Engineering Faculty Document No. 24-22

November 2, 2021

TO: The Faculty of the College of Engineering

FROM: The Faculty of the Weldon School of Biomedical Engineering

RE: New Undergraduate Course, BME 38900, Junior Experimental Design Laboratory

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 38900: Junior Experimental Design Laboratory
Term Offered: Spring, Lab 4, Cr. 2
Prerequisites: BME 20500, BME 20600 and BME 20700
Concurrent prerequisites: BME 39000 and [STAT 35000 or STAT 51100]
Major Restriction: Biomedical Engineering only

Description: Practical experience with engineering design principles is presented through inquiry-based modules. Each module contains computer simulation, experimental design, implementation, and data analysis. Modules address biomedical applications in different areas of BME.

Reason: This new course will provide experimental design training critical for the preparation of students for BME 48901/49000 senior design as required in the BME undergraduate curriculum redesign.

David M. Umulis
Dane A. Miller Head and Professor
Weldon School of Biomedical Engineering

OBJ

Course Information

- **BME 38900: Junior Engineering Design Laboratory**
- **CRN:** TBD
- **Meeting day(s) and time(s)**. TBD
- **Instructional Modality:** Face-to-Face Laboratory with online content available via Brightspace
- **Course credit hours:** 2
- **Prerequisites:** BME 20500, BME 20600, and BME 20700
- **Concurrent Prerequisites:** BME 39000 and [STAT 35000 or STAT 51100]

Instructor(s) Contact Information

- **Instructor:** Prof. Tamara Kinzer-Ursem
  - **Office Location:** MJIS 3084
  - **Purdue Email Address:** tursem@purdue.edu
  - **Student Consultation hours, times, and location**: By appointment
- **Lab Coordinator:** Asem Aboelzahab
  - **Office Location:** MJIS 1084
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- **Teaching Assistants** - TBD

Course Description

Practical experience with engineering design principles is presented through inquiry-based modules. Each module contains computer simulation, experimental design, implementation, and data analysis. Modules address biomedical applications in different areas of BME.

Learning Resources, Technology & Texts

- **Informed Learning resources such as**
  - **Optional textbook:** STANDARD HANDBOOK OF BIOMEDICAL ENGINEERING AND DESIGN (ISBN: 9780071356374)
  - **Software:** Electronics laboratory notebook (MS word)
- **Brightspace learning management system:** All course material will be available here

Learning Outcomes

- Upon completion of the course each student will have the ability to:
  1. *Apply engineering design principles to design biomedical systems, devices, and models using theoretical equations from applied physics and engineering.*
  2. *Design and conduct experiments to investigate device/system functionality and collect, analyze, and interpret resulting data.*
  3. *Compile a comprehensive report that clearly demonstrates the design process and presents the findings and implications of the data.*

4. *Work effectively on a team to develop project goals, plan tasks, and successfully meet design objectives.*

Assignments

The following assignments will be evaluated for each course module. The semester will be divided into two major modules that each student group will complete.

Module Presentations	**20 %**
Individual Demonstrations	**20 %**
Quizzes	**10 %**
Module Notebooks	**10 %**
Module Reports	**20 %**
Peer Reviews	**10 %**
Individual Participation and Rigor	**10 %**

Online Course Evaluations: You must complete all online course evaluations for this class AND submit evidence of survey completion to the LMS before finals week.

Online Material: It is expected and required that students watch and learn any material presented in the online content available through Brightspace. This material is to be learned prior to coming to lab each week it is assigned. The course schedule details when material is assigned. Also included in this grade is completion of short quizzes given in Brightspace that test your retention of the online material.

Laboratory Notebook: Each group must maintain a laboratory notebook. A lab notebook is used to document work in a research setting; it details what was done, when it was done, and who did it. Whether your career takes you into an industrial or academic research setting, you will be expected to maintain a proper lab notebook. In these settings, notebooks become important legal documents which can be used to submit a patent claim and credit an original discovery. **Electronic notebooks (via Microsoft Word or similar) are encouraged for this course.** There will be **weekly notebook checks** to make sure that you are documenting your work. Notebooks should contain the following components, at a minimum:

- Experiment title
- Lab partner(s) names and date
- Design/experiment purpose or problem statement
- Steps taken to achieve the goal of the experiment; this is a description of how you performed the experiment, including
    - schematics to represent what you have done
    - step-by-step procedure (references to previous procedures are allowed, but any deviations from the referenced procedure should be clearly stated)
    - calculations necessary to complete the procedure
    - parameters of experimental set ups, etc.
- Observations/Results obtained as you perform the experiment
    - Record these immediately – you will easily forget important items
    - Including general observations – for instance, the solution turned pink when we added chemical X
    - Include quantitative results—for instance, the concentration of chemical A in well 1 (row X, column Y) was 7.35 mg/ml
    - Including any difficulties you may have encountered and how these may affect your data
- Conclusions
    - Comment on potential sources of error in your experiment

- Any statements you can make based on raw data collected in class
- Appendix
    - List of all items used and the cost of each item (cost analysis of project)—a table will suffice. Provide references for the price estimates.

Please revisit your BME 205, 206, and 207 manuals for further explanation and examples of what should be included in your lab notebook.

Lab Clean-up and Safety

It is expected that you will maintain your lab space and the public lab areas in good working order. Specifically, you will clean up after yourself and properly maintain the laboratory equipment. Your lab group will be assigned an area of the laboratory that you are responsible for keeping organized throughout each module. The teaching team will monitor how well teams clean up after themselves and this will be associated with the laboratory notebook grade. See the rubric for the notebook.

If you find that materials or equipment are not in working order, please inform the TAs immediately. We work very hard to make sure that all teams have the resources that they need to complete the labs. Timely informing TAs of any problems will ensure that the teaching team can maintain a safe and orderly work environment for everyone.

Everyone must be properly trained in the proper use of tools and equipment. If you would like to use tools (saws, cutters, etc.) or equipment (drills, pumps, stir plates, etc.) ask for the TAs for training.

Formal Lab Reports and Post Lab Analysis: At the conclusion of each module, your group will write a formal lab report. This will include an abstract, introduction, materials & methods, results, discussion/analysis, and conclusion sections. The ability to integrate ideas will demonstrate that you have fully achieved the objectives of the lab exercises; this is an important part of your lab report. It is up to your team to integrate the concepts from your work in each module; the background and conclusions sections may be excellent choices to tie the experiments and results together.

Self and Peer Reviews: At the close of each module, your team will complete self and peer evaluations; that is, each person will assess his/her own performance on the team as well as the performance of each team member. Evaluations will be submitted online. At the end of the module, a link to the survey will be sent to you. It is expected that you will provide substantive feedback in the peer evaluations. Your team members will not be able to view this feedback, but this information is essential to the teaching teach so that any problems can be identified and addressed in a timely manner. Evaluation results will be factored in as part of your overall course grade; negative evaluations can adversely affect your grade.

Grading Scale

The following grading scale is a guaranteed minimum; however, based upon student performance, final grades may be curved by the instructor.*

Letter Grade	Percentage	GPA score
A+	100	4.0
A	≥ 95	4.0
A-	≥ 90	3.7
B+	≥ 87	3.3
B	≥ 83	3.0
B-	≥ 80	2.7
C+	≥ 77	2.3

C	≥ 73	2.0
C-	≥ 70	1.7
D+	≥ 67	1.3
D	≥ 63	1.0
D-	≥ 60	0.7
F	60 >grade>0	0

*Note: Negative peer evaluations can adversely affect your final grade.

Grading Rubrics: Grading rubrics for Laboratory Notebooks, Lab Reports, Team Presentations and Individual Demonstrations are available on Brightspace. You should use these as a guide in your preparation for these learning assessments.

Re-grade Policy: Students have the right to contest any grade throughout the semester. Once an assignment has been graded and returned, students have **1 week** to protest a grade; after this time grade disputes will not be accepted. In the event that a student feels an assignment has been inappropriately graded, the student must submit a one page, typed document indicating the source of the problem and an explanation for the re-grade submission. The original assignment must be returned with the protest explanation. 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 risk losing additional points for mistakes missed during the first grading process. Please note that all re-grade requests will be evaluated at the end of the term and will only be considered for those students with a borderline grade (e.g., between an A and B).

All assignments must be submitted to Brightspace before the beginning of the lab period in which the assignment is due.

Attendance Policy

Attendance (100 %) is required to pass the course. If a student misses a class due to an extenuating circumstance (e.g., illness, death in family), they must contact the lab instructor immediately. In some instances, written documentation will be required. Make-up work will be considered and assigned on a case-by-case basis. **To receive credit for the lab, a student must be in the lab on time, no more than 15 minutes late. A student who is more than 15 minutes late and who does not have an excused reason may receive a zero on the lab.**

Office Hours: Lab office hours will be held in MJIS 1087/1097. In addition to using office hours to obtain further understanding of laboratory concepts, office hours may also be used to complete laboratory procedures not finished in lab. Appointments to discuss course material can be made with Prof. Kinzer-Ursem and Mr. Aboelzahab by request.

Course Schedule*

Week	Lab Content	Assignment Due
Course Intro/Begin Module 1		
1	Online material: none prior to class. In Lab: Introduction to course structure; introduction to Module 1; Introduction to experimental design; Literature review and experimental design	
2	**Online material: Module 1**	View online material and take quiz before 2nd Tuesday of classes

	In Lab: Instructor directed example problems and student questions about Module 1; Introduction to computational modeling tools (ie. COMSOL, python, Jupiter notebooks) Literature review and experimental design	
3	Team presentations – Includes: Preliminary design plan, experimental implementation, mathematical modeling, data collection and analysis	In-class: Approval of experimental design
4	Online material: none Implement experiments mathematical modeling, data collection and analysis	Notebook check
5	Online material: none Implement experiments mathematical modeling, data collection and analysis	Individual demo of progress, Notebook check
6	Online material: none Finalizing experiments, modeling	Notebook check
7	Online material: none Finalizing experiment data acquisition, use model to extend results, finalize data analysis	Notebook check
8	Online material: none Finalizing data analysis, notebooks, and report	
Module 1 Wrap-up/Begin Module 2		
9	**M1 lab report and notebook due 5pm Mon** **Online material: Module 2** In Lab: Introduction to Module 2. Instructor directed example problems and student questions about Module 2 Literature review and experimental design	M1 lab report; notebook; peer review **Due by 5pm Mon** View online material and take quiz before 9th Tuesday of classes
10	**Online material: Module 2** In Lab: student directed Q&A for Module 2 Team presentations – Includes: Preliminary design plan, experimental implementation, mathematical modeling, data collection and analysis	View online material and take quiz before class In class: Approval of experimental design
11	Online material: none Implement initial experiments, mathematical modeling, and data collection	Notebook check
12	Online material: none Implement experiments mathematical modeling, data collection and analysis	Individual demo of progress, Notebook check
13	Online material: none Finalizing experiments, modeling	Notebook check
14	Online material: none Finalizing experiment data acquisition, use model to extend results, finalize data analysis	Notebook check
15	Online material: none Finalizing data analysis, notebooks, and report	Notebook check
16	**M2 lab report and notebook due 5pm Mon of Finals week** Flex Week Post-course survey / Course Evaluations	M2 lab report; notebook; peer review **Due by 5pm Mon of Finals week**

*Lab order and assignment due dates are subject to change, as needed.

Classroom Guidance Regarding Protect Purdue

As Protect Purdue protocols continue to evolve, we recommend you do not include specific protocols in your syllabus, but rather refer students to the Protect Purdue information within your course Brightspace, especially the Protect Purdue Pledge. Please include the following statement in your syllabus.

Any student who has substantial reason to believe that another person is threatening the safety of others by not complying with Protect Purdue protocols is encouraged to report the behavior to and discuss the next steps with their instructor. Students also have the option of reporting the behavior to the Office of the Student Rights and Responsibilities. See also Purdue University Bill of Student Rights and the Violent Behavior Policy under University Resources in Brightspace.

Academic Integrity

Academic Conduct: You are expected to behave in a professional and ethical manner in all aspects of this course. Plagiarism or cheating will result in a zero for that particular assignment. Instances of unethical behavior will be reported to the Dean of Students Office and will result in a grade reduction of at least one letter grade. If an individual behaves unprofessionally or unethically during the semester, the instructor reserves the right to fail the student. For more information, see Purdue University Student Conduct Code at: http://www.purdue.edu/usp/acad_policies/student_code.shtml .

Refer to the Brightspace course page for more information and resources regarding academic integrity.

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In the event of a campus wide emergency, the course outline and 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. Check Brightspace and your Purdue email accounts for information.

- Fire Alarm – Leave the building immediately, using the nearest exit. Use stairways only. Do NOT use elevators. Tell others to evacuate. Take your keys, coat, purse, and another other critical personal items with you. Close doors behind you.
- All hazards warning – Shelter in place! Go indoors immediately. Determine the cause of the siren using Purdue communications protocols (text alerts, e-mail messages, Purdue homepage). Take appropriate action for the emergency
- Active threat or campus violence – Interior doors with card swipe entry will lock (access with PUID card). Stay away from glass doors and windows. Determine options for escape or concealment (escape if possible; if not, then hide; last resort is to take action).

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