

The GT bmedSAB presents

THE UNOFFICIAL BMED COURSE GUIDE FOR
2006-2007

Created and Compiled By Michael Xu

With Contributions from Lisa Small, Jon-Michael Caldwell, Erica Oden and Yang Lin

The following represents the opinions and experiences of bmedSAB members and other students in the Biomedical Engineering Program. While this guide is by no means official, we do hope that it gives you insight on the nature of the classes you will be taking while pursuing your BME degree. Furthermore, we hope this course guide serves as a tool as you plan and decide your course schedule for the 2006-2007 school year.

GT bmedSAB

biomedical engineering Student Advisory Board

Table of Contents

<u>BMED 1300 Problems in BME I</u>	4
<u>BMED 2210 Conservation Principles in Biomedical Engineering</u>	4
<u>BMED 2300 Problems in BME II</u>	4
<u>BMED 3300 Biotransport</u>	5
<u>BMED 3400</u>	5
<u>BMED 3500 Sensors and Instrumentation</u>	5
<u>BMED 3160 Systems Physiology I</u>	6
<u>BMED 3161 Systems Physiology II</u>	6
<u>CHEM 1315 Survey of Organic Chemistry</u>	7
<u>CHEM 3511 Survey of Biochemistry</u>	7
<u>MSE 2001 Principles and Applications of Engineering Materials</u>	7
<u>ECE 2025 Introduction to Digital Signal Processing</u>	8
<u>ECE 3710 Circuits and Electronics</u>	8
<u>ECE 3741 Circuits Lab</u>	8
<u>CEE/MATH/ISYE 3770 Probability and Statistics</u>	8
<u>COE 2001 Statics</u>	9

BMED 1300 Problems in BME I

3 hours

BMED 1300 is the introductory Biomedical Engineering course. The first of two Problem Based learning courses in the BME degree, the course consists of a problem solving portion and a lecture portion. Each week, two one hour and a half group meeting sessions are dedicated to solving investigative problems while a one hour lecture each week introduces students to the field of Biomedical Engineering through guest speakers, case studies and lectures on skills important to group-based problem solving.

Throughout the course, you will be give roughly 3-4 problems to work on. These problems take many weeks to “solve”, and even then these answers are often proposals since there are many different approaches that can be taken to solve the answers. Past questions have involved describing new procedures for Breast Cancer detection and creating and executing experiments investigating the accuracy and specificity of consumer medical devices.

BMED 1300 is a great opportunity to explore the field of Biomedical Engineering. It is also a chance to meet and interact with department faculty and other BME students. It is a good chance to make connections and explore other opportunities within the department such as undergraduate research.

BMED 2210 Conservation Principles in Biomedical Engineering

4 hours

Conservation Principles, a chemical engineering course designed for Biomedical Engineering students, focuses on solving mass, heat and energy transfer problems using linear equations. BMED 2210 is a real-world application of the linear algebra techniques learned in Calculus II along with material on basic thermodynamic principles such as humidity, ideal gas law (and nonideal Gas law’s) and vapor pressure.

BMED 2210 is often the first true engineering class encountered by BME Undergrads. Many BME students find it difficult to understand the material and begin thinking like an engineer. However, the actual material is not that difficult, it just requires a process of thinking that many students find hard to grasp at the beginning. So don’t be afraid to sit down and pour over the book, studying different examples to get an understanding of how to approach problems by analyzing degrees of freedom or making assumptions about the problem and providing justifications. These are things that seem difficult and trivial at the same time but are exactly the type of skills that engineers should have.

Some of the concepts in the class may seem unimportant to Biomedical Engineering, but rest assured, many of the analytical processes in the course are useful for classes later in your degree.

Course structure depends on the professor, but generally the class is not terribly hard for those that sit down and give honest efforts to understanding.

BMED 2300 Problems in BME II

3 hours

BMED 2300 is the course following BMED 1300. BMED 2300 follows the same type of class structure as BMED 1300 with group meetings twice a week and a lecture once a week, but focuses on engineering design and problem solving instead of the research and collaboration skills of BMED 1300.

The class is again based on problems spanning many weeks that groups must solve. These problems are engineering design problems that often use programs such as Matlab SIMULINK and SolidEdge to finish. The problems also give real-world constraints such as

weight, size or applicability that must be realized in your designs. These designs can range from a scaffold constructed of notecards that must hold a certain ratio of weight, a portable emergency medical device or other types of problems that require engineering design methodologies.

Tests are given in-class and count for a significant part of the grade. Group participation and ratings from other group members counts for the rest of the grade. Being a motivated team player is important to do well in this class.

BMED 3300 Biotransport

4 hours

Biotransport is the biological application of skills learned in Differential Equations. The course studies fluid dynamics and introduces techniques to solving mass and energy diffusion. The course ends in a biological case study applying these methods to phenomena in the human body. For instance, the diffusion of a medical drug across a membrane may be modeled and described using differential equations.

All BMED 3300 problems require the use of differential equations. For example, knowing how to solve first order differential equations and homogeneous equations proves valuable in completing problems on tests and doing well. It is helpful to know these things beforehand, but Professors or TAs often go over these techniques quickly.

Using the WORD archive available on gtbmed.com is a very good resource for studying. Professors usually pick out a few choice problems for homework, and so looking at past semesters taught by the professor can help give you extra practice and insight into how to solve the problems.

BMED 3400

4 hours

Biomechanics is the last mechanics course in the mechanical engineering branch of the biomedical engineering degree. In the first half of Introduction to Biomechanics, students apply principles learned in Statics to biological systems. While methods from Statics are used, students are often surprised by the amount of materials analysis required by the class.

Remembering your Statics class techniques is particularly good because the teachers begin the semester assuming you understand the basics of Static such as force distributions and, moment equations and frames. As the course progresses, the problems will incorporate material properties as well as introducing dynamic components to the models.

A tip for BMED 3400 is to understand the biological system being studied or being modeled before making assumptions. Also keeping up with the homework is important to success in the class since it is fast paced. Lastly, paying attention in class is very important, as the teachers usually don't assign reading from a textbook and you likely won't be able to "read up" on what you didn't get in class.

BMED 3500 Sensors and Instrumentation

3 hours

Sensors and Instrumentation is the last electrical engineering type class in the BME degree. The class uses all of the electrical engineering prerequisites up to this point and applies them to sensing signals of the body. The class takes the principles taught in your ECE classes and uses knowledge from human physiology to create sensors that can detect behavior of the body.

Digital signal processing techniques will be used in the class. Because biopotentials are mostly measured on the skin, there will be sources of noise from the environment that must be filtered. Applications like these will be discussed in Sensors and Instrumentation.

The course consists of two lectures and a 3-hour lab each week. While doing well on the tests is important for your grade, the labs have much more weight on your grade than most students realize. Be prepared to commit a lot of time outside of your assigned lab time to complete your labs and semester project. Also, going through practice exams or old exams can help to prepare you for the exams. The exams are usually short answer questions. Senior Design I and II, the two “capstone” classes of the major, will probably require some application of the material in this course. Thus, it is important that you understand the concepts and know how to apply them to unique problems.

BMED 3160 Systems Physiology I

4 hours

Systems Physiology I is primarily a cell biology class taught from an engineering perspective. This class explores molecular and cellular biology, tissue physiology, organization, membrane-level transport and kinetics, cell signaling, and energy requirements. This course complements previous general biology courses such as BIOL 1510 while going into much greater depth. The lab component of this class is rigorous, and students can expect to spend a great deal of time both in the lab conducting experiments and preparing several lengthy formal lab reports. Students can also expect a final project towards the end of the semester. The nature of this project varies from year to year and is usually abruptly assigned, making it a potential stumbling block for the procrastinator. However, the project is usually very open-ended allowing for creativity and, in many cases, a well needed grade boost.

Dr. Boyan historically teaches 3160, though her busy schedule requires many guest lecturers (primarily graduate students) to be scheduled throughout the semester. While finding time with the primary professor may be difficult, lectures are carefully prepared and delivered, making class attendance a necessity.

Success in this class is largely dependent on careful note-taking and attention to detail in the lecture notes and slides. Tests vary between multiple choice questions and short answer, and usually require the full class period. Success in the lab component requires a grasp of basic lab skills (such as those used in CHEM 1310) and attention to detail. In order to score well on a lab report, the specified format should be followed EXACTLY.

BMED 3161 Systems Physiology II

4 hours

Systems Physiology II builds on the knowledge learned in Systems Physiology I and takes a model-based approach to human physiology and homeostasis on the organ system level. Great emphasis is placed on the dynamic interaction between various physiological systems to achieve and maintain homeostasis, making the class cumulative in nature. However, tests are usually not cumulative with the exception of the final. The lab component of this class requires less time than many of the activities in 3160, yet some are difficult for the squeamish. Students can expect to perform dissections of organs, physiological experiments on live animals (frogs), and prepare lab reports, though the format is less stringent than 3160. Students can also expect a final research project towards the end of the semester, requiring extensive out-of-class experimentation and preparation.

Success in 3161 requires independent study and careful attention to detail in lecture notes and slides. The breadth of material covered in the class is large, and keeping up with the pace of lectures is a must. Exams are usually a combination of formats including multiple choice, short answer, and essay questions. Homework is also graded based on accuracy and requires, in some cases, extra research.

CHEM 1315 Survey of Organic Chemistry

3 hours

Survey of Organic Chemistry covers in one semester 70% of the material that Pre-med track students cover in two semesters in Organic Chemistry I and II. While CHEM 1315 covers material in less depth, the class moves swiftly through the nomenclature, properties and reactions of various organic compounds in order to fit it all into one semester. The material in CHEM 1315 will be important in the next Chemistry course, CHEM 3511, Survey of Biochemistry.

Because of the breadth and speed through which the course moves through material, Professor Marcus Weck expects at least a ten hour a week commitment to studying in order to do well. Students not even on the Pre-med track have opted to take Organic Chemistry I and II in two semesters instead of CHEM 3511 Survey of Organic Chemistry in one semester because of the difficulty of the course.

A common mistake by students taking CHEM 1315 is to ignore the class participation portion of their grade. This often determines an A from a B or a B from a C. Also, be sure to compare homework with at least two other students (this is allowed) since homework is nearly half of your total grade. Lastly, try to make your last test grade your dropped test grade since it is traditionally the hardest of the four tests.

CHEM 3511 Survey of Biochemistry

3 hours

Survey of Biochemistry follows in the footsteps of your introductory Organic Chemistry class(es). Thus, you are expected to know the basic concepts like stereochemistry, nomenclature, functional groups, and basic thermodynamics from the beginning of the course. Very little time is spent reviewing these topics in the beginning of CHEM 3511 so it is recommended that you either remember your Organic Chemistry or review it if you have forgotten.

The key to doing well in this course is to perfect your memorization skills. Survey of Biochemistry is ~85% memorization. You will be expected to memorize the structures of amino acids, nucleic acids, carbohydrates, and lipids. If you omit committing these structures to memory in the beginning of the semester the course will become much more difficult later when proteins, enzymes, and metabolism are taught.

Professor Donald Doyle (Spring 2006) did not assign homework (a welcome for those who made it through Professor Marcus Weck's Chem 1315.) Also, his tests were of reasonable difficulty and had multiple choice, fill in the blank, short answer, and drawing of structures like most chemistry classes. Dr. Doyle also gave quizzes on structures, which help to boost your grade towards the end of the semester.

MSE 2001 Principles and Applications of Engineering Materials

3 hours

MSE 2001 is a class all by itself. There are no classes leading up to it and no required classes directly using the concepts taught in the class (the BME Elective class Intro to Biomaterials, however, does build upon it). The course covers the structure of engineering materials and the physical consequences of microstructures. Other concepts discussed are the processing of materials and the selection of a material.

The class requires a lot of reading and understanding of visual trends and diagrams. This is one of the few engineering classes where calculations are not as important as predicting trends and demonstrating your understanding of the materials. It is a lot of reading, but the basic concepts of the class are many but simple.

ECE 2025 Introduction to Digital Signal Processing

ECE 2025 is an introduction to Digital Signal Processing. Signal Processing is an important cornerstone of Biomedical Engineering; most electrical circuits used by biomedical engineers involve analog circuitry to "interface" with the real world. These analog signals collected must be processed for information by digital signal processing techniques.

The course begins with methods of representing sinusoidal signals. Understanding the basics of complex amplitudes and basic arithmetic operations of complex numbers is vital to doing well in the rest of the course. Afterwards, the digital processing of these analog inputs is introduced. In this section of the course, Analog/Digital conversion filtering, aliasing, Convolutions and Fourier analysis are studied. Many of these methods will be useful in the class following ECE 2025, Sensors and Instrumentation (BME 3500).

Homework and Lab Reports are usually assigned every week. Both of these can be very time-consuming. However, putting in the effort to understand the homework and labs each week goes a long way towards understanding how to apply Signal Processing to real world problems.

Lastly, ECE 2025 tests have historically been easy until the final and it is a well-known fact that ECE 2025 is much easier during the summer. Both the labs and homework are usually shorter during the summer term.

ECE 3710 Circuits and Electronics

2 hours

An extension to the Circuits component of Physics II, Circuits and Electronics introduces and analyzes the use of electronic components such as resistors, capacitors, inductors, diodes and op-amps. RC, filtering circuits and new methods of circuit analysis such as Thevenin and Norton circuits, Node Voltage Analysis and Mesh Current Analysis are discussed as well.

The circuit analysis skills learned in ECE 3710 are useful later in BMED 3500 Sensors and Instrumentation, which applies the electrical engineering concepts to the body.

The structure and difficulty of the class varies with the teacher teaching the course.

ECE 3741 Circuits Lab

1 hour

ECE 3741 is the lab for ECE 3710. The lab notebook (which, at times, can be fairly confusing) is your guide to setting up circuits that demonstrate concepts taught in ECE 3710. Grading is relatively easy and the labs sometimes don't last the full 3 hours.

The class covers Op-Amps, filters and other analog circuitry and then moves into digital circuits later. Both types are especially useful for BME 3500, Sensors and Instrumentation. You may not understand what is going on while you are doing the labs, but the lab notebook can be useful as a reference in later classes.

CEE/MATH/ISYE 3770 Probability and Statistics

3 hours

This class is offered by the Math, Civil and Industrial Engineering departments. Industrial Engineering has historically offered the course most relevant to engineering students (you are welcome to choose to take the course from any of the three departments)

The class teaches calculations of probability of outcomes and statistics of both estimations of probability distributions and sample data sets. Teachers often have a lot of liberty in how they teach service classes such as these, so your experience in this class may differ from someone else. The class can be taught either very hard or very easy depending on the professor.

Many of the topics covered in the class are not explicitly useful in any other of the BMED courses. However, understanding your data and being able to find significance beyond mean, median and mode can go a long way in your lab reports in other classes.

COE 2001 Statics

2 hours

COE 2001 covers the analysis of forces in static equilibrium. A prerequisite to BMED 3400 (Intro to Biomechanics), this class gives a basic understanding of interacting forces in trusses, machines, frames, etc.

The structure and difficulty of the class varies with the teacher that teaches the course. However, tests usually consist of either one or two long and intricate problems that require critical problem solving skills.