

## ENGRI 131 / BME 131: Introduction to Biomedical Engineering

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### Course description:

Modern biology and medicine is undergoing a revolution as quantitative principles of measurement, analysis, and design are introduced to help solve a variety of scientific and medical problems. This course will provide an introduction to the power of such a quantitative approach for biomedical research. The use of quantitative principles will be illustrated through case studies of contemporary scientific and engineering problems in molecular biology, cellular biology, mammalian physiology, and biomedical instrument design. Emphasis will be placed on the advantages of a multidisciplinary approach and the need to understand a problem from both a biological and an engineering perspective. Background material will be taught as needed for each case study, including the necessary biology, mathematics, and physical science.

Learning in this course will be very collaborative, with students discussing challenging aspects of the material with each other and the instructors during the lectures and labs. Reports for the laboratory portion of the course will be completed in teams, and collaboration on the homework is encouraged.

### Course topics:

The course emphasizes the development of a conceptual understanding of basic biology, human physiology and disease, as well as medical diagnostics. By limiting the course to only three major topic areas and keeping the discussion centered on the conceptual aspects of the science, we will be able to start with basic biology, physics, chemistry, math, medicine, and engineering and bring the discussion up to the frontiers of modern research. The three main topics discussed are:

1. The molecular biology and genetics behind the engineering of a transgenic mouse that models inherited human disease, starting with the chemistry and interactions of the key molecules of life: DNA, RNA, and protein.
2. The cell biology and physiology of light detection and visual processing in the retina, starting with the idea of appropriately folded proteins serving as gated ion channels in lipid membranes.
3. The mechanisms of image formation and contrast in structural and functional magnetic resonance imaging (MRI) as well as its medical relevance, starting with the basic physics of atomic nuclei in static and oscillatory magnetic fields.

Additional topics will be covered briefly, including hearing loss and cochlear implant design, cardiovascular function and disease, and optical technology for producing and studying small-strokes in rodents.

The laboratories complement this set of topics, and include labs on DNA fingerprinting, cellular toxicity, osmosis and dialysis, and fluid flow in capillary-like networks.

**Course website:**

Please check the BME 131 website on Blackboard regularly. Course announcements, reading assignments and quizzes, homework assignments, homework solutions, and extra materials will all be distributed via the website. Please enroll in the BME 131 site at <http://blackboard.cornell.edu/> as soon as possible. The access code to enroll is: **987654**. Detailed instructions for enrolling are given below.

**Textbook:**

*Life: The Science of Biology 7<sup>th</sup> ed.*, W. K. Purves, D. Sadava, G. H. Orians, H. C. Heller, Sinauer/W. H. Freeman (2004)

Additional reading materials will be posted on the course website.

**Schedule:**

Lecture: Tuesday and Thursday, 10:10 to 11:25 am, in 205 Upson Hall.

Laboratory: Meet four times during semester. Section assignments on Wednesday, Thursday, and Friday, from 1:25 to 4:25 pm. Kimball Hall room 171 (behind double doors).

Lab meeting schedule:

February 6 to 8: DNA fingerprinting lab

March 5 to 7: Cell cytotoxicity lab

April 2 to 4: Microvasculature lab

April 23 to 25: Dialysis lab

**No lectures will be held during lab weeks.**

**Clickers:**

Bring your “clicker” to class everyday. The number of questions you answer in each class will determine your course participation score. You will not be graded on whether or not you entered a correct answer, but just on whether or not you tried. You can miss up to two lectures without losing any points on your participation grade. Note: there will be a \$25 replacement fee for lost or damaged clickers.

**Reading quizzes:**

A three question online quiz will be due the day before each lecture at midnight. These quizzes will be posted several days before the lecture, along with the assigned reading. It will not be possible to complete these assignments after midnight on the due date, nor will there be any means of making up this work. The first two questions will ask you to write a short essay response to a problem that is related to the reading that was assigned for the lecture. The final question asks that you describe any material in the reading material you found confusing (or interesting, if nothing was confusing). You will not be required to have perfectly correct answers to receive full credit, but it must be clear from your responses to all three questions that you have read the assigned reading and have thought carefully about the questions.

**Homework:**

Three problem sets will be given over the course of the semester, each consisting of several problems. The assignments will be posted on the course website. Homeworks are generally due the week after they are posted. Work handed in late will not be graded. Solutions will be posted on the course web site after the homework due date. You are encouraged to work together and discuss the homework assignments, but the solutions you turn in must be your own work. If you work in a team, please list the names of everyone you worked with on your solution set.

**Laboratory reports:**

Laboratory reports are generally due the week after the lab meeting time. Late lab reports will not be graded. Laboratory experiments will be completed as a team, with one report handed in for each team. Please list the names of your team members on the report you turn in. You must also turn in a Peer Evaluation form with **each** laboratory report where you rate the performance of your team members as well as yourself. The form is available on Blackboard and turning in your evaluation form is required to for your report to be graded.

**Due dates for homework and laboratory reports:**

Homeworks and laboratory reports must be placed in the appropriately labeled box in Kimball 171 (on the left as you walk in) **before** 5:00 pm on the due date.

<b>Assignment:</b>	<b>Due date:</b>
Lab Report 1	Friday, February 15
Homework 1	Friday, February 29
Lab Report 2	Friday, March 14
Homework 2	Friday, April 5
Lab Report 3	Friday, April 12
Homework 3	Friday, May 2
Lab Report 4	Friday, May 2

**Exams:**

The midterm and final exam will have four to six multiple part essay questions. Much of the material will be based on the conceptual questions asked during class and in the homework and labs. Some questions will ask you to apply the ideas you learned to new situations. The midterms and final exams from the last two years are posted on the course website.

For the midterm exam (not the final), you will have the opportunity to earn back up to 25% of the points you missed by handing in “thoughtful corrections.” These corrections consist of four key parts:

1. Describe how you were thinking about the problem when you answered it incorrectly in the exam.
2. Describe what you now know to be incorrect about your earlier reasoning.
3. Describe what you have learned since that allows you to now answer the question correctly.
4. Provide a complete, correct solution to the entire problem.

All four parts must be included with your corrections to receive credit. You may hand in corrections for all, some, or none of the questions that you missed points on in the exam. These corrections are graded subjectively based on how well you have corrected your earlier misunderstanding, as evidenced by what you write. There will be no re-grading of these corrections, except for arithmetic errors. Your corrections will be due one week after the graded midterm exams are handed back to you.

Midterm exam:

Tuesday, March 25, 7:30 pm (tentative), room TBA

Final exam:

Tuesday, May 13, 7:30 pm, room TBA

**Grading:**

Course participation: 5%

Reading quizzes: 10%

Homework: 20%

Lab reports: 20%

Midterm: 15%

Final exam: 30%

### How to succeed in ENGRI 131:

1. **Read the assigned material before coming to class** and complete the reading quizzes. We will not spend significant time in lecture re-telling you the things you are asked to read about on your own. Rather lecture time will be spent on helping you to gain a firm conceptual understanding of the material you read about, and showing you how it is connected to other areas of science and engineering and how it can be applied. If you do not read ahead of time, you will be lost during the lecture. If we were teaching Shakespeare, you wouldn't come to class without reading the first two acts of Macbeth, right? The reading for this course is not quite as eloquent as Shakespeare, but is equally important.
2. **Come to the lectures and actively participate** in the "clicker" questions. The focus of this class is the development of a strong conceptual understanding of the three main and other smaller topics that are listed above. There will not be anything you can memorize that will guarantee your success in the course. Rather there are some facts and definitions you will have to learn (mostly from the assigned reading) and remember in order to be in a position to *begin* to try to build the conceptual understanding you need to succeed. It is the goal of the lectures to help you start with the material you learned from the reading and assimilate it into your own understanding of "how things work." It is this conceptual understanding you will be tested on, and attending the lectures (assuming you are prepared!) is probably the most effective way to gain it.
3. **Work together** on the in-class questions, the homework, the labs, and studying for exams. Nothing will help you to learn something better than having to explain it to your peers. Note that working together on assignments does not mean dividing up the work and copying each other's solutions (this would be a violation of the code of academic integrity), but rather working as a team to help everyone get to the point that they understand the material well enough to solve the problem on their own.
4. **Be patient with yourself.** This course covers challenging, high-level material. You will not always "get it" the first time. It is important to be patient with yourself and to enjoy the "ah ha" moment of understanding when it comes. It is the joy of those moments that motivates most of your professors to devote so much of their lives to their research. Come to Prof. Schaffer's or one of the TA's office hours to discuss things you do not understand. It is best to get this help early, when you realize there is something you are uncomfortable with, rather than waiting until right before an exam.

### Academic integrity:

Academic integrity is expected of all students of Cornell University at all times, whether in the presence or absence of members of the faculty. Violations of the code of academic integrity will be prosecuted through the Academic Integrity Hearing Board. For more information, see the following page on academic integrity: <http://cuinfo.cornell.edu/Academic/AIC.html>.

### Blackboard Basics:

To Enroll in a Blackboard Site:

1. In a web browser, go to <http://blackboard.cornell.edu>.
2. Click the Login button.
3. Enter your Blackboard user name and password and click the Login button.
  - If you don't have a Blackboard account, you will need to get one before you can enroll. Click the "Create Blackboard Account" link near the top of the page and follow the instructions.
4. Click on the "All Blackboard Sites" tab along the top of the page.
5. Click on the "Browse Course Catalog" link on the right. Courses are listed by school and department.
6. Locate "Introduction to Biomedical Engineering (ENGRI 131/BME 131)" by navigating first to "Engineering" then to "Introduction to Engineering." If you don't see it, contact your instructor.
7. Click the Enroll button to the right of the course listing. A confirmation screen will appear.
8. When asked for an Access Code, enter "987654".
9. Click the Submit button to enroll in the site.
10. Click the OK button on the next screen to go straight to the site. From now on, a link to the site will appear in the course list on your My Blackboard page when you log in.