**BIEN 401 – Biomedical Mass Transport**

**BIEN 501 – Physiological Modeling I**

**Instructor:** Dr. Louis Reis

**Office Hours:** TR 8:00 am – 10:00 am

WF 1:00 pm – 3:00 pm **or by appointment**

**Contact Information:**

**Office:** BMEB 212

**Office Phone:** (318) 257-2954

**Email:** [Lgreis@Latech.edu](mailto:Lgreis@Latech.edu)

**Class Time:** MWF: 8:00-9:15 AM

**Class Location:** BEC 154

**Course Prerequisites:** BIEN 301, MATH 245

**Course Description:** This course is a logical extension of BIEN 301 in the sense that it is a course on transport. Transport is frequently divided into three subjects, fluid transport, heat transfer, and mass transfer. BIEN 401 focuses in mass transfer and emphasizes the mechanism of diffusion. This course (along with BIEN 301) is one of the few places where you will need to model phenomena simultaneously in the time and spatial domains to such an extent that you will need to work with partial differential equations. Whereas you have not had a formal course in partial differential equations, you will need to carefully follow the methods provided with the associated problems. Applications of the course material include bioreactors, tissue engineering, dialysis, drug delivery, and hemostasis.

**Textbook:** Ronald L. Fournier, *Basic Transport Phenomena in Biomedical Engineering*, 4th ed., Taylor & Francis, New York, 2018.

**Grading:**

Homework - 20%

Project - 10%

Model Assignments - 5%

Exams (2) - 40%

High exam - 25%

Low exam - 15%

Final Exam (cumulative) - 25%

**Grading Scale:**

A – >89.9%

B – 79.9 – 89.9%

C – 69.9 – 79.9%

D – 59.9 – 69.9%

F – <59.9%

\*The instructor reserves the right to lower the cut off for the letter grades. This is usually done with a variety of statistical tools and cannot be calculated until all grades are submitted.

**Homework:**  
Homework assignments can be found on Canvas. Each homework assignment is due before midnight on Monday (unless the instructor states otherwise). Each homework will cover materials learned from the previous week. Though group discussion is encouraged, the submitted work must be that of the individual (i.e., no copying of work). All homework assignments will be submitted on Canvas unless the teacher instructs otherwise. All homework will be TYPED (see homework guide for specific editing requests). There are six (6) homework assignments; students in BIEN 501 will have a seventh homework assignment due at the end of the quarter.

**Modeling Assignments:**

Throughout the course you will learn to model various mass transport systems using COMSOL Multiphysics. If you have not had any experiences with COMSOL (or if you need a refresher), please review the tutorial materials on Canvas. You have access to the software through the COES Virtual Workspace (go to virtual.latech.edu and type in your Canvas credentials). You will also become familiar with Simulink (a tool within MATLAB); this can also be found on the COES Virtual Workspace or you may download it onto your own desktop using the link in Canvas. You will complete individual assignments that are designed to help you become familiar with the software and its usefulness for solving complex transport-related problems. Students in BIEN 501 will do an additional modeling assignment related to a transport phenomenon (possibly related to their research). A “conference-proceeding”-like paper will be submitted documenting the work.

**Project:**

A quarter-long project will involve the use of COMSOL and microfluidic fabrication to produce a concentration gradient generator. Some assignments will be done individually, while the final fabrication will be done in teams of two. You will model and “test” designs using COMSOL. After finding a working design, you will produce a microfluidic device and test it. We will use image analysis techniques and MATLAB programming to confirm that the desired gradient was generated. The project grading will be composed of multiple checkpoints (individual COMSOL models, physical device, MATLAB programming, etc.).

**Attendance:**

Regular and punctual class attendance is required (refer to the current [University Bulletin](http://www.latech.edu/registrar/bulletin/select.shtml) regarding attendance). An unexcused absence for an examination, quiz, presentation, or any other in-class activity will result in a zero grade for that activity. If you will be absent from class, you are required to inform your instructor prior to the absence if you would like an excuse considered. Acceptable means of informing your instructor include email. Any makeup examinations may contain significantly different content than the missed exam.

**Academic Conduct:**

Claiming the work of someone else as your own is cheating. The integrity of academic institutions and our society relies on each student being evaluated on their own work, and cheating undermines this system. Looking at another student's work during an exam or quiz is cheating, as is copying another student's work for homework or lab reports. In addition to these specific examples, see this list for other specific examples of cheating.

Louisiana Tech has an Honor Code that all students are expected to know. Please take time to read it and follow it. Assisting another student to cheat (e.g. providing them with unauthorized assistance) is also considered cheating.

Students caught cheating will be given a zero grade on the assignment(s) for which the cheating took place. Students caught cheating may also be subject to other sanctions imposed by the instructor or university, including but not limited to: restructuring of grading categories, additional/different course requirements, a failing grade in the course, academic probation, suspension, or expulsion from the university. The instructor is not required to have irrefutable proof that cheating took place in order to begin sanctions against the suspected student(s).

**Testing and Disability Services:**

Students needing testing or classroom accommodations based on a disability are encouraged to discuss those needs with the instructor as soon as possible. Testing and Disability Services' website is found at www.latech.edu/ods.

**Syllabus Changes:**

The contents of this syllabus are not expected to change. However, the instructor retains the right to interpretation and/or alteration of the policies contained herein. In the case of alteration, ample notice will be provided.

**Emergency Notification System:**

All Louisiana Tech students are strongly encouraged to enroll and update their contact information in the Emergency Notification System. It takes just a few seconds to ensure that you are able to receive important text and voice alerts in the event of a campus emergency. For more information on the Emergency Notification System, please visit [www.latech.edu/administration.ens.shtml](http://www.latech.edu/administration.ens.shtml).

**COVID -19 Policy:**

Students can access COVID-19 related information, guidelines, FAQs, and policies at Louisiana Tech’s website: [www.latech.edu/coronavirus](file:///C:\Users\Louis%20Reis\Downloads\www.latech.edu\coronavirus).

Louisiana Tech’s Return to Campus Plan is located at [www.latech.edu/return-to-campus](file:///C:\Users\Louis%20Reis\Downloads\www.latech.edu\return-to-campus). Masks are required to be worn indoors on campus. Masks are required to be worn outdoors if six feet of physical distance cannot be maintained. Every member of the Tech Family will need to take personal responsibility for their behavior, which includes wearing masks, maintaining physical distancing, washing hands regularly, using proper sneeze and cough practices, helping maintain clean academic and office areas, and monitoring for symptoms of COVID-19.

Failure to comply with the Safety Protocols listed in the “Back to Campus Culture of Sharing” booklet, located at [www.latech.edu/documents/2020/07/covid-return-book.pdf/](http://www.latech.edu/documents/2020/07/covid-return-book.pdf/), specifically on pages 5-7 about masks and social distancing, could result in students being in violation of the Classroom Behavior Policy listed on page 123 of the “Student Handbook,” located at [www.latech.edu/documents/2018/09/student-handbook.pdf/](file:///C:\Users\Louis%20Reis\Downloads\www.latech.edu\documents\2018\09\student-handbook.pdf\).

Students who are feeling ill with COVID-19 symptoms, have been exposed to, or have tested positive for COVID-19 should not come to class and should follow the reporting guidelines detailed below:

The direct link to the reporting protocol for students exposed to, displaying symptoms of, or testing positive for COVID-19 is located at [www.latech.edu/return-to-campus-plan/for-students/](file:///C:\Users\Louis%20Reis\Downloads\www.latech.edu\return-to-campus-plan\for-students\). Students must reach out to Stacy Gilbert, Dean of Student Services & Academic Support, at [stacyc@latech.edu](mailto:stacyc@latech.edu) for help with accommodations and additional information. Accommodations may not be granted until proper University protocol has been followed. Short-term COVID-19 accommodations are not disability accommodations.

**Counseling Services:**

Information and contact numbers and sites for Louisiana Tech Counseling Services are located at <https://www.latech.edu/current-students/student-advancement-affairs/counseling-services/>

**Expected Topics Schedule:**

(Schedule is subject to changes.)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Day** | **Date** | **Lecture #** | **Topic** | **Assignments Due** |
| W | 12-Mar | 1 | Course Introduction; Material balances and reactions |  |
| F | 14-Mar | 2 | Thermodynamic concepts and review of older materials |  |
| M | 17-Mar | 8 | COMSOL review and examples |  |
| W | 19-Mar | 3 | Fluids and the cell membrane |  |
| F | 21-Mar | 4 | Flow properties | HW1 |
| M | 24-Mar | 5 | Mass Transport, Fick's Laws, Diffusion | Model 1 |
| W | 26-Mar |  | Project Intro and Work Day |  |
| F | 28-Mar | 6 | More examples | HW2 |
| M | 31-Mar | 7 | Boundary Layer Flow and Sherwood number | Model 2 |
| W | 2-Apr | 9 | Review |  |
| **F** | **4-Apr** |  | **Exam 1** | HW3 |
| M | 7-Apr | 10 | Boundary Layer |  |
| W | 9-Apr | 11 | Solute Permeability Heterogenous Media |  |
| F | 11-Apr | 12 | Krogh Tissue Cylinder | Model 3 |
| M | 14-Apr | 13 | Oxygen Transport | HW4 |
| W | 16-Apr | 14 | Pharmacokinetic Analysis I | Project check |
| F | 18-Apr |  | ***Easter holiday break (no classes)*** |  |
| M | 21-Apr |  | ***Easter holiday break (no classes)*** |  |
| W | 23-Apr | 15 | Pharmacokinetic Analysis II |  |
| F | 25-Apr | 16 | Simulink | HW5 |
| M | 28-Apr | 17 | Review |  |
| **W** | **30-Apr** |  | **Exam 2** |  |
| **F\*** | **2-May** |  | Project Work Day |  |
| M | 5-May | 18 | Extracorporeal devices | Model 4 |
| W | 7-May | 19 | Blood Oxygenators |  |
| F | 9-May |  | ***Advisory Board (no class)*** |  |
| M | 12-May | 20 | Enzyme Reactors | Project check |
| W | 14-May | 21 | Wrap-up |  |
| F | 16-May |  | Project Work Day | HW6 |
| M | 19-May | 22 | Review | Final Project |
| **W** | **21-May** |  | **Final** |  |
| F | 23-May |  |  |  |

**\*Last day to withdraw from a class with a W grade, Friday May 2**