, IL 61801

-----Original Message-----
From: Sutton, Brad
Sent: Thursday, January 03, 2013 1:36 PM
To: Henderson, Jerrod Antwone
Cc: Amos, Jennifer; Sutton, Brad
Subject: Two BIOE course proposals

Jerrod,

We are working hard to get an update of our BIOE undergraduate curriculum to continue to focus on systems engineering approaches and further integration of relevant biological examples into the treatment of fundamental engineering principles.

As part of this, we are proposing two additional courses: BIOE 220 - Bioenergetics and BIOE 360 - Transp Phen Biol (Transport Phenomena in Biology). We would like to get a letter of support from ChBE for these courses as there is some minor overlap in content, as outlined below. As part of our course proposal, we need to include a letter from your department's executive officer (ie you) to support our proposal and acknowledge that the application area and examples will have very little to no overlap. An email is fine.

BIOE 220 - Bioenergetics: This course will include coverage of quantum, sub-molecular, molecular, up to cell-level thermodynamics. Thermodynamics, energetics, and metabolism will be covered as they relate to life processes and in a biological context, with the specific topics that Bioengineers will need in research and industry. There is overlap with ChBE 321, but the systems covered in our course will be focused more on metabolism and energetics of the cell.

BIOE 360 - Transp Phen Biol. This course will cover fundamental flow concepts in microfluidics, biological flows, blood flow, drug delivery, and interactions of biomedical and bioimaging devices with flows. Biological fluids behave very differently than industrial fluids and our proposed course will prepare Bioengineering students for dealing with these challenging flow systems. There is overlap with ChBE 421, but the systems covered in our course will be more focused on biological flows.

We have acknowledged the overlaps in our course proposal forms and have mentioned that there is very little overlap in application areas for these basic engineering principles.

Please let me know if you have any questions or concerns. I have attached the preliminary course proposal and course syllabus. Thanks for your help on this.

Brad

"Christensen, Kenneth T" <ktc@illinois.edu> January 13, 2013 4:15 PM
To: "Sutton, Brad" <bsutton@illinois.edu>
Cc: "Amos, Jennifer" <jamos@illinois.edu>, "Christensen, Kenneth T" <ktc@illinois.edu>, "Smith, Tammy Sue" <tssmith1@illinois.edu>
Re: Two other BIOE course proposals

Brad,

I have looked through the materials you provided in detail and have also received feedback from those that regularly teach the courses with which these might have some perceived overlap.

With regard to BIOE 220 (Bioenergetics), we believe there to be quite little overlap with ME 300 (Thermodynamics) in both content and in applications and examples.

With regard to BIOE 360 (Transport Phenomena in Biology), while there will inevitably be a certain level of overlap with respect to the fundamental fluid mechanics concepts presented, the context, applications and examples will be quite different. So we believe there to be little overlap with either TAM 335 (Introductory Fluid Mechanics) or ME 310 (Fundamentals of Fluid Dynamics; you may wish to add ME 310 to your list of potential overlap courses for completeness). With regard to ME 320 (Heat Transfer), since this proposed course contains no heat transfer, the only overlap could be with respect to the bit of mass transfer covered in ME 320. However, ME 320 focuses on the heat transfer/mass transfer analogy which appears to not be a part of the proposed course. Hence, essentially no overlap with ME 320.

Please let me know if you require any further information or consideration on the part of MechSE with respect to these courses.

Best Regards,

Ken

Kenneth T. Christensen, Ph.D.
Professor and Kritzer Faculty Scholar
Associate Head for Undergraduate Programs
Associate Head for Mechanics Programs
Mechanical Science and Engineering Department
University of Illinois at Urbana-Champaign
E-mail: ktc@illinois.edu

Administrative Assistant:
Pam Vanetta
vanetta@illinois.edu

> -----Original Message-----
> From: Sutton, Brad
> Sent: Thursday, January 03, 2013 1:28 PM
> To: Philpott, Michael L
> Cc: Amos, Jennifer; Sutton, Brad
> Subject: Two other BIOE course proposals
>
> Michael,
>
> Thanks for your previous support of the BIOE controls course. We are working hard to get an update of our curriculum in to continue to focus on systems engineering approaches and further integration of relevant biological examples into the treatment of fundamental engineering principles.

ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

NEW COURSE OUTLINE

Departments/units should complete this form, obtain all necessary approvals and submit to their College Office to establish a new course. The outline will be reviewed by the College and forwarded to appropriate campus offices for additional approval.

All gray boxes on this form, except gray check boxes, are expandable text fields. Place your cursor in the box and start typing.

Instructions and guidance to complete certain numbered items in this form are contained in *Proposing New Courses* (http://provost.illinois.edu/programs/cps/proposingcourses.html) and *Procedures for Presenting New or Revised Graduate Courses* (http://www.grad.illinois.edu/courses-procedures).

Proposed Effective Term: ☐ Fall ☒ Spring ☐ Summer – 2014

Department/Unit Name: Bioengineering

Department/Unit ORG Code: 1343

1. Course Subject and Number: BIOE 310
2. Course Title (limit to 30 characters): Comp Tools Bio Data
3. Course description (Include subject matter, and any special course requirements such as field trips, special equipment, etc. Exclude other course information of any numbered items below; the Office of the Registrar will include it in the *Course Catalog* entry. It should read like a publication abstract and ideally be limited to about 75 words.):
   Fundamental and applied statistics, including probability distributions, parameter estimation, descriptive statistics, hypothesis testing, and linear regression. Statistical methods in genomics including sequence analysis, gene expression data analysis, human genomic variation, regulatory genomics, and cancer genomics.
4. Course prerequisites (prerequisite statements are not enforced through the Banner system):
   BIOE 205 and BIOE 206
5. Is there a restricted audience for this course? (Audience restrictions may only be placed in the Class Schedule. Do not include in prerequisite statement.)
   ☒ Yes ☐ No If yes, please specify the restrictions (e.g., "for majors only" or "junior standing required"): Departmental approval required for nonmajors

COURSE JUSTIFICATION

6. **Please attach the course syllabus.** The syllabus should include basic and recommended texts (author, title, year of publication) as well as a list of the principal topics covered in this course, number of examinations, contact hours, work required of students, and basis for determining grade.
7. Justify the course in terms of new subject matter and how the addition of this course relates to the overall pattern of courses in your unit: This course will integrate applied statistics with genomics, which is an important part of computational bioengineering. It will continue our pattern of providing foundational biology concepts

required of Bioengineers in an engineering framework. Currently, there is no course at UIUC which teaches statistical analysis for genomic data using engineering principles

8. Explain the nature and degree of duplication or overlap with existing courses on campus: The course has 40% overlap with IE 300 in coverage of statistical analysis of data, however, the material is presented in the proposed course with an emphasis on genomic data. The course provides a critical synthesis of material, providing basic information on genomic networks and quantitative treatment of genomic information along with statistical analysis methodologies. Although the statistics concepts are more generally applicable, providing them in a specific context that is relevant to Bioengineers is necessary for an efficient curriculum.
   Note: If the proposed course has significant overlap with an existing course outside your unit, please obtain a letter of comment from that unit's executive officer.

COURSE DETAIL

9. Frequency with which this course will be offered (mark all that apply):
   ☐ Every fall ☒ Every spring ☐ Every summer ☐ Other (describe, e.g. "Spring terms, odd years"):
   _____
10. Duration of course: ☒ Full term ☐ Less than full term (describe) : _____
11. Anticipated enrollment: 65
12. Expected distribution of student registration:

Freshman: ___%	Sophomore: 25%
Junior: 75%	Senior: ___%
Graduate: ___%	Professional: ___%

13. Course credit (The number of class contact hours in organized instruction is one factor affecting the amount of credit earned. It is customary for courses to meet 14 to 20 hours per semester for each hour of credit earned. See *Student Code* Article 3, Part 7, § 3-704 (b) {http://admin.illinois.edu/policy/code/article3_part7_3-704.html} for an explanation of the relationship between course credit and contact hours.):

A. Undergraduate credit only

100- to 300-level: 3* undergraduate hours

400-level: _____* undergraduate hours (no graduate credit available)

B. Both Undergraduate and Graduate credit

400-level: _____* undergraduate hours **and** 400-level: _____* graduate hours

Note: Courses offered for both undergraduate and graduate credit require completion of Item 14.

C. Graduate credit only

500-level: _____* graduate hours

Note: Courses offered for graduate credit require completion of Item 14.

D. Professional credit only

600- and 700-level: _____* professional hours

E. Both Graduate and Professional credit

_____* graduate hours **and** _____* professional hours

Note: Courses offered for both graduate and professional credit require completion of Item 14.

* For A-E, if a course is offered for varying amounts of credit please select one of the two options:

☐ Variable credit: this course is available for a range of credit hours (e.g., 1 to 3 hours)

☐ Differential credit: this course is only available for two distinct credit-hour options (e.g., 1 or 3 hours)

In addition, complete Item 15.

14. For any course awarding graduate credit, please justify why it should, in terms of level of content, previous knowledge required, relevance to current research, methodology, etc. (See *Graduate College Policy for Proposed New and Revised Courses that Carry Graduate Credit* for criteria to judge graduate courses.): _____

15. For any course requesting variable or differential credit, please justify why the amount of credit varies and specify the work required for the additional credit: _____

16. May this course be repeated? (See *Procedures for Presenting New or Revised Graduate Courses* or Provost's *Proposing New Courses* for guidance in completing Parts A - C.)

☐ Yes ☒ No If yes, please fill out A - C below:

A. Course Type

Indicate the **one** type of course the proposed course matches:

☐ Honors ☐ Subject mastery/skill proficiency ☐ Individualized instruction

☐ Research or ongoing study ☐ Special topics, seminars ☐ Applied experiences

B. Repeatable – same term

May students register in this course more than once (duplicate registration) in the same term?

☐ Yes ☐ No If yes, for how many total hours (fill all fields: NA = not applicable; U = unlimited)?

_____ undergraduate; _____ graduate; _____ professional

☐ check if "if topics vary" is an added qualifier

C. Repeatable – separate terms

May this course be repeated in separate terms?

☐ Yes ☐ No If yes, for how many total hours (fill all fields: NA = not applicable; U = unlimited)?

_____ undergraduate; _____ graduate; _____ professional

☐ check if "if topics vary" is an added qualifier

17. Are there credit restrictions?

☒ Yes ☐ No If yes, please specify the restrictions (e.g., for MATH 221: "Credit is not given for both MATH 221 and MATH 220."): Credit is not given for both BIOE 310 and IE 300

18. Grading Type:

☒ Letter grade

☐ S/U (Any course offered for zero hours of graded credit must include S/U grade mode.)

☐ Both If Both is selected, which should be the default mode? ☐ Letter grade ☐ S/U

☐ DFR If DFR is selected, please justify the use of the grade: _____

CROSS-LISTING

19. Is this course to be cross-listed?

☐ Yes ☒ No If yes, please complete A and B and take notice of C:

A. Indicate the subject and course number of the cross-listing(s) (please note, all cross-listed courses must be offered at the same numerical level): _____

B. Please give the justification for establishing the cross-listing: _____

C. **Note: Additional approvals are required to establish a cross-listing.** An authorized official of each non-controlling department must endorse the cross-listing. In addition, if the cross-listing involves a different college, a dean of that college must also approve. (Letter, e-mail, or use of the Additional Approvals signature block at the end of this form are all acceptable methods of endorsement or approval.)

ADDITIONAL COURSE INFORMATION

20. Does this course replace an existing course?

☐ Yes ☒ No If yes, please list the course to be discontinued and note that submission of a Course Revision Form is necessary to remove it from the Course Catalog: _____

21. Does the addition of this course impact other courses (i.e., prerequisite or credit restriction statements)?

☐ Yes ☒ No If yes, please list the course(s) affected, and note that submission of Course Revision Form(s) are necessary to update the impacted course(s): _____

22. Does the addition of this course have any impact on your department's current curriculum (i.e., Programs of Study catalog, concentrations, minors, etc.)?

☒ Yes ☐ No If yes, please specify the curriculum and explain: BIOE 398 section GEN; CRN 51446; Spring 2011, 29 enrolled; BIOE 398 Section JM; CRN 57193; Spring 2012, 29 enrolled; Spring 2013, 47 enrolled.

23. Has this course been offered as a special topics or other type of experimental course?

☒ Yes ☐ No If yes, please indicate the Banner subject, course number, section ID, term, and enrollment for each offering: It will replace IE 300 in the Bioengineering Technical Core in a revision to the Bioengineering B.S. degree which is being submitted for approval.

24. Will this course be submitted for General Education credit?

☐ Yes ☒ No

25. Does this course require students to register in multiple schedule components (e.g., lecture and a lab)?

☐ Yes ☒ No

26. Is a special facility needed to effectively teach this class (e.g., lab, studio, or ITS room)?

☐ Yes ☒ No If yes, please describe: _____

27. Will this course be offered on-line?

☐ Yes, online only ☐ Yes, online and traditionally ☒ No

28. Faculty member(s) who will teach this course: Jian Ma, Ting Lu

29. Course proposed by: Jian Ma Date: 12/20/12

NEW COURSE OUTLINE APPROVALS **Subject and Course Number:** BIOE 310

(Signatures required)

Department/Unit	Date 1/24/13
School (if applicable)	Date
College	Date
Graduate College (Requests for Graduate Credit)	Date
Provost	Date

ADDITIONAL APPROVAL(S)

The space below may be used for additional approvals involving cross-listed courses. – see Section 19.C; – in lieu of letters or e-mails. Indicate department or college after signature and provide date.)

Revised 6/2010

Course Syllabus

BIOE 310 – Comp Tools Bio Data

Required Texts:

Lee, JK: *Statistical Bioinformatics: A Guide for Life and Biomedical Science Researchers*, Wiley-Blackwell, (2010).

Ewens, WJ and Grant, GR: *Statistical Methods in Bioinformatics: An Introduction*, 2nd ed, Springer, (2005).

Optional Text:

Montgomery, DC and Runger, GC: Applied Statistics and Probability for Engineers, 5th Edition. John Wiley & Sons, Inc.

Credit: 3 undergraduate hours.

Meeting Schedule/Contact Hours: two 75-minute lectures (3.0 contact hours) per week.

Topical Outline:

Topic	Contact Hours
Statistics in Engineering & Elements of Probability	1.5
Bayes Theorem	1.5
Discrete Random Variables	3
Poisson Distribution and Genome Assembly	1.5
Continuous Random Variables	3
Joint Probability Distributions	1.5
Descriptive Statistics and Parameter Estimation	1.5
Maximum Likelihood Estimation	1.5
Confidence Interval	1.5
Hypothesis Testing (t-test, chi, sensitivity, ANOVA, ROC)	4.5
Midterm Exam	1.5
Modeling Cancer Progression (I)	3
Hypothesis Test and Gene Expression Analysis	1.5
Statistical Methods for Sequence Alignment	1.5
R & Bioconductor	1.5
High-throughput Sequencing Data Analysis	1.5
Clustering for Gene Expression Data	1.5
HMMs and Gene Finding	1.5
Probabilistic Models for Constructing Gene Network	1.5
Computational Cancer Genomics	1.5
In class Quizzes	1
Project Presentations	4.5
TOTAL	**43**

Grading:

Homework assignments and project 30%, in-class quizzes 15%, one midterm 25%, and a final 30%. Homework will build on topics covered in lectures and will consist of simulations, problem sets from current literature articles that are related to topics covered in lecture. The project involves students designing an experiment and providing analysis of results for a given set of data.

Proposed By: Jian Ma

Carolyn L Beck <clbeck50@gmail.com> January 3, 2013 2:13 PM
To: "Pang, Jong-Shi" <jspang@illinois.edu>
Cc: "Sreenivas, Ramavarapu S" <rsree@illinois.edu>, "Beck, Carolyn L" <beck3@illinois.edu>, "Stipanovic, Dusan M" <dusan@illinois.edu>, <bsutton@illinois.edu>
Re: FW: Two BIOE courses proposed

Hi all,

I think the courses proposed look very interesting and see no issues with the apparent overlap with our courses. The focus of the BIO controls course is solely on physiological models; it looks like a good course.

In the Course Proposal for the controls course, under the discussion of overlap with GE 320, I would suggest to change the phrase "and a variety of other non-living things", to something like "with no specific focus on living organisms", as I do use the anesthesia example in my discussions, and sometimes other bio-inspired examples in GE 320.

Best,
Carolyn

On Thu, Jan 3, 2013 at 1:19 PM, Pang, Jong-Shi <jspang@illinois.edu> wrote:

> Hi RS, Carolyn, and Dusan,
>
> I would appreciate your feedback to the attached email.
>
> Brad, I apologize for the long delinquency in my reply to this request. As soon as I have heard from my colleagues, I will get back to you.
>
> Happy New Year to All,
>
> Jong-Shi
>
> ---
> From: Sutton, Brad
> Sent: Thursday, January 03, 2013 12:50 PM
> To: Pang, Jong-Shi; Craddock, Heidi C
> Cc: Amos, Jennifer; Sutton, Brad
> Subject: Two BIOE courses proposed
>
> Jong-Shi and Heidi,
>
> We are going to submit course proposals for two new Bioengineering courses: BIOE 310 - Computational Tools for Biological data and BIOE 420 - Introduction to Biological Control Systems. We would like to get a letter of support from IE/GE for these courses as there is some minor overlap in content, as outlined below. As part of our course proposal, we need to include a letter from your department's executive officer (ie you) to support our proposal and acknowledge that the application area and examples will have very little to no overlap. An email is fine.
>
> The BIOE 310 course will teach statistical treatment of genomic data using the tools of the trade, R and Matlab. It will focus on getting large data sets from genomic databases and performing analyses that are found in the literature. This course overlaps with IE 300 which is required in our current curriculum. The overlap is in basic statistical principles, however, the application topic area that we treat will have very little overlap with the topics in IE 300.
>
> For the BIOE 420 course, It will teach basic controls: diff EQ to Laplace, transfer function, open/closed loop, transient, steady state, system identification, stability. It will focus on human physiology systems, such as endocrine control, homeostasis, muscle position, neuronal circuits, and cardiovascular function. We will also work on integrating a microcontroller and physiological measurements into a class project to control or simulate control of a physiological system. This course has overlap with GE 320 - Control Systems, I course I remember well from my undergraduate days in GE.
>
> We have acknowledged the overlaps in our course proposal forms and have mentioned that there is no overlap in application areas for these basic engineering principles.
>
> Please let me know if you have any questions. I have attached the preliminary course proposal and course syllabus. Thanks for your help on this.
>
> Brad

--
Prof. Carolyn L. Beck
University of Illinois at Urbana-Champaign

email: beck3@illinois.edu
voice: 217-244-9714

ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

NEW COURSE OUTLINE

Departments/units should complete this form, obtain all necessary approvals and submit to their College Office to establish a new course. The outline will be reviewed by the College and forwarded to appropriate campus offices for additional approval.

All gray boxes on this form, except gray check boxes, are expandable text fields. Place your cursor in the box and start typing.

Instructions and guidance to complete certain numbered items in this form are contained in *Proposing New Courses* (http://provost.illinois.edu/programs/cps/proposingcourses.html) and *Procedures for Presenting New or Revised Graduate Courses* (http://www.grad.illinois.edu/courses-procedures).

Proposed Effective Term: ☐ Fall ☒ Spring ☐ Summer – 2014

Department/Unit Name: Bioengineering

Department/Unit ORG Code: 1343

1. Course Subject and Number: BIOE 360
2. Course Title (limit to 30 characters): Transport & Flow in Bioengrg
3. Course description (Include subject matter, and any special course requirements such as field trips, special equipment, etc. Exclude other course information of any numbered items below; the Office of the Registrar will include it in the *Course Catalog* entry. It should read like a publication abstract and ideally be limited to about 75 words.):
   Fundamentals of fluid dynamics and mass transport applied to analysis of biological systems. Quantitative understanding of microscopic to macroscopic phenomena in biological systems related to their sensing by imaging techniques. Molecular phenomena in both healthy tissue and disease using examples from cardiovascular problems and cancer using ultrasound, optical and MRI techniques.
4. Course prerequisites (prerequisite statements are not enforced through the Banner system):
   BIOE 201and BIOE 301
5. Is there a restricted audience for this course? (Audience restrictions may only be placed in the Class Schedule. Do not include in prerequisite statement.)
   ☒ Yes ☐ No If yes, please specify the restrictions (e.g., "for majors only" or "junior standing required"): Departmental approval required for nonmajors

COURSE JUSTIFICATION

6. **Please attach the course syllabus.** The syllabus should include basic and recommended texts (author, title, year of publication) as well as a list of the principal topics covered in this course, number of examinations, contact hours, work required of students, and basis for determining grade.
7. Justify the course in terms of new subject matter and how the addition of this course relates to the overall pattern of courses in your unit: This course will impart basic understanding of fluid dynamics and transport

needed for applications in bioengineering design and industry at the undergraduate level as well as relate it to sensing and imaging of biological systems in life processes and disease.

8. Explain the nature and degree of duplication or overlap with existing courses on campus: This course has overlap with CHBE 421 and 451 as well as TAM 335. Overlap with CHBE 421 and 451 will be roughly 30% in coverage of theories and equations of flow systems using Navier-Stokes and rheological modeling and mass transfer laws such as Fick's Law. BIOE 360 will not address heat transfer or momentum transfer as covered in roughly 50% of CHBE 421 and 451. The flow situations dicussed will be within the Bioengineering framework of biological systems and analysis of living systems. The overlap with TAM 335 is similar in terms of fluid dynamics covered, Navier-Stokes equations, and energy principles, however, we will only cover basic flow systems to address cardiovascular and lymphatic systems and not address complex flow situations or industrial flow situations. The proposed course allows us to provide Bioengineers with the education in transport and fluid dynamics that they will need for careers as bioengineers in industry without taking a 2 part series of courses with content not tailored toward living systems.

   Note: If the proposed course has significant overlap with an existing course outside your unit, please obtain a letter of comment from that unit's executive officer.

COURSE DETAIL

9. Frequency with which this course will be offered (mark all that apply):

   ☐ Every fall ☒ Every spring ☐ Every summer ☐ Other (describe, e.g. "Spring terms, odd years"):

   _____

10. Duration of course: ☒ Full term ☐ Less than full term (describe) : _____

11. Anticipated enrollment: 60

12. Expected distribution of student registration:

Freshman: ___%	Sophomore: ___%
Junior: 100%	Senior: ___%
Graduate: ___%	Professional: ___%

13. Course credit (The number of class contact hours in organized instruction is one factor affecting the amount of credit earned. It is customary for courses to meet 14 to 20 hours per semester for each hour of credit earned. See *Student Code* Article 3, Part 7, § 3-704 (b) {http://admin.illinois.edu/policy/code/article3_part7_3-704.html} for an explanation of the relationship between course credit and contact hours.):

A. Undergraduate credit only

100- to 300-level: 3* undergraduate hours

400-level: _____* undergraduate hours (no graduate credit available)

B. Both Undergraduate and Graduate credit

400-level: _____* undergraduate hours **and** 400-level: _____* graduate hours

Note: Courses offered for both undergraduate and graduate credit require completion of Item 14.

C. Graduate credit only

500-level: _____* graduate hours

Note: Courses offered for graduate credit require completion of Item 14.

D. Professional credit only

600- and 700-level: _____* professional hours

E. Both Graduate and Professional credit

_____* graduate hours **and** _____* professional hours

Note: Courses offered for both graduate and professional credit require completion of Item 14.

* For A-E, if a course is offered for varying amounts of credit please select one of the two options:

☐ Variable credit: this course is available for a range of credit hours (e.g., 1 to 3 hours)

☐ Differential credit: this course is only available for two distinct credit-hour options (e.g., 1 or 3 hours)

In addition, complete Item 15.

14. For any course awarding graduate credit, please justify why it should, in terms of level of content, previous knowledge required, relevance to current research, methodology, etc. (See *Graduate College Policy for Proposed New and Revised Courses that Carry Graduate Credit* for criteria to judge graduate courses.): _____

15. For any course requesting variable or differential credit, please justify why the amount of credit varies and specify the work required for the additional credit: _____

16. May this course be repeated? (See *Procedures for Presenting New or Revised Graduate Courses* or Provost's *Proposing New Courses* for guidance in completing Parts A - C.)

☐ Yes ☒ No If yes, please fill out A - C below:

A. Course Type

Indicate the **one** type of course the proposed course matches:

☐ Honors ☐ Subject mastery/skill proficiency ☐ Individualized instruction

☐ Research or ongoing study ☐ Special topics, seminars ☐ Applied experiences

B. Repeatable – same term

May students register in this course more than once (duplicate registration) in the same term?

☐ Yes ☐ No If yes, for how many total hours (fill all fields: NA = not applicable; U = unlimited)?

_____ undergraduate; _____ graduate; _____ professional

☐ check if "if topics vary" is an added qualifier

C. Repeatable – separate terms

May this course be repeated in separate terms?

☐ Yes ☐ No If yes, for how many total hours (fill all fields: NA = not applicable; U = unlimited)?

_____ undergraduate; _____ graduate; _____ professional

☐ check if "if topics vary" is an added qualifier

17. Are there credit restrictions?

☒ Yes ☐ No If yes, please specify the restrictions (e.g., for MATH 221: "Credit is not given for both MATH 221 and MATH 220."): Credit is not given for both BIOE 360 and any of CHBE 421, CHBE 451, or TAM 335

18. Grading Type:

☒ Letter grade

☐ S/U (Any course offered for zero hours of graded credit must include S/U grade mode.)

☐ Both If Both is selected, which should be the default mode? ☐ Letter grade ☐ S/U

☐ DFR If DFR is selected, please justify the use of the grade: _____

CROSS-LISTING

19. Is this course to be cross-listed?

☐ Yes ☒ No If yes, please complete A and B and take notice of C:

A. Indicate the subject and course number of the cross-listing(s) (please note, all cross-listed courses must be offered at the same numerical level): _____

B. Please give the justification for establishing the cross-listing: _____

C. **Note: Additional approvals are required to establish a cross-listing.** An authorized official of each non-controlling department must endorse the cross-listing. In addition, if the cross-listing involves a different college, a dean of that college must also approve. (Letter, e-mail, or use of the Additional Approvals signature block at the end of this form are all acceptable methods of endorsement or approval.)

ADDITIONAL COURSE INFORMATION

20. Does this course replace an existing course?

☐ Yes ☒ No If yes, please list the course to be discontinued and note that submission of a Course Revision Form is necessary to remove it from the Course Catalog: _____

21. Does the addition of this course impact other courses (i.e., prerequisite or credit restriction statements)?

☐ Yes ☒ No If yes, please list the course(s) affected, and note that submission of Course Revision Form(s) are necessary to update the impacted course(s): _____

22. Does the addition of this course have any impact on your department's current curriculum (i.e., Programs of Study catalog, concentrations, minors, etc.)?

☒ Yes ☐ No If yes, please specify the curriculum and explain: It will replace TAM 335 from the Bioengineering B.S. curriculum.

23. Has this course been offered as a special topics or other type of experimental course?

☐ Yes ☒ No If yes, please indicate the Banner subject, course number, section ID, term, and enrollment for each offering: _____

24. Will this course be submitted for General Education credit?

☐ Yes ☒ No

25. Does this course require students to register in multiple schedule components (e.g., lecture and a lab)?

☐ Yes ☒ No

26. Is a special facility needed to effectively teach this class (e.g., lab, studio, or ITS room)?

☐ Yes ☒ No If yes, please describe: _____

27. Will this course be offered on-line?

☐ Yes, online only ☐ Yes, online and traditionally ☒ No

28. Faculty member(s) who will teach this course: Rohit Bhargava, Princess Imoukhuede

29. Course proposed by: Rohit Bhargava Date: 12/12/12

NEW COURSE OUTLINE APPROVALS **Course Subject and Number:** BIOE 360

(Signatures required)

Bradley B. Fuhr Department/Unit	1/24/13 Date
School (if applicable)	Date
College	Date
Graduate College (Requests for Graduate Credit)	Date
Provost	Date

ADDITIONAL APPROVAL(S)

The space below may be used for additional approvals involving cross-listed courses. – see Section 19.C; – in lieu of letters or e-mails. Indicate department or college after signature and provide date.

Revised 8/2012

Course Syllabus

BIOE 360 – Transport & Flow in Bioengineering

Required text: *Basic Transport Phenomena in Biomedical Engineering,* Ronald L. Fournier, 3rd Edition CRC Press, 2011.
The text will be supplemented with notes and slides from the instructor, and research papers from conferences and journals.

Credit: 3 undergraduate hours

Meeting Schedule/Contact Hours: Two 75-minute lectures per week; i.e., 3.0 contact hours per week.

Topical Outline:

Topics	**Contact Hours**
Fundamentals of macroscopic flows	
Kinematics	1
Rheology of blood flow	2
Flow in cardiovascular systems	4
Fundamentals of microscopic flows	
Capillary flow	2
Flow in tumors	2
Mass Transport in living systems – cells and tissues	
Fick's Law and other approaches	2
Diffusion in tissues	4
Modeling Drug Delivery methods	4
Modeling and Experimental Techniques for imaging and diagnostic systems	
Flow Doppler	4
Phase contrast imaging	4
Flow in MRI systems	4
Microfluidic devices	4
Project	4
Mid-term tests	4
Total	45

Grading: Two mid-term tests 30%, final examination 35%, and assignments (20%) and project (15%) will make up the grades. The assignments will include homework problems, simulation exercises, and may include hands-on experiments using existing cell culture models from BIOE 202 or physiology models from BIOE 303 (hands-on experiment will be performed by teams of 2-3 students). Any hands-on experiments assigned for the class will be performed using equipment to be provided to the students.

Proposed by: Rohit Bhargava

"Henderson, Jerrod Antwone" <jahender@illinois.edu> January 11, 2013 5:12 PM
To: "Sutton, Brad" <bsutton@illinois.edu>
Cc: "Amos, Jennifer" <jamos@illinois.edu>
RE: Two BIOE course proposals

Hi Brad,

After reviewing the proposals for BIOE 220 and BIOE 360, I have determined that although there is some overlap with ChBE 321 and ChBE 421 respectively. This overlap is not significant and there is very little overlap in application areas for the basic engineering principles.

Please let me know if you need something on a formal letter head. I noticed that your note said that email was fine.

Cheers,
Jerrod

Jerrod A. Henderson, Ph.D.
Department of Chemical & Biomolecular Engineering
118 Roger Adams Laboratory, MC-712
600 S. Mathews Ave.
Urbana, IL 61801

-----Original Message-----
From: Sutton, Brad
Sent: Thursday, January 03, 2013 1:36 PM
To: Henderson, Jerrod Antwone
Cc: Amos, Jennifer; Sutton, Brad
Subject: Two BIOE course proposals

Jerrod,

We are working hard to get an update of our BIOE undergraduate curriculum to continue to focus on systems engineering approaches and further integration of relevant biological examples into the treatment of fundamental engineering principles.

As part of this, we are proposing two additional courses: BIOE 220 - Bioenergetics and BIOE 360 - Transp Phen Biol (Transport Phenomena in Biology). We would like to get a letter of support from ChBE for these courses as there is some minor overlap in content, as outlined below. As part of our course proposal, we need to include a letter from your department's executive officer (ie you) to support our proposal and acknowledge that the application area and examples will have very little to no overlap. An email is fine.

BIOE 220 - Bioenergetics: This course will include coverage of quantum, sub-molecular, molecular, up to cell-level thermodynamics. Thermodynamics, energetics, and metabolism will be covered as they relate to life processes and in a biological context, with the specific topics that Bioengineers will need in research and industry. There is overlap with ChBE 321, but the systems covered in our course will be focused more on metabolism and energetics of the cell.

BIOE 360 - Transp Phen Biol. This course will cover fundamental flow concepts in microfluidics, biological flows, blood flow, drug delivery, and interactions of biomedical and bioimaging devices with flows. Biological fluids behave very differently than industrial fluids and our proposed course will prepare Bioengineering students for dealing with these challenging flow systems. There is overlap with ChBE 421, but the systems covered in our course will be more focused on biological flows.

We have acknowledged the overlaps in our course proposal forms and have mentioned that there is very little overlap in application areas for these basic engineering principles.

Please let me know if you have any questions or concerns. I have attached the preliminary course proposal and course syllabus. Thanks for your help on this.

Brad

"Christensen, Kenneth T" <ktc@illinois.edu> January 13, 2013 4:15 PM
To: "Sutton, Brad" <bsutton@illinois.edu>
Cc: "Amos, Jennifer" <jamos@illinois.edu>, "Christensen, Kenneth T" <ktc@illinois.edu>, "Smith, Tammy Sue" <tssmith1@illinois.edu>
Re: Two other BIOE course proposals

Brad,

I have looked through the materials you provided in detail and have also received feedback from those that regularly teach the courses with which these might have some perceived overlap.

With regard to BIOE 220 (Bioenergetics), we believe there to be quite little overlap with ME 300 (Thermodynamics) in both content and in applications and examples.

With regard to BIOE 360 (Transport Phenomena in Biology), while there will inevitably be a certain level of overlap with respect to the fundamental fluid mechanics concepts presented, the context, applications and examples will be quite different. So we believe there to be little overlap with either TAM 335 (Introductory Fluid Mechanics) or ME 310 (Fundamentals of Fluid Dynamics; you may wish to add ME 310 to your list of potential overlap courses for completeness). With regard to ME 320 (Heat Transfer), since this proposed course contains no heat transfer, the only overlap could be with respect to the bit of mass transfer covered in ME 320. However, ME 320 focuses on the heat transfer/mass transfer analogy which appears to not be a part of the proposed course. Hence, essentially no overlap with ME 320.

Please let me know if you require any further information or consideration on the part of MechSE with respect to these courses.

Best Regards,

Ken

Kenneth T. Christensen, Ph.D.
Professor and Kritzer Faculty Scholar
Associate Head for Undergraduate Programs
Associate Head for Mechanics Programs
Mechanical Science and Engineering Department
University of Illinois at Urbana-Champaign
E-mail: ktc@illinois.edu

Administrative Assistant:
Pam Vanetta
vanetta@illinois.edu

> -----Original Message-----
> From: Sutton, Brad
> Sent: Thursday, January 03, 2013 1:28 PM
> To: Philpott, Michael L
> Cc: Amos, Jennifer; Sutton, Brad
> Subject: Two other BIOE course proposals
>
> Michael,
>
> Thanks for your previous support of the BIOE controls course. We are working hard to get an update of our curriculum in to continue to focus on systems engineering approaches and further integration of relevant biological examples into the treatment of fundamental engineering principles.

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NEW COURSE OUTLINE

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Proposed Effective Term: ☒ Fall ☐ Spring ☐ Summer – 2013

Department/Unit Name: BIOE

Department/Unit ORG Code: 1343

1. Course Subject and Number: BIOE 420
2. Course Title (limit to 30 characters): Intro Bio Control Systems
3. Course description (Include subject matter, and any special course requirements such as field trips, special equipment, etc. Exclude other course information of any numbered items below; the Office of the Registrar will include it in the *Course Catalog* entry. It should read like a publication abstract and ideally be limited to about 75 words.):
   Systems engineering approach to modeling physiological systems to examine natural biological control systems, homeostasis, and control through external medical devices. Introduces open loop and closed loop feedback control; Laplace and Fourier analysis of system behavior; impulse and steady state responses; physiological modeling and system identification; and stability. Includes biological systems for endocrine function, muscle position, neuronal circuits, and cardiovascular function. Mathematical modeling, Matlab and Simulink simulation, and physiological measurements to relate control systems to maintenance of internal environment.
4. Course prerequisites (prerequisite statements are not enforced through the Banner system):
   BIOE 205, BIOE 302, BIOE 303, BIOE 414, BIOE 415
5. Is there a restricted audience for this course? (Audience restrictions may only be placed in the Class Schedule. Do not include in prerequisite statement.)
   ☒ Yes ☐ No If yes, please specify the restrictions (e.g., "for majors only" or "junior standing required"): Department approval required for nonmajors.

COURSE JUSTIFICATION

6. **Please attach the course syllabus.** The syllabus should include basic and recommended texts (author, title, year of publication) as well as a list of the principal topics covered in this course, number of examinations, contact hours, work required of students, and basis for determining grade.
7. Justify the course in terms of new subject matter and how the addition of this course relates to the overall pattern of courses in your unit: BIOE 420 continues the department's focus on integrating mathematical modeling and systems engineering with deep understanding of critical human physiological systems. This course follows BIOE 205 which introduces systems engineering approaches to analyzing biological systems including neuronal currents and blood flow. BIOE 302 and BIOE 303 are the human physiology lecture and lab courses that are required prerequisites for the proposed course. Those courses teach modeling of basic physiological function of several organ systems. The models are developed in Matlab and many of those models will be further developed in BIOE 420. Transient, steady-state, and frequency behavior of these systems will be identified in the proposed course, along with examining stability and the potential for external control of these systems with a medical device. Additionally, in BIOE 414 and 415, students learn to measure biological signals, how to make transducers, and how to interpret those signals to infer physiological function. BIOE 420 will use this knowledge in the development of a device to measure and control a physiological system. This course will prepare Seniors in BIOE to complete their senior design project in the Spring semester, many of which have a controller as part of the design solution.
8. Explain the nature and degree of duplication or overlap with existing courses on campus: Since controls is the application of systems engineering to a particular dynamic system, there are several controls courses in the College of Engineering. However, many of these courses teach fundamentals of controls with respect to well controlled and well-described electrical, mechanical, and chemical processes. The current course is unique in that it focuses on control issues arising from biological systems that are adaptive, variable between people, and difficult to measure. Although many of these controls courses have significant overlap in the technical control topics covered, it is critical that this course exposes students to relevant systems in their domain. BIOE 420 does not have overlap with other courses in the area of application of the control systems. Following is a list of controls courses in several engineering departments and how their focus is different from the proposed course. In ECE 486 - Control Systems, students develop control concepts while controlling a servo motor position. This control is focused on control of an electromechanical device, not living systems. GE 320 - Control Systems focuses on modeling and control of physical systems, including buildings, vehicles, with no specific focus on living organisms. The proposed course, focusing on biology, will have very little overlap in the systems being analyzed, signals available, and in the behavior of the system. Similar statements hold for AE 353 - Aerospace Control Systems. The ME department has several courses focused on concepts of control systems, including: ME 340 - Dynamics of Mechanical Systems, ME 452 - Num Control of Mfg Processes, and ME 460 - Industrial Control Systems which focus on control of mechanical systems and industrial process control. These courses do not focus on the signals associated with biological systems.

   Note: If the proposed course has significant overlap with an existing course outside your unit, please obtain a letter of comment from that unit's executive officer.

COURSE DETAIL

9. Frequency with which this course will be offered (mark all that apply):
   ☒ Every fall ☐ Every spring ☐ Every summer ☐ Other (describe, e.g. "Spring terms, odd years"):
   _____
10. Duration of course: ☒ Full term ☐ Less than full term (describe) : _____
11. Anticipated enrollment: 65
12. Expected distribution of student registration:

Freshman: ___%	Sophomore: ___%
Junior: 10%	Senior: 80%
Graduate: 10%	Professional: ___%

13. Course credit (The number of class contact hours in organized instruction is one factor affecting the amount of credit earned. It is customary for courses to meet 14 to 20 hours per semester for each hour of credit earned. See *Student Code* Article 3, Part 7, § 3-704 (b) {http://admin.illinois.edu/policy/code/article3_part7_3-704.html} for an explanation of the relationship between course credit and contact hours.):

A. Undergraduate credit only

100- to 300-level: _____* undergraduate hours

400-level: 3* undergraduate hours (no graduate credit available)

B. Both Undergraduate and Graduate credit

400-level: _____* undergraduate hours **and** 400-level: _____* graduate hours

Note: Courses offered for both undergraduate and graduate credit require completion of Item 14.

C. Graduate credit only

500-level: _____* graduate hours

Note: Courses offered for graduate credit require completion of Item 14.

D. Professional credit only

600- and 700-level: _____* professional hours

E. Both Graduate and Professional credit

_____* graduate hours **and** _____* professional hours

Note: Courses offered for both graduate and professional credit require completion of Item 14.

* For A-E, if a course is offered for varying amounts of credit please select one of the two options:

☐ Variable credit: this course is available for a range of credit hours (e.g., 1 to 3 hours)

☐ Differential credit: this course is only available for two distinct credit-hour options (e.g., 1 or 3 hours)

In addition, complete Item 15.

14. For any course awarding graduate credit, please justify why it should, in terms of level of content, previous knowledge required, relevance to current research, methodology, etc. (See *Graduate College Policy for Proposed New and Revised Courses that Carry Graduate Credit* for criteria to judge graduate courses.): _____
15. For any course requesting variable or differential credit, please justify why the amount of credit varies and specify the work required for the additional credit: _____

16. May this course be repeated? (See *Procedures for Presenting New or Revised Graduate Courses* or Provost's *Proposing New Courses* for guidance in completing Parts A - C.)

☐ Yes ☒ No If yes, please fill out A - C below:

A. Course Type

Indicate the **one** type of course the proposed course matches:

☐ Honors ☐ Subject mastery/skill proficiency ☐ Individualized instruction

☐ Research or ongoing study ☐ Special topics, seminars ☐ Applied experiences

B. Repeatable – same term

May students register in this course more than once (duplicate registration) in the same term?

☐ Yes ☐ No If yes, for how many total hours (fill all fields: NA = not applicable; U = unlimited)?

_____ undergraduate; _____ graduate; _____ professional

☐ check if "if topics vary" is an added qualifier

C. Repeatable – separate terms

May this course be repeated in separate terms?

☐ Yes ☐ No If yes, for how many total hours (fill all fields: NA = not applicable; U = unlimited)?

_____ undergraduate; _____ graduate; _____ professional

☐ check if "if topics vary" is an added qualifier

17. Are there credit restrictions?

☒ Yes ☐ No If yes, please specify the restrictions (e.g., for MATH 221: "Credit is not given for both MATH 221 and MATH 220."): Credit is not given for both BIOE 420 and any of AE 353, ECE 486, GE 320, ME 340.

18. Grading Type:

☒ Letter grade

☐ S/U (Any course offered for zero hours of graded credit must include S/U grade mode.)

☐ Both If Both is selected, which should be the default mode? ☐ Letter grade ☐ S/U

☐ DFR If DFR is selected, please justify the use of the grade: _____

CROSS-LISTING

19. Is this course to be cross-listed?

☐ Yes ☒ No If yes, please complete A and B and take notice of C:

A. Indicate the subject and course number of the cross-listing(s) (please note, all cross-listed courses must be offered at the same numerical level): _____

B. Please give the justification for establishing the cross-listing: _____

C. **Note: Additional approvals are required to establish a cross-listing.** An authorized official of each non-controlling department must endorse the cross-listing. In addition, if the cross-listing involves a different

college, a dean of that college must also approve. (Letter, e-mail, or use of the Additional Approvals signature block at the end of this form are all acceptable methods of endorsement or approval.)

ADDITIONAL COURSE INFORMATION

20. Does this course replace an existing course?

☐ Yes ☒ No If yes, please list the course to be discontinued and note that submission of a Course Revision Form is necessary to remove it from the Course Catalog: _____

21. Does the addition of this course impact other courses (i.e., prerequisite or credit restriction statements)?

☐ Yes ☒ No If yes, please list the course(s) affected, and note that submission of Course Revision Form(s) are necessary to update the impacted course(s): _____

22. Does the addition of this course have any impact on your department's current curriculum (i.e., Programs of Study catalog, concentrations, minors, etc.)?

☒ Yes ☐ No If yes, please specify the curriculum and explain: This course will be required in the undergraduate Major of Bioengineering. A proposal to update this curriculum accompanies this course proposal.

23. Has this course been offered as a special topics or other type of experimental course?

☐ Yes ☒ No If yes, please indicate the Banner subject, course number, section ID, term, and enrollment for each offering: _____

24. Will this course be submitted for General Education credit?

☐ Yes ☒ No

25. Does this course require students to register in multiple schedule components (e.g., lecture and a lab)?

☐ Yes ☒ No

26. Is a special facility needed to effectively teach this class (e.g., lab, studio, or ITS room)?

☒ Yes ☐ No If yes, please describe: ITS room, computer with Matlab.

27. Will this course be offered on-line?

☐ Yes, online only ☐ Yes, online and traditionally ☒ No

28. Faculty member(s) who will teach this course: Brad Sutton, Ken Gentry

29. Course proposed by: Brad Sutton Date: 12/15/2012

NEW COURSE OUTLINE APPROVALS **Course Subject and Number:** BIOE 420

(Signatures required)

Bradley B. Scott Department/Unit	1/24/13 Date
School (if applicable)	Date
College	Date
Graduate College (Requests for Graduate Credit)	Date
Provost	Date

ADDITIONAL APPROVAL(S)

The space below may be used for additional approvals involving cross-listed courses. – see Section 19.C; – in lieu of letters or e-mails. Indicate department or college after signature and provide date.

Revised 8/2012

Course Syllabus

BIOE 420 – Intro Bio Control Systems

Required Text:
Textbook: Physiological Control Systems: Analysis, Simulation, and Estimation. Michael C. K. Khoo. Available Free Online through library:
http://ieeexplore.ieee.org/xpl/bkabstractplus.jsp?bkn=5263864
Supplementary Texts:

- Nise. *Control Systems Engineering*, 6th Ed. John Wiley and Sons, Inc. 2011.
- Hoppensteadt and Peskin. *Modeling and Simulation in Medicine and the Life Sciences*. Springer-Verlag, 2004.

Credit: 3 undergraduate hours

Meeting Schedule/Contact Hours: Three 50-minute lecture-discussions per week; i.e., 3.0 contact hours per week.

Overview:
The Bioengineering student is faced with complex, personalized physiology for each patient and condition that medicine may encounter. However, the capabilities to measure and interact with that biology are reaching new levels through nanomedicine, sensitive detectors, and targeted agents. This course will give students the tools that they need to understand homeostatic systems in the body, characterize them mathematically, and enable simulation and control of the system. In addition, the student will learn to design controllers to impact the system to restore homeostasis when pathology has disrupted it. Students will complete a project, characterizing a physiological control system, design a controller to modify performance when pathology restricts its proper behavior, and they will simulate the impact of their controller.

Topical Outline:

Topic	Physiology System	Contact Hours
Diff EQ to Laplace to Transfer Function		
Review: input/output relationships in static physiological systems, perturbations	Windkessel model of cardiovascular physiology; muscle spindle/ patellar reflex	2
Review: Diff EQ, Laplace, State Space, Systems of Diff EQ, Solutions		2

Laplace Transforms, transient analysis		2
State Space Analysis	Respirator/lung tidal volume	2
Solution of transient responses by Matlab, transfer function, Simulink,	Neuromuscular reflex motion	1
Frequency Domain analysis of linear control systems		
Frequency response of systems, Nyquist criteria, steady state response to sinusoidal inputs	Lung mechanics	2
Graphical representation of frequency response, Bode plot		3
Evaluation of system in Matlab, Simulink, and with Bode plot.	Lung mechanics, circulatory control (baroreflex)	1
Stability Analysis		
Damped transient responses	Lung mechanics with proportional feedback	1
Root locus plots, Routh-Hurwitz stability	Lung mechanics proportional and integral control	3
Stability analysis of example system	Pupillary light reflex	1
Identification of Physiological Control Systems		
Nonparametric identification: step input, numerical deconvolution, least squares estimation, correlation functions, frequency domain	Pupillary light, functional brain imaging, blood glucose regulation	3
Parameter model estimation	Blood glucose regulation	2
Identifiability and Sensitivity in parameter estimation		1
Matlab system identification toolbox		1
Design of Control Systems for Physiological Signals		
Controlling transient response via gain adjustment and root locus plot	Pupillary reflex, muscle position	2
PD, PI, PID control		2
Design via Frequency response	Control of	2

	respiration	
Matlab control systems toolbox		1
Adaptive control of physiological variables	Buffering of fluctuations in arterial PCO2	2
Intro to Neural networks for adaptive control	Attention control in brain	2
Course Project Preparation		
Implementation of control in hardware using Matlab and Simulink	Pulse pressure, heart rate	2
Project Presentation Fair		2
Exams		1
TOTAL		**43**

Grading: The course will consist of one midterm exam, a final, a final project and 8-10 homework assignments integrating traditional paper and pencil problems on basics with Matlab problems involving models of a physiological system. The grade weights of these components are: 25% Mid-term Exam, 25% project, 30% Final Exam, 20% homework

Weekly homework assignments will consist of derivations of transfer functions or system properties from example physiological systems, requiring students to work through examples to manipulate the mathematics of the systems to derive functional relationships or characteristics of the system. The second half of homework assignments will utilize Matlab and Simulink to implement the systems, model behavior under a variety of physiological and pathological conditions, explore stability, stabilize a system, or perform system identification on data sets made available to the class.

The class project will involve working in groups of 2-3 to create a mathematical and computer model of a target human physiology system and an associated pathology. Necessary measurements of physiological signals will have to be determined and a monitoring/intervention control unit will have to be designed to stabilize the pathological condition to maintain physiologically healthy values. Students will implement the control device on a microcontroller through interface libraries available in Simulink in Matlab. Students will be encouraged to explore systems where non-invasive physiological sensors can make the relevant measures on students taking the course.

Proposed by: Brad Sutton

"Elliott, Gregory S" <elliottg@illinois.edu>
To: Brad Sutton <bsutton@illinois.edu>
RE: Letter of support for BIOE 420

Brad,

After reviewing the syllabus and topics for the proposed course, Introduction to Biological Control Systems (BIOE 420), I do not believe that it has significant overlap with the course offered in Department of Aerospace Engineering Course (AE 353 - Aerospace Control Systems). Although there are some similarities in concepts covered as background in both courses (i.e. modeling of dynamic systems, Laplace transform techniques, feedback control systems) the application of these fundamentals is significantly different. The Aerospace Engineering course is focused on aircraft and spacecraft vehicle applications and the Biological Engineering course focuses on human physiology systems. If you need additional information please feel free to contact me.

Best Regards,
Greg Elliott

Greg Elliott
Professor and Associate Head of Undergraduate Studies
Aerospace Engineering
University of Illinois
104 South Wright Street
Urbana, IL 61801
Please note that my e-mail address has changed to
elliottg@illinois.edu
Phone: 217-265-9211

-----Original Message-----
From: Sutton, Brad
Sent: Monday, December 17, 2012 5:02 PM
To: Elliott, Gregory S
Subject: Re: Letter of support for BIOE 420

Greg,

I was wondering if you had a chance to consider our request for a supporting letter for a new course in BIOE. Please let me know if you have any questions.

Brad

On Dec 11, 2012, at 11:31 PM, Brad Sutton <bsutton@illinois.edu> wrote:

"Kudeki, Erhan" <erhan@illinois.edu> December 19, 2012 10:51 PM
To: "Sutton, Brad" <bsutton@illinois.edu>
Cc: "Kudeki, Erhan" <erhan@illinois.edu>
Re: Letter of support for BIOE 420

OK, correcting my typos, pls use:
****

Brad, I've discussed with our controls faculty your plans for BioE 420, Intro to Biological Control Systems. This course will not have major overlaps with ECE 486 and will be unlikely to have a major impact on its enrollment numbers. Thus we are happy to support your plan. Let me know if you need a more formal letter about this.

Best regards,

Erhan

Erhan Kudeki Tel: 217 265 0128 erhan@illinois.edu
Professor and Associate Head for Undergraduate Affairs
Department of Electrical and Computer Engineering
University of Illinois at Urbana-Champaign
1406 W. Green St., Urbana, IL 61801

On Dec 19, 2012, at 2:17 PM, "Kudeki, Erhan" <erhan@illinois.edu> wrote:

> Brad, I've discussed with our control faculty your plans for BioE 420, Intro to Biological Control Systems. This course will not have major overlaps with ECE 486 and will be unlikely to have a major impact in its enrollment numbers. This we are happy to support your plan. Let me know if you need a more formal letter about this.
>
> Best regards,
>
> Erhan
>
> > support of our course and that our physiology-based applications will have very little overlap with the application topics in your control course.

Erhan Kudeki Tel: 217 265 0128 erhan@illinois.edu
Professor and Associate Head for Undergraduate Affairs
Department of Electrical and Computer Engineering
University of Illinois at Urbana-Champaign
1406 W. Green St., Urbana, IL 61801

> > Erhan,
> >
> > We are going to submit a course proposal to develop a new Bioengineering course called Introduction to Biological Control Systems, BIOE 420. It will teach basic controls: diff EQ to Laplace, transfer function, open/closed loop, transient, steady state, system identification, stability. It will focus on human physiology systems, such as endocrine control, homeostasis, muscle position, neuronal circuits, and cardiovascular function. We will also work on integrating a microcontroller and physiological measurements into a class project to control or simulate control of a physiological system.
> >
> > This course has overlap with ECE 486 - Control Systems. We have acknowledged the overlap in our course proposal (including putting that credit would not be given for both BIOE 420 and ECE 486). Our course will be restricted to majors in BIOE, and I don't think that many students have taken your course, although we have listed it as a possibility in the imaging and sensing concentration track.
> >
> > As part of our course proposal, we need to include a letter from your department's executive officer (ie you) to support our proposal and acknowledge that the application area and examples will have very little to no overlap. An email is fine.

Please let me know if you have any questions. I have attached the preliminary course proposal and course syllabus. Thanks for your help on this.

Brad

<BioControl_Syllabus.docx><BioControls_BannerCourseProposal.docx>

Carolyn L Beck <clbeck50@gmail.com> January 3, 2013 2:13 PM
To: "Pang, Jong-Shi" <jspang@illinois.edu>
Cc: "Sreenivas, Ramavarapu S" <rsree@illinois.edu>, "Beck, Carolyn L" <beck3@illinois.edu>, "Stipanovic, Dusan M" <dusan@illinois.edu>, <bsutton@illinois.edu>
Re: FW: Two BIOE courses proposed

Hi all,

I think the courses proposed look very interesting and see no issues with the apparent overlap with our courses. The focus of the BIO controls course is solely on physiological models; it looks like a good course.

In the Course Proposal for the controls course, under the discussion of overlap with GE 320, I would suggest to change the phrase "and a variety of other non-living things", to something like "with no specific focus on living organisms", as I do use the anesthesia example in my discussions, and sometimes other bio-inspired examples in GE 320.

Best,
Carolyn

On Thu, Jan 3, 2013 at 1:19 PM, Pang, Jong-Shi <jspang@illinois.edu> wrote:

> Hi RS, Carolyn, and Dusan,
>
> I would appreciate your feedback to the attached email.
>
> Brad, I apologize for the long delinquency in my reply to this request. As soon as I have heard from my colleagues, I will get back to you.
>
> Happy New Year to All,
>
> Jong-Shi
>
> ---
> From: Sutton, Brad
> Sent: Thursday, January 03, 2013 12:50 PM
> To: Pang, Jong-Shi; Craddock, Heidi C
> Cc: Amos, Jennifer; Sutton, Brad
> Subject: Two BIOE courses proposed
>
> Jong-Shi and Heidi,
>
> We are going to submit course proposals for two new Bioengineering courses: BIOE 310 - Computational Tools for Biological data and BIOE 420 - Introduction to Biological Control Systems. We would like to get a letter of support from IE/GE for these courses as there is some minor overlap in content, as outlined below. As part of our course proposal, we need to include a letter from your department's executive officer (ie you) to support our proposal and acknowledge that the application area and examples will have very little to no overlap. An email is fine.
>
> The BIOE 310 course will teach statistical treatment of genomic data using the tools of the trade, R and Matlab. It will focus on getting large data sets from genomic databases and performing analyses that are found in the literature. This course overlaps with IE 300 which is required in our current curriculum. The overlap is in basic statistical principles, however, the application topic area that we treat will have very little overlap with the topics in IE 300.
>
> For the BIOE 420 course, It will teach basic controls: diff EQ to Laplace, transfer function, open/closed loop, transient, steady state, system identification, stability. It will focus on human physiology systems, such as endocrine control, homeostasis, muscle position, neuronal circuits, and cardiovascular function. We will also work on integrating a microcontroller and physiological measurements into a class project to control or simulate control of a physiological system. This course has overlap with GE 320 - Control Systems, I course I remember well from my undergraduate days in GE.
>
> We have acknowledged the overlaps in our course proposal forms and have mentioned that there is no overlap in application areas for these basic engineering principles.
>
> Please let me know if you have any questions. I have attached the preliminary course proposal and course syllabus. Thanks for your help on this.
>
> Brad

--
Prof. Carolyn L. Beck
University of Illinois at Urbana-Champaign

email: beck3@illinois.edu
voice: 217-244-9714

"Philpott, Michael L" <mphilpot@illinois.edu> December 20, 2012 1:24 PM
To: Brad Sutton <bsutton@illinois.edu>
RE: Letter of support for BIOE 420

Hi Brad;

The feedback I am getting from those that teach the subject is that there i is indeed overlap with ME340. We would like to suggest that this could perhaps be a follow on course to ME340, or the ECE equivalent, focused on biological/physiological systems open to other majors. We think it might be quite popular with many ME and ECE students.

On the positive support side, your proposed course as-is seems well designed and does differ from ME340 in that it is more focused on biological systems. As this would be restricted to majors in BIOE it would not have significant impact on ME340 enrollment and we would not have any objection to it being offered.

Best regards,

Mike

Mike L. Philpott PhD, CEng
Interim Associate Head for Undergraduate Programs,
Department of Mechanical Science and Engineering,
University of Illinois, Urbana, IL 61801
Ph: (217) 244-3184

From: Sutton, Brad
Sent: Tuesday, December 11, 2012 11:23 PM
To: Philpott, Michael L
Subject: Letter of support for BIOE 420

Michael,

We are going to submit a course proposal to develop a new Bioengineering course called Introduction to Biological Control Systems, BIOE 420. It will teach basic controls: diff EQ to Laplace, transfer function, open/closed loop, transient, steady state, system identification, stability. It will focus on human physiology systems, such as endocrine control, homeostasis, muscle position, neuronal circuits, and cardiovascular function. We will also work on integrating a microcontroller and physiological measurements into a class project to control or simulate control of a physiological system.

This course has overlap with several ME courses that teach controls fundamentals, but especially ME 340. We have acknowledged the overlap in our course proposal (including putting that credit would not be given for both BIOE 420 and ME 340). Our course will be restricted to majors in BIOE, and I don't think that any of these have taken your course.

As part of our course proposal, we need to include a letter from your department's executive officer (ie you) to support our proposal and acknowledge that the application area and examples will have very little to no overlap. An email is fine.

Please let me know if you have any questions. I have attached the preliminary course proposal and course syllabus. Thanks for your help on this.

Brad

UNIVERSITY OF ILLINOIS
AT URBANA-CHAMPAIGN

University Library
Office of Dean of Libraries
and University Librarian
230 Main Library, MC-522
1408 West Gregory Drive
Urbana, IL 61801

October 2, 2013

Umberto Ravaioli
Interim Associate Dean
206 Engineering Hall
M/C 272

Dear Dean Ravaioli:

Thank you for providing the University Library with the opportunity to review the College of Engineering's proposal to the Senate Committee on Educational Policy to revise the requirements of the Bachelor of Science in Bioengineering. Based upon the proposal that we reviewed, we do not believe that there will be any substantive impact on existing library offerings—either in terms of library materials or personnel.

The librarians in the Grainger Engineering Library have an excellent relationship with the College and if additional services or materials are required as the program develops, I have every confidence that we will be able to work together to meet the needs of the students.

Sincerely,

John P. Wilkin
Juanita J. and Robert E. Simpson
Dean of Libraries and University Librarian

c: Thomas Teper
William Mischo
Mary Schlembach
Elizabeth Stovall, Graduate Programs Director, CoE

telephone 217-333-0790 • *fax* 217-244-4358

UNIVERSITY OF ILLINOIS
AT URBANA-CHAMPAIGN

University Library
Office of Dean of Libraries
and University Librarian
230 Main Library, MC-522
1408 West Gregory Drive
Urbana, IL 61801

October 2, 2013

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Interim Associate Dean
206 Engineering Hall
M/C 272

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Sincerely,

John P. Wilkin
Juanita J. and Robert E. Simpson
Dean of Libraries and University Librarian

c: Thomas Teper
William Mischo
Mary Schlembach
Elizabeth Stovall, Graduate Programs Director, CoE

telephone 217-333-0790 • *fax* 217-244-4358

UNIVERSITY OF ILLINOIS
AT URBANA-CHAMPAIGN

Office of the Provost and Vice Chancellor
for Academic Affairs

Swanlund Administration Building
601 East John Street
Champaign, IL 61820

October 9, 2013

Gay Miller, Chair
Senate Committee on Educational Policy
Office of the Senate
228 English Building, MC-461

Dear Professor Miller:

Enclosed is a copy of a proposal from the College of Engineering to revise the Bachelor of Science in Bioengineering.

The proposal has been reviewed and approved by the College of Engineering Executive Committee. It now requires Senate review.

Sincerely,

Kristi A. Kuntz
Assistant Provost

Enclosures

c: R. Bashir
R. Dennis
J. Hart
A. Singer
E. Stovall
B. Sutton

UNIVERSITY OF ILLINOIS
AT URBANA-CHAMPAIGN

College of Engineering
306 Engineering Hall, MC-266
1308 West Green Street
Urbana, IL 61801

September 27, 2013

Kristi Kuntz
Assistant Provost
217 Swanlund Administration Building
MC-304

Via: Andreas Cangellaris, Engineering College

Dear Provost Kuntz:

The College of Engineering Executive Committee has reviewed and approved the following:

Course Revision: Revision to the Bachelor of Science in Bioengineering, Department of Bioengineering, College of Engineering

Attached is a copy of the request.

Sincerely yours,

John C. Hart, Vice Chair
Executive Committee

Approval Recommended:

Andreas Cangellaris, Dean
College of Engineering

9/27/2013
Date

JH/rd

Enclosure

c: Rashid Bashir
Andy Singer
John Hart
Brad Sutton
Elizabeth Stovall
Robin Dennis

ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA CHAMPAIGN

Senate Educational Policy Committee
Proposal Check Sheet

PROPOSAL TITLE (Same as on proposal): Revision to the Bachelor of Science in Bioengineering, Department of Bioengineering, College of Engineering

PROPOSAL TYPE (select all that apply below):

A. ☒ Proposal for a NEW or REVISED degree program. Please consult the Programs of Study Catalog for official titles of existing degree programs.

1. Degree program level:

   ☐ Graduate ☐ Professional ☒ Undergraduate

2. ☐ Proposal for a new **degree** (e.g. B.S., M.A. or Ph.D.):

   Degree name, "*e.g., Bachelor of Arts or Master of Science*": _____

3. ☐ Proposal for a new or revised **major, concentration, or minor**:

   ☐ New or ☒ Revised **Major** in (name of existing or proposed major): Bioengineering

   ☐ New or ☐ Revised **Concentration** in (name of existing or proposed concentration): _____

   ☐ New or ☐ Revised **Minor** in (name of existing or proposed minor): _____

4. ☐ Proposal to rename an existing major, concentration, or minor:

   ☐ Major ☐ Concentration ☐ Minor

   Current name: _____

   Proposed new name: _____

5. ☐ Proposal to terminate an existing degree, major, concentration, or minor:

   ☐ Degree ☐ Major ☐ Concentration ☐ Minor

   Name of existing degree, major, or concentration: _____

6. ☐ Proposal involving a multi-institutional degree:

   ☐ New ☐ Revision ☐ Termination

   Name of existing Illinois (UIUC) degree: _____

Name of non-Illinois partnering institution: _____

Location of non-Illinois partnering institution:

☐ State of Illinois ☐ US State: _____ ☐ Foreign country: _____

B. ☐ Proposal to create a new academic unit (college, school, department, program or other academic unit):

Name of proposed new unit: _____

C. ☐ Proposal to rename an existing academic unit (college, school, department, or other academic unit):

Current name of unit: _____

Proposed new name of unit: _____

D. ☐ Proposal to reorganize existing units (colleges, schools, departments, or program):

1. ☐ Proposal to change the status of an existing and approved unit (e.g. change from a program to department)

   Name of current unit including status: _____

2. ☐ Proposal to transfer an existing unit:

   Current unit's name and home: _____

   Proposed new home for the unit: _____

3. ☐ Proposal to merge two or more existing units (e.g., merge department A with department B):

   Name and college of unit one to be merged: _____

   Name and college of unit two to be merged: _____

   Proposed name and college of new (merged) unit: _____

4. ☐ Proposal to terminate an existing unit:

   Current unit's name and status: _____

E. ☐ **Other educational policy proposals** (e.g., academic calendar, grading policies, etc.)

Nature of the proposal: _____

Revised 10/2012