Engineering Faculty Document No. 45-19
October 9, 2019

TO: The Faculty of the College of Engineering

FROM: The Faculty of the School of Biomedical Engineering

RE: Change to Undergraduate-Level Course BME 30600 prerequisite

The faculty of the School of Biomedical Engineering has approved the change in requisites of the course listed below. This action is now submitted to the Engineering Faculty with a recommendation for approval.

FROM: **BME 30600 Biotransport Laboratory**
Term offered: Spring, Lecture 1, Lab 3, Cr. 2
Restriction: Must be enrolled in the School of Biomedical Engineering
Prerequisite: BME 30400
Concurrent Prerequisite: STAT 35000 or STAT 51100 or (STAT 41600 and STAT 41700) or CHE 32000 or IE 33000

Description: Practical experience with transport principles related to physiological systems is presented through inquiry-based modules. Modules contain elements of computer simulation, experimental design, implementation, and data analysis and address biomedical applications.

TO: **BME 30600 Biotransport Laboratory**
Term offered: Spring, Lecture 1, Lab 3, Cr. 2
Restriction: Must be enrolled in the School of Biomedical Engineering
Prerequisite: BME 30400 and BME 20600
Concurrent Prerequisite: STAT 35000 or STAT 51100 or (STAT 41600 and STAT 41700) or CHE 32000 or IE 33000

Description: Practical experience with transport principles related to physiological systems is presented through inquiry-based modules. Modules contain elements of computer simulation, experimental design, implementation, and data analysis and address biomedical applications.

REASON: Skills acquired in BME 20600 are necessary for student success BME 30600.

George R. Wodicka

George Wodicka
Dane A. Miller Head and Professor
Weldon School of Biomedical Engineering

BME 306: Biotransport Laboratory
Spring 2020

Instructor of Record: Prof. Tamara Kinzer-Ursem
Email: tursem@purdue.edu
Office: MJIS 3084
Office hours: By appointment

Lab Coordinator: Mr. Asem Aboelzahab
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Course TAs:

Mrugesh Parasa
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TA Office Hours: WEEKNIGHTS: Monday 5-7pm, Wednesday 5-7pm. **SIGN UP FOR EQUIPMENT AVAILABILITY** through PASS (link available on Blackboard Learn).

WEEKENDS BY APPOINTMENT ONLY: Saturday 2-4pm, Sunday 2-4pm. **MUST SIGN UP BY 5PM ON THURSDAY** through PASS (link available on Blackboard Learn).

Class Location: MJIS 1061

Lab: One of the following:
Tuesday 8:30 – 11:20am , 1:30 – 4:20pm
Thursday 8:30 – 11:20am, 1:30 – 4:20pm
Friday 8:30 – 11:20am

Pre-requisites: BME 206 and BME 304
STAT 511 or equivalent (concurrent)

Course Description:

Practical experience with fluid and mass transport principles is presented through inquiry-based modules. Each module contains computer simulation, experimental design, implementation, and data analysis. Modules address biomedical applications such as the effect of molecular size on diffusion, dialysis, and pharmacokinetics.

Course Outcomes:

Upon completion of the course each student will have the ability to:

1. Use theoretical equations from fluid, heat, and mass transport to describe, model, analyze, and explain biomedical data.
2. Design experiments to investigate biomedical transport phenomena, collect relevant data, and compile a comprehensive report that clearly demonstrates the findings and implications of the data.
3. Work in a team to simulate and experimentally model biomedical transport, and use peer- and self-reviews to describe how each team member contributed to group efforts.

Required Supplies:

- Laboratory Notebook
- Safety Goggles

Optional Course Textbook:

- R. Fournier. *Basic Transport Phenomena in Biomedical Engineering*, 3rd ed. New York, New York: Taylor and Francis Group, LLC. , 2011. (ISBN-10: 1439826706)

Laboratory Attire: Safety regulations require that you wear long pants (or equivalent) and closed-toe shoes while working in the laboratory. You will not be allowed to work in the lab if you are improperly dressed.

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 .

All assignments must be submitted to **Blackboard Learn** (http://mycourses.purdue.edu) before the beginning of the lab period in which the assignment is due. All hard copies of assignments must be submitted in the first 15 minutes of the laboratory period.

Class Attendance: Attendance (100 %) is required to pass the course. If a student misses a class due to an extenuating circumstances (e.g., death in family), he/she 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 1061. 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. Office hours are listed on page 1 of this syllabus, extra office hours will be announced in class. Appointments to discuss course material can be made with Prof. Kinzer-Ursem and Mr. Aboelzahab by request.

Campus Emergency Response Procedures:

http://www.purdue.edu/fire/safety_handbook.pdf

- **Fire Alarm** – Evacuate MJIS 1061 through the south door (nearest the elevator); then, leave the building through the doors which exit to the east side of the building (back of the building near the construction of the Herrick Labs extension). Only gather personal items if it does not jeopardize your safety. Assist those who need help. Proceed to the front lawn Lilly Hall of Life Sciences (corner of State St. and S. Russell Dr.) **Report to a course instructor your name before leaving the emergency assembly area.**
- **All hazards warning** (Tornado, hazardous release, civil unrest, etc.) – When you hear the all hazards alarm immediately seek shelter (**Shelter-In-Place**) in a safe location. For a tornado, proceed to the basement of MJIS, using either the stairwell on the northwest side (by the police station) or the southeast side (across from MJIS 1087).

Campus Emergency Policy: In the event of a major campus emergency, course requirements, deadlines, and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances. If an emergency should occur, check Blackboard and your Purdue email accounts to learn about modifications to the course.

Online Course Evaluations: You must complete all online course evaluations for this class AND submit to the lab coordinator evidence of survey completion before finals week. If no evidence of survey completion is submitted you will not receive a grade for the Lab Practical.

Online Material: It is expected and required that students watch and learn the material presented in the online lectures available through Blackboard. This material is to be learned prior to coming to lab each week it is assigned. The course schedule details when each lecture is assigned. Watching and learning this material is part of the lecture component of the course (you signed up for this as a separate section) and constitutes 10% of your grade for the course. Also included in this grade is completion of short quizzes given in Blackboard that test your retention of the online lecture 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.** There will be **weekly notebook checks** to make sure that you are documenting your work. Hard copy notebooks should be completed in a legible manner in ink will also be accepted for this course. Notebooks contain the following components, at a minimum:

- Experiment title
- Lab partner(s) names and date
- Experiment purpose or problem statement
- Steps taken to achieve you're the goal of the experiment; this is a description of how you performed the experiment
    - Including schematics to represent what you have done
    - Including step-by-step procedure (references to previous procedures are allowed, but any deviations from the referenced procedure should be clearly stated)
    - Including calculations necessary to complete the procedure
    - Including 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 305 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 respect 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 TA's immediately. We work very hard to make sure that all teams have the resources that they need to complete the labs. Timely informing TA's 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.

Expectations for each module: for Module 1, these will be extended over six weeks

Week one

- Problem statement (given)
- Screen literature base
- Testing system design
- Experiment design (factors, replicates, etc.)

Week two

- Present experimental design to classmates and course mentors for feedback
- Construct and use mathematical model to set experimental conditions and parameters
- Conduct any necessary preliminary experiments to obtain key estimates of model parameters

Week Three

- Present individual progress to course mentors
- Lab Notebook check
- Conduct the primary experiment
- Analyze data experimental results and mathematical model predictions
- Interpret experimental results within context of mathematical model and your problem statement

Week Four

- Continue to modify and use mathematical model to extend findings to predict behaviors that are too complex to evaluate experimentally
- Lab Notebook check
- Complete lab report

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 Blackboard. You should use these as a guide in your preparation for these learning assessments.

Grading Breakdown:

Module Presentations	10 %
Individual Demonstrations	10 %
Blackboard Lectures and Quizzes	10 %
Module Notebooks	10 %
Module Reports	30 %
Peer Reviews	10 %
Individual Participation and Rigor	10 %
Lab Practical (individual)	10 % *

* If you do not complete the course evaluation you will not receive a grade for the lab practical

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).

Course Schedule*:

Week	Week of:	Lab	Required Reading	Assignment Due
Module 1: Intro to modeling and statistics; Effect of molecular size on static and convective diffusion				
1	1/6	Online material: none prior to class. In Lab lecture: Introduction to course structure; introduction to Module 1; Introduction to experimental design; Literature review and experimental design	Ch. 5 (Fournier) 5.4, 5.5, 5.6, 5.10	
2	1/13	**Online material: Module 1 Lecture 1 Parts 1 and 2** In Lab lecture: Instructor directed example problems and student questions about Module 1; Introduction to COMSOL; COMSOL tutorials are available on Blackboard Literature review and experimental design		
3	1/20	**Online material: Module 1 Lecture 2** Team presentations – Includes: Experimental implementation, mathematical modeling, data collection and analysis		Approval of experimental design
4	1/27	Online material: none Implement experiments mathematical modeling, data collection and analysis		Notebook check
5	2/3	Online material: none Implement experiments mathematical modeling, data collection and analysis		Individual demo of progress, Notebook check
6	2/10	Online material: none Finalizing experiments, modeling, and analysis		Notebook check
Module 2: Pharmacokinetics and the distribution of oral medications				
7	2/17	**M1 lab report and notebook due 5pm Mon 2/17** **Online material: Module 2 Lecture 1 Parts 1 and 2** In Lab: Instructor directed example problems and student questions about Module 2	Ch. 7 (Fournier) 9.11, 10.6.5	M1 lab report; notebook; peer review **Due by 5pm Mon 2/17**

		Literature review and experimental design		
8	2/24	**Online material: Module 2 Lecture 2 Parts 1 and 2** In Lab: student directed Q&A for Module 2 Team presentations – Includes: Experimental implementation, mathematical modeling, data collection and analysis		Approval of experimental design
9	3/2	Online material: none Implement experiments mathematical modeling, data collection and analysis		Individual demo of progress, Notebook check
3/9-3/13 Spring Break (no class, no lab)				
11	3/16	Online material: none Finalizing experiments, modeling, and analysis		Notebook check
Module 3: Exploration of cryopreservation and heat transfer				
12	3/23	**M2 lab report and notebook due 5pm Mon 3/23** **Online material: Module 3 Lecture 1 Parts 1 and 2** In Lab: Instructor directed example problems and student questions about Module 3 Literature review and experimental design	To be distributed on Blackboard	M2 lab report; notebook; peer review **Due by 5pm Mon. 3/23**
13	3/30	**Online material: Module 3 Lecture 2** In Lab: student directed Q&A for Module 3 Team presentations – Includes: Experimental implementation, mathematical modeling, data collection and analysis		Approval of experimental design
14	4/6	Online material: none Implement experiments mathematical modeling, data collection and analysis		Individual demo of progress, Notebook check
15	4/13	Online material: none Finalizing experiments, modeling, and analysis		Notebook check
16	4/20	**M3 lab report and notebook due 5pm Mon 4/20** Flex Week Post-course survey / Course Evaluations		M3 lab report; notebook; peer review **Due by 5pm Mon 4/20**
17	4/27	**Final Exam Week**		**Lab Practical Due by Fri 5pm 5/01**

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