

**New Course Request**

**Indiana University**

Indianapolis Campus

Check Appropriate Boxes: Undergraduate credit  Graduate credit  Professional credit

1. School/Division School of Engineering and Technology 2. Academic Subject Code BME

3. Course Number 411 (must be cleared with University Enrollment Services) 4. Instructor \_\_\_\_\_

5. Course Title Quantitative Physiology

Recommended Abbreviation (Optional) Quantitative Physiol  
(Limited to 32 Characters including spaces)

6. First time this course is to be offered (Semester/Year): Fall 2008

7. Credit Hours: Fixed at 3 or Variable from \_\_\_\_\_ to \_\_\_\_\_

8. Is this course to be graded S-F (only)? Yes \_\_\_\_\_ No

9. Is variable title approval being requested? Yes  No

10. Course description (not to exceed 50 words) for Bulletin publication: This course applies systems theory and explores feedforward and feedback control in the context of physiological systems. Control, frequency response, and linear systems concepts are applied to action potential generation, motor control, heart rate regulation, and other physiological processes. Prerequisite: BME 331.

11. Lecture Contact Hours: Fixed at 3 or Variable from \_\_\_\_\_ to \_\_\_\_\_

12. Non-Lecture Contact Hours: Fixed at 0 or Variable from \_\_\_\_\_ to \_\_\_\_\_

13. Estimated enrollment: 25 of which 0 percent are expected to be graduate students.

14. Frequency of scheduling: yearly Will this course be required for majors? yes

15. Justification for new course: New BME undergraduate curriculum

16. Are the necessary reading materials currently available in the appropriate library? yes

17. Please append a complete outline of the proposed course, and indicate instructor (if known), textbooks, and other materials.

18. If this course overlaps with existing courses, please explain with which courses it overlaps and whether this overlap is necessary, desirable, or unimportant.

19. A copy of every new course proposal must be submitted to departments, schools, or divisions in which there may be overlap of the new course with existing courses or areas of strong concern, with instructions that they send comments directly to the originating Curriculum Committee. Please append a list of departments, schools, or divisions thus consulted.

Submitted by: [Signature] Date 3/18/08  
Department/Chairman/Division Director

Approved by: [Signature] Date 3/19/08  
Dean

\_\_\_\_\_  
Date \_\_\_\_\_  
Dean of Graduate School (when required)

\_\_\_\_\_  
Date \_\_\_\_\_  
Chancellor/Vice-President

\_\_\_\_\_  
Date \_\_\_\_\_  
University Enrollment Services

After School/Division approval, forward the last copy (without attachments) to University Enrollment Services for initial processing, and the remaining four copies and attachments to the Campus Chancellor or Vice-President.

## BME 411 QUANTITATIVE PHYSIOLOGY

**Instructor:** Ken Yoshida, Ph.D.  
Office: SL-220F  
E-mail: yoshidak@iupui.edu

**Class:** Monday and Wednesday, 10:30 – 11:45 AM

**Office Hours:** TBA

**Prerequisite:** BME 331

**Textbooks:** Franklin, Powell and Emami-Naeini, *Feedback Control of Dynamic Systems*, 5<sup>th</sup> ed., Pearson Prentice Hall Press, ISBN 0121488300  
Berne, Levy, Koeppen & Stanton, *Physiology*, 5<sup>th</sup> ed, Elsevier Mosby, ISBN 03230339903

**Course Description:** This course applies systems theory and explores feedforward and feedback control in the context of physiological systems. Feedback control, frequency response, and linear systems concepts are applied to action potential generation, motor control, heart rate regulation, and other physiological processes.

**Outline of Topics:** (roughly by lectures, order may vary)

1. Review of Linear Systems (C)
2. Resting Membrane Potentials (P)
3. Poles and Zeros (C)
4. Action Potentials (P)
5. Time Domain Specifications (C)
6. Peripheral Nervous System (P)
7. Skeletal Muscles (P)
8. Dynamic Response, Stability (C)
9. Synaptic Transmission, Neuromuscular Junction (P)
10. Feedback Controllers (C)
11. Muscle Afferents (P)
12. Frequency Domain Analysis, Bode Plots, Root Locus (C)
13. Smooth and Cardiac Muscles (P)
14. System Identification (C)
15. Somatosensory System (P)
16. Special Systems (P)
17. Physiological Control Systems

<b>Grading:</b>	Homework	5%
	Exam 1	15%
	Exam 2	15%
	Group Project	25%
	Presentations	10%
	Final Exam	30%

**Instructional Goals:**

After completion of this course the successful student should be able to:

1. Describe major physiological features of the peripheral nervous system, skeletal muscle, and other physiological systems. [l]
2. Analyze and model dynamic physiological systems from the literature using linear systems techniques. [a,b,c,l,m]
3. Design feedback controllers for linear systems. [a,e]
4. Analyze the stability of a system that relies on feedback. [a,e]
5. Analyze frequency response and construct Bode plots. [a,k]
6. Work in teams to understand and implement a model of a physiological system. [d]

BME495 (BME411) – Quantitative PhysiologyKen Yoshida, SL220F, [yoshidak@iupui.edu](mailto:yoshidak@iupui.edu)

Place/Time: LD-018 / MW 1030-1145

## Textbooks:

Franklin, Powell and Emami-Naeini, *Feedback Control of Dynamic Systems*, 5th ed., Pearson Prentice Hall Press, ISBN 0131499300Berne, Levy, Koeppen & Stanton, *Physiology*, 5th ed, Elsevier Mosby, ISBN 03230339903Course Schedule (*Revised 17 Oct 2007*):

Week	mm	Date	Subject	Topic	Notes
1	1	22-Aug-07	Introduction	Course Introduction	
2	2	27-Aug-07	Control	Review of Linear Systems 1	
2	3	29-Aug-07	Physiology	Resting Membrane Potentials	Group Formation
3		3-Sep-07	Holiday	Labor Day	
3	4	5-Sep-07	Control	Review of Linear Systems 2	Group Project Topics
4	5	10-Sep-07	Physiology	Action Potentials	
4	6	12-Sep-07	Control	Poles and Zeros	
5	7	17-Sep-07	Physiology	Action Potentials	
5	8	19-Sep-07	Control	Time Domain Specifications	
6	9	24-Sep-07	Physiology	Peripheral Nervous System	
6	10	26-Sep-07	Control	Time Domain Specifications 2 Review	
7	11	1-Oct-07	Exam	Midterm Examination 1	
7	12	3-Oct-07	Physiology	Skeletal Muscles	
8	13	8-Oct-07	Presentation 1	Group Project Proposal	Group Projects Introductory Presentations. Project goals
8	14	10-Oct-07	Control	Dynamic Response, Stability	
9	15	15-Oct-07	Physiology	Skeletal Muscles 2, Synaptic Transmission, Neuromuscular Junction	
9	16	17-Oct-07	Control	Feedback Controllers 1	
10	17	22-Oct-07	Physiology	Muscle Afferents	
10	18	24-Oct-07	Control	Feedback Controllers 2	
11	19	29-Oct-07	Physiology	Reflexes and Segmental Motor Control	
11	20	31-Oct-07	Presentation 2	Group Project Progress Report	Anatomy and system components. Inputs/outputs of the system
12	21	5-Nov-07	Control	Root Locus Design	
12	22	7-Nov-07	Control	Frequency Response, Bode Plots	
13	23	12-Nov-07	Control	System Identification	
13	24	14-Nov-07	PCS	Physiological Control Systems 1 Vestibular Organ, Control of Posture)	
14	25	19-Nov-07	Exam	Midterm Examination 2	
14		21-Nov-07	Holiday	Thanksgiving	
15	26	26-Nov-07	PCS	Physiological Control Systems 2 Beat to Beat regulation of the heart	

15	27	28-Nov-07	PCS	Physiological Control Systems 3 Ocular Motor System (Prof. Suzuki)	Project Reports Due
16	28	3-Dec-07	Presentations	Project Presentation 1	Groups 1 & 2
16	29	5-Dec-07	Presentations	Project Presentation 2	Groups 3 & 4
17	30	10 Dec 07	Review	Review	
		17-Dec-07	Exam	Final Exam	1030-1230

**Evaluation:**

Homework: 5%, Midterm Exam 1: 15%, Midterm Exam 2: 15%, Project Report (20%) & Presentation (5%): 25%, Intermediate presentations 10% (5% each), Final Exam: 30%

## PURDUE SCHOOL OF ENGINEERING & TECHNOLOGY OUTCOMES AND ASSESSMENT DATA SHEET

This is an internal document to identify and record expected outcomes and anticipated assessment strategies for all courses taught within the School of Engineering and Technology. Submission of this form, as noted below, is required and must accompany all new course and course change requests. Copies of this form should also be retained within the department and kept on file with the outline or syllabus for each course.

Course Number: BME 411 Course Title: Quantitative Physiology

Procedure:

First, identify all instructional outcomes expected for this course, and then select all ABET outcomes which are consistent with those anticipated objectives from TABLE 1 below.

TABLE 1 - ABET OUTCOMES	
ENGINEERING - EAC Criteria #3	#
An ability to apply knowledge of mathematics, science, and engineering	a
An ability to design and construct experiments as well as to analyze and interpret data.	b
An ability to design a system, component, or process to meet desired needs.	c
An ability to function on multi-disciplinary teams.	d
An ability to identify, formulate and solve engineering problems.	e
An understanding of professional and ethical responsibility.	f
An ability to communicate effectively.	g
The broad education necessary to understand the impact of engineering solutions in global societal context.	h
A recognition of the need for and ability to engage in life-long learning.	i
A knowledge of contemporary issues.	j
An ability to use the techniques, skill and modern engineering tools necessary for engineering practice.	k

Subsets for each of the six IUPUI Principles of Undergraduate Learning (PUL) are given on the reverse side in TABLE 2. Using a number corresponding to each ABET outcome identified from TABLE 1 above to select a column, place a "" or "X" mark in the applicable TABLE 2 row(s) cell for each PUL. Courses will often address multiple ABET outcomes and ABET outcomes frequently will overlap more than one PUL subset. Thus, it is expected completed data sheets may contain marks in several cells thereby indicating the course simultaneously satisfies multiple Principles of Undergraduate Learning while fulfilling its intended ABET objective(s).

After completing TABLE 2, briefly define or explain how the course outcomes or objectives will be evaluated within the context of the departmental assessment program in the space below:

Course objectives will be assessed by student performance on homework, exams, and group projects.  
Individual assignments linked to specific course and ABET outcomes will be used to assess successful achievement of those outcomes.

Submitted By: Karen D Alfrey Date: 18 Mar 2008



**PURDUE UNIVERSITY**  
REQUEST FOR ADDITION, EXPIRATION,  
OR REVISION OF AN UNDERGRADUATE COURSE  
(100-400 LEVEL)



DEPARTMENT Biomedical Engineering

EFFECTIVE SESSION Fall 2008

**INSTRUCTIONS:** Please check the items below which describe the purpose of this request.

- |   |   |
|---|---|
| <input checked="" type="checkbox"/> 1. New course with supporting documents | <input type="checkbox"/> 7. Change in course attributes (department head signature only)  |
| <input type="checkbox"/> 2. Add existing course offered at another campus   | <input type="checkbox"/> 8. Change in instructional hours                                 |
| <input type="checkbox"/> 3. Expiration of a course                          | <input type="checkbox"/> 9. Change in course description                                  |
| <input type="checkbox"/> 4. Change in course number                         | <input type="checkbox"/> 10. Change in course requisites                                  |
| <input type="checkbox"/> 5. Change in course title                          | <input type="checkbox"/> 11. Change in semesters offered (department head signature only) |
| <input type="checkbox"/> 6. Change in course credit/type                    | <input type="checkbox"/> 12. Transfer from one department to another                      |

<b>PROPOSED:</b>		<b>EXISTING:</b>		<b>TERMS OFFERED</b> Check All That Apply:	
Subject Abbreviation <u>BME</u>		Subject Abbreviation _____		<input checked="" type="checkbox"/> Summer <input checked="" type="checkbox"/> Fall <input checked="" type="checkbox"/> Spring	
Course Number <u>411</u>		Course Number _____		<b>CAMPUS(ES) INVOLVED</b>	
Long Title <u>Quantitative Physiology</u>		_____		<input type="checkbox"/> Calumet <input type="checkbox"/> N. Central	
Short Title <u>Quantitative Physiol</u>		_____		<input type="checkbox"/> Cont Ed <input type="checkbox"/> Tech Statewide	
_____		_____		<input type="checkbox"/> Ft. Wayne <input type="checkbox"/> W. Lafayette	
_____		_____		<input checked="" type="checkbox"/> Indianapolis	
Abbreviated title will be entered by the Office of the Registrar if omitted. (22 CHARACTERS ONLY)					

<b>CREDIT TYPE</b>		<b>COURSE ATTRIBUTES: Check All That Apply</b>			
1. Fixed Credit: Cr. Hrs. <u>3</u>		1. Pass/Not Pass Only	<input type="checkbox"/>	7. Registration Approval Type	<input checked="" type="checkbox"/>
2. Variable Credit Range:		2. Satisfactory/Unsatisfactory Only	<input type="checkbox"/>	Department	
Minimum Cr. Hrs. _____		3. Repeatable	<input type="checkbox"/>	8. Variable Title	<input type="checkbox"/>
(Check One) To <input type="checkbox"/> Or <input type="checkbox"/>		Maximum Repeatable Credit:		9. Remedial	<input type="checkbox"/>
Maximum Cr. Hrs. _____		4. Credit by Examination	<input type="checkbox"/>	10. Honors	<input type="checkbox"/>
3. Equivalent Credit: Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>		5. Designator Required	<input type="checkbox"/>	11. Full Time Privilege	<input type="checkbox"/>
4. Thesis Credit: Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>		6. Special Fees	<input type="checkbox"/>	12. Off Campus Experience	<input type="checkbox"/>

Instructional Type	Minutes Per Mtg	Meetings Per Week	Weeks Offered	% of Credit Allocated	Delivery Method (Asyn. Or Syn.)	Delivery Medium (Audio, Internet, Live, Text-Based, Video)	Cross-Listed Courses
Lecture	75	2	15				
Recitation							
Presentation							
Laboratory							
Lab Prep							
Studio							
Distance							
Clinic							
Experiential							
Research							
Ind. Study							
Pract/Observ							

**COURSE DESCRIPTION (INCLUDE REQUISITES):**  
P: BME 331. This course applies systems theory and explores feedforward and feedback control in the context of physiological systems. Control, frequency response, and linear systems concepts are applied to action potential generation, motor control, heart rate regulation, and other physiological processes.

Calumet Department Head _____ Date _____	Calumet School Dean _____ Date _____
Fort Wayne Department Head _____ Date _____	Fort Wayne School Dean _____ Date _____
<i>[Signature]</i> _____ Date <u>3/19/08</u>	<i>[Signature]</i> _____ Date <u>3/19/08</u>
Indianapolis Department Head _____ Date _____	Indianapolis School Dean _____ Date _____
North Central Department Head _____ Date _____	North Central Chancellor _____ Date _____
West Lafayette Department Head _____ Date _____	West Lafayette College/School Dean _____ Date _____
	West Lafayette Registrar _____ Date _____