8/10/11

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 Fall 2011

201210

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

- [X] 1. New course with supporting documents
- [ ] 2. Add existing course offered at another campus
- [ ] 3. Expiration of a course
- [ ] 4. Change in course number
- [ ] 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
- [ ] 9. Change in course description
- [ ] 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	BME	Subject Abbreviation	
Course Number	48900	Course Number	
Long Title	Senior Design Project Lab		
Short Title	Senior Design Project Lab		

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

TERMS OFFERED
Check All That Apply:
[ ] Summer [X] 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. 2
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	2	16	
Lab Prep				
Studio				
Distance				
Clinic				
Experiential				
Research				
Ind. Study				
Pract/Observ				

Cross-Listed Courses

RECEIVED
OFFICE OF THE REGISTRAR
2011 AUG -9 AM 9:43

COURSE DESCRIPTION (INCLUDE REQUISITES/RESTRICTIONS):

Concurrent Prerequisite: BME 48800. The biomedical engineering design process is completed starting from a preliminary system design. Students will work with their teammates to implement (e.g. build, test, iterate and evaluate) a solution to address a biomedical engineering problem statement and meet the technical specifications set forth. The resulting project design is presented and evaluated through an oral presentation, laboratory demonstration, and a final written document.

*COURSE LEARNING OUTCOMES:

Students will have demonstrated the ability to: Integrate and apply knowledge and skills obtained in earlier course work with new concepts and practices essential to the design and testing of a system or device to meet desired needs. Implement the engineering design process and project management within the context of relevant design constraints. Effectively communicate skills in oral and written form, both individually and as part of a team. Explain/discuss realistic design constraints, including regulatory issues, societal influences, and ethical and professional responsibilities of biomedical engineers, as related to the engineering design process.

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
West Lafayette Department Head: George R. Wodicka	5/2/11	West Lafayette College/School Dean: [signature]	7/6/11
		West Lafayette Registrar: [signature]	8/1/11

OFFICE OF THE REGISTRAR

BME 48900

Engineering Faculty Document No. 80-10

February 3, 2011

TO: The Faculty of the College of Engineering

FROM: The Faculty of the School of Biomedical Engineering

RE: New Undergraduate Course, BME 48900, Senior Design Project Lab

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

BME 48900 Senior Design Project Lab
Terms offered: Fall and Spring, Lab 6, Cr. 2
Restriction: Must be enrolled in the School of Biomedical Engineering (BME)
Concurrent Prerequisite: BME 48800

Description: The biomedical engineering design process is completed starting from a preliminary system design. Students will work with their teammates to implement (e.g. build, test, iterate and evaluate) a solution to address a biomedical engineering problem statement and meet the technical specifications set forth. The resulting project design is presented and evaluated through an oral presentation, laboratory demonstration, and a final written document.

Reason: This course replaces two lab credits of the old BME 405. This new graded course is required of all BME students completing their senior design requirements and serves to focus effort on the execution and completion of the design. We have distributed the essential elements of the BME senior design process from one required course to three required courses to be able to accommodate projects that extend over both the Fall and Spring semesters. This strategy will support a more diverse set of design projects that span all five of the major research areas within the Weldon School of Biomedical Engineering.

BME 48800 Preliminary Senior Project Design (1 credit lab)
BME 48900 Senior Design Project Lab (2 credit lab)
BME 49000 Professional Elements of Design (1 credit studio)

George R. Wodicka

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

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

ECC Minutes #17

Date 4/20/11

Chairman ECC R. Cipra

BME 48900

BME 48900 Senior Design Project Lab
Class time: Tues/Thurs 1:30 – 4:20 pm
Locations: MJIS 1087
2 credit hours

Course Staff

Course Instructor:
Dr. Pedro Irazoqui

Lab Coordinators:
Dr. Marcia Pool
Dr. Allison Sieving

Teaching Assistants:

Course Operation

Course Description: The biomedical engineering design process is completed starting from a preliminary system design. Students will work with their teammates to successfully implement a solution to address a biomedical engineering problem statement and meet the technical specifications set forth. The resulting project design is presented and evaluated through an oral presentation, laboratory demonstration, and a final written document.

Class Attendance: Attendance at all BME 489 laboratories is mandatory. To ensure personal safety and the safety of others, and to prevent equipment damage, students will not be allowed to use designated equipment or conduct selected laboratory techniques until they have been certified by a course instructor. Occasionally there will be ***mandatory*** training sessions held during the laboratory sessions; completion of these sessions and demonstration of sufficient knowledge is required prior to receiving certification. ***Lab instructors reserve the right to prohibit or revoke the privilege of using designated equipment and supplies for selected laboratory techniques until training standards are met and followed.***

Required Supplies: Laboratory Notebook with duplicate pages (e.g., National 43-644, 43-641, or 43-645)

Laboratory Attire: Safety regulations require that you wear long pants (or equivalent) and closed-toe shoes while working in the laboratory. Laboratory coats and safety goggles will be available.

Campus Emergency Response Procedures:

- Fire Alarm – Evacuate the building using the exits on the east side of RM 1087 or 1083 MJIS. Only gather personal items if it does not jeopardize your safety. Assist those who need help, if possible. Proceed to the front lawn of the Burton Morgan Building. Report to a course instructor your name before leaving the emergency assembly area.
- All hazards warning (examples of hazards: tornado (severe weather)/hazardous materials release/civil unrest/directed by police personnel) – When you hear the all hazards alarm immediately seek shelter. Continue to a safe location (typically the lowest level of the building in an area without windows).

Campus Emergency Policy: In the event of a campus wide emergency the class outline and course requirements may be subject to change. The course instructor will provide information in regards to changes in the course requirements or course schedule as a result of a campus wide emergency.

Course Assessment

Course Overview: This course will provide each student with a significant original design experience in biomedical engineering. This will be an iterative decision-making process in which basic science, mathematics, and engineering, are applied to solve a problem with clinical or biomedical research impact. Among the fundamental elements of the design process are the establishment of objectives and criteria, synthesis, analysis, construction, testing, documentation and evaluation.

The course consists of bi-weekly 3-hour laboratory periods. Laboratory sessions will be used for gathering information, learning laboratory techniques, designing and building system components, and calibrating and testing devices.

Through this course, you will complete a design review, demonstrations, and reports that document and detail the design and development process associated with your project. These assignments have been developed to mimic a typical industrial design experience and to prepare you for success in the workforce as a biomedical design engineer.

BME 489 provides many opportunities for you to demonstrate mastery and accomplishment of the skills essential to a BME. Ultimately, students who successfully fulfill the course requirements will have demonstrated the ability to:

	Course outcome	**Relationship to BME program outcomes**
I	Integrate and apply knowledge and skills obtained in earlier course work with new concepts and practices essential to the design and testing of a system or device to meet desired needs.	1,2,4,5
II	Implement the engineering design process and project management within the context of relevant design constraints.	3
III	Effectively communicate skills in oral and written form, both individually and as part of a team.	6, 7
IV	Explain/discuss realistic design constraints, including regulatory issues, societal influences, and ethical and professional responsibilities of biomedical engineers, as related to the engineering design process	8,9

Academic Conduct: You are expected to behave in a professional and ethical manner in all aspects of this course. Plagiarism, cheating, or other acts of academic dishonesty will not be tolerated. Any infractions whatsoever will result in immediate expulsion from the course and a failing grade for the semester. Instances of plagiarism or cheating will also be reported to the Dean of Students Office to be recorded on your permanent academic record. If an individual behaves in any other manner that is unprofessional or unethical during the semester, the course instructor(s) reserves the right to fail the student for that as well. For more

information, see the Purdue University Student Conduct Code at:
http://www.purdue.edu/odos/adminstration/codeconduct.htm.

Grading Scheme: Grading is based upon the following assignments:

▪ Design review (written)	10%
▪ Team demonstration	15%
▪ Design review (oral)	6%
▪ Peer review (2)	2%
▪ Design Journal (2)	10%
▪ Innovation	6%
▪ Final System Delivery and Demonstration	20%
▪ Final design document*	25%
▪ Oral presentation of final design	6%
Total	100%

Grading Scale: The following grading scale is a guaranteed minimum; however, based upon individual student performance and/or the functionality of the final demonstration, final grades may be curved by the instructor.

GPA	Grade	Percent Range
4	A	≥93
3.7	A-	92 – 90
3.3	B+	89 – 87
3.0	B	86 – 83
2.7	B-	82 – 80
2.3	C+	79 – 77
2.0	C	76 – 73
1.7	C-	72 – 70
1.3	D+	69 – 67
1	D	66 – 60
0	F	≤59%

Re-grade Policy: Students have the right to contest grades throughout the semester. In the event that a student feels an assignment has been inappropriately graded, the student must submit a one page typed document indicating the nature of the problem and an explanation for the re-grade submission. Along with this document, the original assignment must be returned to the instructor. Students have 1 week after the return of a graded assignment to protest a grade; after this time grade disputes will not be accepted. Papers submitted for a re-grade will be completely reevaluated (i.e., the entire paper will be re-graded, not only the portion under protest), which means that students may lose additional points for mistakes missed during the first grading process.

BME 48900

Course Assignment Descriptions

Design Review (written) –
The Design Review is the last time you will interact with and entertain design concerns from the customer prior to product delivery. For this purpose, a concise document is prepared for the customer to review. In this review you should give a full description of your finished system and outline its expected performance. This assignment should be no longer than 20 pages and contains updated and more technically detailed excerpts on the following components:

1. *Updated Problem Statement.*
2. *Updated System Design.* Highlight design changes at the beginning of this section. This notifies the customer of important alterations right away. A summary table is extremely useful in this regard.
    a. For each subsystem the report should include:
        i. The fundamental scientific principles supporting the design
        ii. The technical specifications and operation of the components utilized
        iii. The output of the subsystem and how you will (or have) measure or quantify it. Please utilize as many schematics, circuit diagrams, figures, and tables (with appropriate titles, legends, etc.) as necessary to fully convey the technical operation of your components.
3. *Updated Testing Plans and Results.* At this point it is expected that each subsystem will have calibration and testing data with statistical analyses to present. Plans for whole system testing should be included.
4. *Updated achievement of design specifications and realistic constraints.*
5. *Unresolved Issues.* Address any issues discussed at your team's Preliminary Design Review, both resolved and unresolved. A summary table is extremely helpful to the customer. For all resolved issues, describe the processes used to overcome your troubles. For unresolved issues, describe your plans to address these areas.
6. *Hazard and FEMCA Analysis.*
7. *Updated Team Responsibilities and Gantt chart.*
8. *Updated Cost Estimate.*
9. *Updated Timeline*

Team Demonstration –
At this demonstration, you will be expected to demonstrate the functionality of 2 - 3 components associated with each sub-system. As a team you will have 30 minutes to demonstrate to two customers. For each demonstration the customer should be given a brief background/justification for the entire device, discussion on the different components of the device, and then a detailed explanation of the elements that will be demonstrated. The customer is expecting to be presented preliminary data and calibration information. PowerPoint slides are not appropriate for this assignment. You may provide support data (tables/graphs) to the evaluator. During the demonstrations, be prepared to answer questions related to your part/component selection, calibration procedures, data collection, data and statistical analysis, and next steps in the progress of the design or in regards to integrating elements with the overall system. A major key to having a successful demonstration is the flow. With all of you presenting at one time you will want to make sure it is organized in a manner that makes sense to the customer.

BME 48900

Design Review (oral) –
The Design Review presentation is 10 minute power point presentations which summarizes the team's design. The presentation will be made to and evaluated by BME faculty, company representatives, lab coordinators, and GTAs. Following the presentation will be a question and answer session. The entire session for each team will last no more than 20 minutes. Your team should be prepared to address detailed technical and financial questions about your system.

The presentation order will be determined by a random drawing on the first day of presentations; therefore you must be ready to present on the first day of presentations. **Your team's power point file must be submitted (via email) to the laboratory instructor by 10:00 am on the due date.**

Design reviews are intentionally challenging. This mimics real world design reviews where the customer must decide after the review if they want to provide you with substantial funding to generate a complete prototype working system. Thus they will ask questions, interact, and negotiate on system specifications to ensure that they have a reasonable level of comfort to proceed to the final design stages. In extreme cases, the customer may fire a team or force them to start over should the design be totally insufficient.

Peer Review –
Assignment: Twice during the course students will conduct self and peer evaluations on participation in team endeavors. Feedback from these evaluations will be used to help guide instructor/student interactions. Each student will be given a summary feedback from the peer reviews; however, all evaluations will remain anonymous. Results are factored in as part of your overall course grade. Peer reviews will be evaluated both by the student's ability to provide constructive comments to peers as wells as the student's peers' impressions of their team performance. Students will be evaluating for the following areas::

- Team player (description: an ability to assist teammates in their tasks as needed; reliable team member overall).
- Work ethic (description: attitude; effort; participation in team tasks; preparation in team meetings).
- Goal setting and achievement of goals (description: sets goals for team assignment, in lab activities, etc; assists team in meeting goals).
- Communication (description contributes ideas/opinions/concerns to the group; listens to and shows respect for others' input; able to negotiate/compromise well with team members).
- Innovation (description: provides novel concepts to solve solutions).
- There is an additional section that addresses areas in which improvement is needed.

Design Journal –
Assignment: Each team member must maintain a design journal to document their individual contributions to the design project. The purpose of your design journal is to provide a complete and chronological record of your work on the BME 488/489/490 sequence; this will include individual literature searches, personal planning sessions, team planning sessions, laboratory sessions, etc. Ultimately, each step you take towards achieving a design solution must be documented in your journal. Each entry should include date, time, location, and participants in the session. It is recommended that the standard notebook layout with a brief statement of the objective of the activity, the procedure followed, and results and conclusions is followed. Journals will be graded twice during the course. At each submission date, the duplicate journal pages and hard copies of any attached documentation will be turned in for storage in a back-up location. Grading of your

journal will be primarily determined by whether a person versed in the field but unfamiliar with your work, could duplicate your efforts with only your journal to go by.

Innovation –
For this course innovation is broken down into three specific areas: spark, create, implement. Spark is the generation of a novel idea/solution/test. Spark can be further broken down into disruptive (completely new), incremental (builds off of what already exists), or architectural (used in a new way). Create is the building of the spark. Essentially, this stage is the iterations used to make the spark work. Finally, implement is the integration of the created idea into a form that is usable by the public. Points given for sparks will be on a gradient scale in which the more novel the idea, the more points it is worth. For creation points, mentors will look at iterations and final sub-system demonstration to determine how well the component works. Implementation will be evaluated at whole system integration. Evaluators will be looking for how your innovation has contributed to the novelty of the final solution.

Final System Delivery and Demonstration –
The Final system demonstration is your team's opportunity to show the prototype system to the customer. During the demonstration, each team will have 20 minutes to demonstrate to the mentor staff operation of the system and demonstrate that it meets the design specifications, technical specifications, and realistic constraints. In the event that the system is not fully functional, demonstrate the components of your system that work and indicate which aspects do not. The customer may request certain tests be run.

Final Design Document –
The final design document must be in the format of 1 of the 4 real world deliverable options: draft of a journal article, draft of a provisional patent, application to a national design competition, or draft of grant proposal. The deliverable format must be discussed and approved by the course instructor and team mentor, if appropriate. The deliverable must demonstrate a unique solution to the problem the team was challenged with at the start of the senior design course as well as documentation towards proof of concept.

Oral Presentation of Final Design –
The final oral presentation is your opportunity to relay your team's design strategy and findings to BME faculty, company representatives, BME staff, and BME students. The presentation must be no longer than 10 minutes, with 4 additional minutes for a question/answer session. Time limits will be strictly enforced. It is at this presentation and demonstration that the public votes on the best project. Each member of the team that is selected as the having the best project will receive a plaque and a monetary award. Criteria that the public will use to identify the best project are:

1. Provides adequate background information to illustrate where the project adds to the field (uniqueness/creativity/innovation/marketability)
2. Utilized a methodically structured plan to design and test the idea/device (considered all relevant testing aspects and no trivial testing)
3. Presented the testing results in a unified manner for ease of understanding (easy for listener to draw the same conclusion from the data)
4. Proof of concept of the prototype was show (prototype functions properly according to design constraints set by design team).