Office of the Registrar
FORM 40 REV. 11/09

PURDUE UNIVERSITY
REQUEST FOR ADDITION, EXPIRATION,
OR REVISION OF AN UNDERGRADUATE COURSE
(10000-40000 LEVEL)

Print Form

EFD 8-10

DEPARTMENT Biomedical Engineering — EFFECTIVE SESSION Spring 2011

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

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

PROPOSED:	EXISTING:
Subject Abbreviation	Subject Abbreviation BME
Course Number	Course Number 20600
Long Title Biomechanics and Biomaterials Laboratory	
Short Title Biomechanics & Biomaterial Lab	

Abbreviated title will be entered by the Office of the Registrar if omitted. (30 CHARACTERS ONLY)

TERMS OFFERED
Check All That Apply:
[ ] Summer [ ] Fall [x] Spring

CAMPUS(ES) INVOLVED
[ ] Calumet [ ] N. Central
[ ] Cont Ed [ ] Tech Statewide
[ ] Ft. Wayne [x] W. Lafayette
[ ] Indianapolis

CREDIT TYPE
1. Fixed Credit: Cr. Hrs. 1
2. Variable Credit Range: Minimum Cr. Hrs ____ (Check One) To [ ] Or [ ]
Maximum Cr. Hrs. ____
3. Equivalent Credit: Yes [ ] No [ ]

COURSE ATTRIBUTES: Check All That Apply
1. Pass/Not Pass Only [ ]
2. Satisfactory/Unsatisfactory Only [ ]
3. Repeatable [ ]
Maximum Repeatable Credit: [ ]
4. Credit by Examination [ ]
5. Special Fees [ ]
6. Registration Approval Type — Department [ ] Instructor [ ]
7. Variable Title [ ]
8. Honors [ ]
9. Full Time Privilege [ ]
10. Off Campus Experience [ ]

ScheduleType	Minutes Per Mtg	Meetings Per Week	Weeks Offered	% of Credit Allocated
Lecture				
Recitation				
Presentation				
Laboratory	150	1	16	
Lab Prep				
Studio				
Distance				
Clinic				
Experiential				
Research				
Ind. Study				
Pract/Observ				

Cross-Listed Courses

COURSE DESCRIPTION (INCLUDE REQUISITES/RESTRICTIONS):
Term offered: Spring, Lab 3, Cr.1. Restriction: Must be enrolled in the School of Biomedical Engineering (BME). Prerequisite: BME 20500 and, ME 27000 or ME 27100 Concurrent prerequisite: MSE 23000. Co-requisite: BME 20400
Provides hands-on training in engineering and biological principles of biomaterials and biomechanics. Topics include evaluation and interpretation of experimental results, modeling and testing of tissue and body mechanics, and interactions of living (e.g., tissue/cell) and nonliving (e.g., biomaterial) systems.

*COURSE LEARNING OUTCOMES:
1. Independently employ fundamental analytical tools and techniques used in the analysis of mechanical properties of tissues and biomaterials, cellular interactions with biomaterials, and finite element analysis. 2. Collect, record, process, statistically analyze, and report experimental data related to the analysis of mechanical testing and cellular interactions with biomaterials. 3.Theoretically design a device and/or method for solving a biomechanical or medically relevant problem.

	Date		Date
Calumet Department Head		Calumet School Dean	
Fort Wayne Department Head		Fort Wayne School Dean	
Indianapolis Department Head		Indianapolis School Dean	
North Central Department Head		North Central Chancellor	
West Lafayette Department Head	George R. Wodicka 5/13/10	West Lafayette College/School Dean	5/24/2010
West Lafayette Registrar			7/29/10

OFFICE OF THE REGISTRAR

7/29/10

Office of the Registrar
FORM 40 REV. 11/09

PURDUE UNIVERSITY
REQUEST FOR ADDITION, EXPIRATION,
OR REVISION OF AN UNDERGRADUATE COURSE
(10000-40000 LEVEL)

Print Form

EFD 8-10

DEPARTMENT Biomedical Engineering

EFFECTIVE SESSION Spring 2011

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

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

PROPOSED:	EXISTING:
Subject Abbreviation	Subject Abbreviation BME
Course Number	Course Number 20600
Long Title Biomechanics and Biomaterials Laboratory	
Short Title Biomechanics & Biomaterial Lab	

Abbreviated title will be entered by the Office of the Registrar if omitted. (30 CHARACTERS ONLY)

TERMS OFFERED
Check All That Apply:
[ ] Summer [ ] Fall [x] Spring

CAMPUS(ES) INVOLVED
[ ] Calumet [ ] N. Central
[ ] Cont Ed [ ] Tech Statewide
[ ] Ft. Wayne [x] W. Lafayette
[ ] Indianapolis

CREDIT TYPE
1. Fixed Credit: Cr. Hrs. 1
2. Variable Credit Range: Minimum Cr. Hrs
(Check One) To [ ] Or [ ]
Maximum Cr. Hrs.
3. Equivalent Credit: Yes [ ] No [ ]

COURSE ATTRIBUTES: Check All That Apply
1. Pass/Not Pass Only [ ]
2. Satisfactory/Unsatisfactory Only [ ]
3. Repeatable [ ]
Maximum Repeatable Credit: [ ]
4. Credit by Examination [ ]
5. Special Fees [ ]
6. Registration Approval Type
Department [ ] Instructor [ ]
7. Variable Title [ ]
8. Honors [ ]
9. Full Time Privilege [ ]
10. Off Campus Experience [ ]

ScheduleType	Minutes Per Mtg	Meetings Per Week	Weeks Offered	% of Credit Allocated
Lecture				
Recitation				
Presentation				
Laboratory	150	1	16	
Lab Prep				
Studio				
Distance				
Clinic				
Experiential				
Research				
Ind. Study				
Pract/Observ				

Cross-Listed Courses

COURSE DESCRIPTION (INCLUDE REQUISITES/RESTRICTIONS):
Term offered: Spring, Lab 3, Cr.1. Restriction: Must be enrolled in the School of Biomedical Engineering (BME). Prerequisite: BME 20500 and, ME 27000 or ME 27100
Concurrent prerequisite: MSE 23000. Co-requisite: BME 20400
Provides hands-on training in engineering and biological principles of biomaterials and biomechanics. Topics include evaluation and interpretation of experimental results, modeling and testing of tissue and body mechanics, and interactions of living (e.g., tissue/cell) and nonliving (e.g., biomaterial) systems.

*COURSE LEARNING OUTCOMES:
1. Independently employ fundamental analytical tools and techniques used in the analysis of mechanical properties of tissues and biomaterials, cellular interactions with biomaterials, and finite element analysis. 2. Collect, record, process, statistically analyze, and report experimental data related to the analysis of mechanical testing and cellular interactions with biomaterials. 3.Theoretically design a device and/or method for solving a biomechanical or medically relevant problem.

Calumet Department Head	Date	Calumet School Dean	Date
Fort Wayne Department Head	Date	Fort Wayne School Dean	Date
Indianapolis Department Head	Date	Indianapolis School Dean	Date
North Central Department Head	Date	North Central Chancellor	Date
George R. Wodicka 5/13/10 West Lafayette Department Head	Date	West Lafayette College/School Dean 5/24/2010	Date
		West Lafayette Registrar	Date

OFFICE OF THE REGISTRAR

TO: The Faculty of the College of Engineering

FROM: The Faculty of the School of Biomedical Engineering

RE: Changes in Undergraduate-Level Course, BME 20600 Biomedical Engineering Laboratory II, title, restriction, description, and content.

The Faculty of the School of Biomedical Engineering has approved the following changes to an existing course. This action is now submitted to the Engineering Faculty with a recommendation for approval.

From:

BME 206000 Biomedical Engineering Laboratory II
Term offered: Spring, Lab 3, Cr.1
Prerequisite: BME 20500, ME 27000 or ME 27100
Co-requisites: BME 20400 and MSE 23000

Provides hands-on training in engineering and biological principles of biomaterials and biomechanics. Biomaterials topics include crystal structure, deformation of materials, and materials defects. Biomechanics topics include rigid body equilibrium, gait analysis, finite element analysis, and loading/modeling of hard and viscoeleastic biomaterials. Physiological systems addressed include the musculoskeletal system, nerves, spinal cord, and vascular tissue.

To:

BME 20600 Biomechanics and Biomaterials Laboratory
Term offered: Spring, Lab 3, Cr.1
Restriction: Must be enrolled in the School of Biomedical Engineering (BME)
Prerequisite: BME 20500 and, ME 27000 or ME 27100
Concurrent prerequisite: MSE 23000
Co-requisite: BME 20400

Provides hands-on training in engineering and biological principles of biomaterials and biomechanics. Topics include evaluation and interpretation of experimental results, modeling and testing of tissue and body mechanics, and interactions of living (e.g., tissue/cell) and nonliving (e.g., biomaterial) systems.

APPROVED FOR THE FACULTY
OF THE SCHOOLS OF ENGINEERING
BY THE ENGINEERING
CURRICULUM COMMITTEE

ECC Minutes #26

Date 5/13/10

Chairman ECC R. Cipra

Reason: The title and description changes are to provide more clarity and alignment with course content for the students. The proposed change in the course content is necessary in order to integrate hands-on problem based laboratories and provide students more training in experimental methods that are useful to practicing biomedical engineers in the critical areas of biomechanics and biomaterials. A restriction is employed since this is a limited space laboratory course.

George R. Wodicka

George R. Wodicka, Professor and Head
Weldon School of Biomedical Engineering

Supplementary Materials

Content revisions: Examples of new hands-on and experimental methods included in the course are cell culture techniques, material testing, and statistics. A detailed description of revised content changes is found in the tables below. The revision includes a decrease in the number of topics from 12 to 9 and subsequent extension of several topics to multiple weeks. This change allows bridging topics, providing opportunity for students to benefit from the problem-based learning style, and increasing the robustness of the term project. Note that in the revised syllabus (page 3 of the supplementary section) the laboratory content is still associated with the original 3 modules (statics and mechanics, biomaterials, and strengths in materials – page 4 of the supplementary section). However, the revised syllabus is now organized in a problem-based learning hierarchal structure, and as a result the modules are not as readily grouped.

Table 1 - Summary of Changes in BME206 Laboratory Content

Original Laboratory Sessions that were removed		**New Laboratory Sessions**	
Old Lab topics	**Reason for removal**	**Replacement Lab topics**	**Benefit of the new laboratory**
Introduction to lab II and final design presentation (session 1)	Explanation of the syllabus and term project did not require 3 hours.	Introduction to cell culture and ANOVA (lab 1) – 2 week lab	In addition to explaining the syllabus and term project students are introduced to cell culturing and statistics. The ability to cell culture with biomaterials and perform statistical analyses are vital tools to a biomedical engineer.
Polymer scaffolds; tissue engineering (lab 5)	Students have no exposure to cell culturing techniques – the lab had limited importance since the cell culture aspect was not included.		
Influence of loading on muscle forces (lab 2)	This project requires a large room with open beams in the ceiling to conduct the experiment. An adequate location to continually offer this laboratory has not been identified.	Biomechanics of the rat hind limb (lab 6)	Students explore the underlying concepts of joint mechanics, and then apply this information to explore disease and tissue replacement scenarios. Biomechanical concepts covered in the original lab are still present in the revised lab.
Imperfections and crystalline structure (lab 4)	Due to the nature of this lab, students were not afforded hands-on opportunities with the subject matter.	Macrophage response to biomaterials (Lab 3) – a two week lab	This laboratory is the third part of a problem based learning series. Students are challenged to develop experimental protocols to answer a research question by building on concepts learned from labs 1 and 2.
Therapeutic applications of degradable polymers (lab 8)	This lab did not integrate well with the course content.		

Table 1 – Continued.

Gait analysis (lab 3	Due to the nature of this lab, students were not afforded hands-on opportunities with the subject matter.	Fatigue of Biomaterials and Bone using 3 and 4 Point Bending (lab 9) this is a two week lab	The addition of 6 screw driven mechanical testing machines provides students' the opportunity to learn how to program, run, and interpret mechanical tests within the biomedical engineering context. The fatigue test will be performed in a bending format.
Four point bend test on bone composite (lab 11)	Lab concepts are still taught in the replacement lab.		
Polymer degradation (lab 9)	Due to the nature of the topic it is difficult to conduct this laboratory in a 3 hour lab period.	Term Project Session ("last chance" term project material testing laboratory)	It is important for students to understand how to develop a research question, and then compose and implement experimental protocols to find a solution to the problem. The initial term project was designed to be solved theoretically. This project has evolved to include a hands-on component. To incorporate this an additional lab session is needed.
Design Project; class meets	Students prepare presentations for term project.	Review of term project data and poster presentation	Students analyze term data and prepare poster for presentation.
Present group project (last week of classes)	Students orally presented their findings on a theoretical design project.	Finals week	Poster presentation of term project research. Students present to technical and non-technical personnel on their term project. The inclusion of a poster presentation has significant real world applications.

Table 2 - Revised Laboratory Schedule – Spring 2010

Week	Week of	Lab Activity	Assignment Due
1	1/11	**Lab 1:** Introduction to Cell Culture and ANOVA Statistics	PreLab 1
2	1/18		***Milestone 1 part 1 of the Term Project: Identify 3 clinical problems,***
3	1/25	**Lab 2:** Cytotoxicity of Biomaterials	PreLab 2, NB 1, and PostLab 1
4	2/1		***Milestone 1 part 2 of the Term Project: Clinical problem statement***
5	2/8	**Lab 3:** Macrophage response to Biomaterials	NB2 and PostLab 2
6	2/15		
7	2/22	**Lab 4:** Protein interactions with biomaterials	PreLab 4, NB3, and Formal Report Lab 3
8	3/1	**Lab 5:** Vector Principles Applied to the Human Body	PreLab 5, Peer Review of NB3, NB 4, and PostLab 4
9	3/8	**Lab 6:** Biomechanics of the rat	PreLab 6, NB 5, PostLab 5, and ***Milestone 2 of the Term Project: Project Outline***
10	3/15	*Spring Break ~ no lab*	
11	3/22	**Lab 7:** Tension and Compression testing of biomaterials and rat tissues	PreLab 7, NB 6, and Formal Report Lab 6 (Due on 3/26)
12	3/29	**Lab 8:** Finite Element Analysis of PMMA and Trabecular Bone Compression	PreLab 8, Peer Review of NB 6, NB 7, and PostLab 7
13	4/5	**Lab 9:** Fatigue of Biomaterials and Bone using 3 and 4 Point Bending	NB 8 and PostLab 8
14	4/12		
15	4/19	"Last Chance" Term Project Material Testing Laboratory	NB 9 and Formal Report Lab 9
16	4/26	Review of Term Project Data and Poster Preparation (Milestone 3)	Peer Review of NB 9 and ***Milestone 3: Design Notebook is due at the conclusion of class***
17	TBD	Finals week – Poster presentations (Milestone 4)	***Peer review of design project notebook due 5 pm Friday of finals week***

Table 3 - Original Laboratory Schedule – Spring 2006

CLASS	DATE	LAB ACTIVITY	MEETING LOCATION	ASSIGNMENT DUE
MODULE 1: STATICS AND MECHANICS				
1	1/11 or 1/13	Introduction to Lab II and Final Design Project	Potter; room 118	
2	**1/18 or 1/20**	**Lab 1:** Vector Principles Applied to the Human Body	Potter; room 118	Turn in Pre Lab Questions for lab 1, and ***definition of design problem and how you will research the problem.***
3	1/25 or 1/27	**Lab 2:** Influence of Loading on Muscle Forces	Lambert Hall; room	Turn in Pre Lab Questions for lab 2 and Lab report for lab 1
4	2/1 or 2/3	**Lab 3:** Gait Analysis	Lambert Hall; room 206	Turn in Pre Lab Questions for lab 3 and lab report for lab 2
MODULE 2: BIOMATERIALS				
5	2/8 or 2/10	**Lab 4:** Imperfections and Crystalline Structure	Potter; room 118	Turn in Pre Lab Questions for lab 4 and Post Lab Analysis for lab 3
6	2/15 or 2/17	**Lab 5:** Polymer Scaffolds; Tissue Engineering	Lilly Hall; room 2-132	Turn in Pre Lab Questions for lab 4 and lab report for lab 5
7	2/22 or 2/24	**Lab 6:** Cytocompatability	Lilly Hall; room 2-132	Turn in Pre Lab Questions for lab 5 and lab report for lab 6
8	3/1 or 3/3	**Lab 7:** Cytotoxicity	Lilly Hall; room 2-132	Turn in Pre Lab Questions for lab 7 and lab report for lab 6
9	3/8 or 3/10	**Lab 8:** Therapeutic Applications of Degradable Polymers	Lilly Hall; room 2-132	Turn in Pre Lab Questions for lab 8 and lab report for lab 7
10	3/15 or 3/17	SPRING BREAK		
11	3/22 or 3/24	**Lab 9:** Polymer Degradation	Lilly Hall; room 2-132	Turn in Pre Lab Questions for lab 9 and lab report for lab 8
MODULE 3: STRENGTHS IN MATERIALS				
12	**3/29 or 3/31**	**Lab 10:** Compression Testing on Bone Composite	ME; room 242A	Turn in Pre Lab Questions for lab 10, lab report for lab 9, and ***an outline of your design project.***
13	4/5 or 4/7	**Lab 11:** Four Point Bend Test on Bone Composite	ME; room 242A	Turn in Pre Lab Questions for lab 11 and lab report for lab 10
14	4/12 or 4/14	**Lab 12:** Finite Element Analysis of Orthopaedic implants	Potter, room 118	Turn in Pre Lab Questions for lab 12 and lab report for lab 11
15	4/19 or 4/21	Design Project; class meets	Potter; room 118	Turn in lab report for lab 12
16	**4/26 or 4/28**	***Present Group Project***	Potter; room 118	

*Dates in bold indicate dates when a segment of design project is due.