

UNOFFICIAL COURSE GUIDE

bmedSAB

2012-2013



**bmedSAB**  
Biomedical Engineering Student Advisory Board

**THE WALLACE H. COULTER DEPARTMENT OF BIOMEDICAL ENGINEERING**

# Letter From the Board

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 2011-2012 and 2012-2013 school years. The tips and comments are written by BME undergraduates who have recently taken the course. All course GPAs were calculated using SGA's website at <http://www.sga.gatech.edu/critique/>. Please see updated course grade averages there. Please contact your bmedSAB representatives with any questions you may have regarding this publication or BME courses.

Tyler Mitchell  
2012-2013 Chair, Biomedical Engineering Student Advisory Board

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## BMED 1000: Introduction to Biomedical Engineering

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**Prerequisites:** None

**Credit Hours:** 1

**Average GPA:** S

This course is centered around a group project, where teams of 6 students will identify a company and employee who serves in the role of a biomedical engineer. The goal is for students to gain a better insight into what a biomedical engineer does in real life.

Presentations will be given by professors, alumni, current students, and others to tell you about the opportunities available for biomedical engineers. These opportunities range from med school and research to co-ops/internships and career paths. The idea is that you will be exposed to the paths available as well as the vast resources you have at Tech and you will be able to use it during your time here.

**THE Tip:** Come to class. Attendance is mandatory and you need a PRS (a handheld computerized clicker that allows students to send in answers and attendance electronically). No laptops in class, so don't try.

**Recall:** Why did you come to Tech and choose BME in the first place?

**Spend your time...** While there is no significant work outside of class, spend your time thinking about what you would like to do with BME and how you can take advantages of the resources available.

**Take Home:** The CITI training comes in handy for 1300. This class is a chance for you to see what careers and experiences you can have with BME, so take the lessons with you as you work your way through undergrad.

## BMED 1300: Problems in BME I

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**Prerequisite:** BMED 1000

**Credit Hours:** 3

**Average GPA:** 3.31

The class is divided into groups (~8 people) with a faculty member as a facilitator and given three complex, interdisciplinary problems to solve throughout the semester. Your team researches, arrives at a solution, presents the proposed solution to several other groups, and then collaboratively writes a technical report all with limited guidance from you facilitator.

**THE Tip:** Be proactive, be organized, speak up, and take responsibility

**Recall:** Literature review skills (skim, scan, summarize)

**Spend your time...** meeting with your team (in and out of class) and researching independently. It helps to read articles and then summarize them; make copies of your summaries for your teammates so the meetings can go more effectively and efficiently (as they will have something to refer to when you speak). Tackle the problems as a team; this means speak up, listen attentively and give feedback, take responsibility, engage and encourage your teammates and be prepared to work hard. Communicate with your facilitator – is the team where it needs to be? What are some future improvements? What can you, as a member of the team, do better?

**Take Home:** The team building, communication, and literature review skills come in handy in future BME courses and are a great starting point for knowing what direction you want to take with BME (research & development, statistical analysis, programming, management, etc).

## BMED 2210: Conservation Principles in BME

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**Prerequisites:** BMED 1300 and CHEM 1211 and PHYS 2211

**Credit Hours:** 4

**Average GPA:** 2.47

Everything becomes a system requiring a specific process of establishing assumptions, setting up equations, and less importantly, solving towards an answer. Teaching and grading styles differ vastly from professor to professor, so do your research when registering for this class.

**THE tip:** Don't look at the answers and convince yourself you could solve it on your own. You can't ride through this class. Work lots of practice problems before each exam and be prepared to work quickly. Test grading has a lot to do with how you approached the problem, so take the time to write down everything.

**Recall:** Chemistry

**Spend your time...** working lots of problems. Don't just "accept" the given answer if you get stuck; find someone to explain it to you. Work to learn how to assess and approach each problem. Some tests seem like a time crunch, so it's important you can decide how to approach each problem quickly. Go to office hours if they're offered or work lots of problems with friends to study for tests.

**Take Home:** Great problem solving skills and problems from group work and general understanding of chemical engineering.

## BMED 2300: Problems in BME II

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**Prerequisite:** BMED 1300

**Credit Hours:** 3

**Average GPA:** 3.29

This is a team project based class using reverse engineering, user-in-mind design, and SolidWorks. The weekly lecture is interesting, but mostly helpful for the exams. The projects require time management and assigning jobs based on each group member's strengths.

**THE tip:** Start writing sections of the report as soon as you start the project. Talk to your TA outside of class so that she/he knows you're putting forth the effort.

**Recall:** BMED 1300 team skills and literature review

**Spend your time...** focusing on the rubrics and learning and refining SolidWorks skills for class, work, and resume. Keep your notebook updated... the notebook checks are unannounced.

**Take Home:** SolidWorks skills and a background on the design iteration process

## BMED 2400: Biostatistics

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**Prerequisites:** MATH 1501 and CS 1371

**Credit Hours:** 3

**Average GPA:** 3.10

This course covers statistical concepts that range from simple mean, median, mode to more complex topics such as ANOVA (Analysis of Variances), ANCOVA, and Bayesian statistics. There are about 6 homework assignments, two tests, and a project. If you already know statistics from high school, it will help with the concepts in this class. Do your homework and work out problems from old tests/textbook, read the course textbook, do not get overwhelmed by complex proofs/theorems – make sure you understand the underlying concept and application of each topic.

**THE tip:** If you do not understand statistics, find someone who does! For the homework, find similar problems on the online text and use them as templates. Use MATLAB for everything you can, it can do all sorts of statistics, and it doesn't ever mess up. Save your homework files for open note exams.

**Recall:** CS 1371, High school Statistics, MATLAB

**Spend your time...** by attending class (attendance is recorded), taking notes, & doing homework regularly. Find a good study partner, and DO NOT cram for your tests – start ahead of time.

Learn from friends. Spend class time working on homework and figuring out MATLAB.

**Take Home:** This is an extremely useful class as you will extensively reuse topics learned in this course for future courses such in BMED 3110 and doing scientific data analysis in the future.

## BMED 3100: Systems Physiology

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**Prerequisite:** CHEM 1315 OR 2311 OR Junior Standing

**Credit Hours:** 3

**Average GPA:** 2.71

This class goes through the different systems (circulatory, digestive, etc) of the body. Towards the end, you are expected to integrate your knowledge of the different systems to explain the causes of different pathologies and suggest treatments.

**THE Tip:** Be a self-learner and go the extra mile to learn the material. Don't memorize facts; understand the reasons behind any action. Keep up with reading the text.

**Recall:** Biology

**Spend your time...** reading the book and use outside sources to figure out how and why systems work together.

## BMED 3110: Quantitative Engineering & Physics Lab I

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**Prerequisites:** BMED 3400 and 3100 and (BMED 2400 or CEE/ISYE/MATH 3770)

**Credit Hours:** 2

**Average GPA:** 3.08

You complete experiments using given information that's incomplete with sometimes faulty equipment. You write stringently graded technical reports. This class will give you the opportunity to learn how to problem-solve, work with a team, and write wonderful reports.

**THE tip:** Decide on team members and register for the same class. This is a time-consuming class, plan your classes accordingly.

**Recall:** DSP, statistics

**Spend your time...** in lab. You will regularly have to complete experiments outside of scheduled lab times (prior to the first lab you are to have an "after-hours access" application filled out).

## BMED 3300: Biotransport

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**Prerequisites:** BMED 2210 and MATH 2403

**Credit Hours:** 4

**Average GPA:** 3.00

Biotransport is movement of mass, fluid or heat as driven by gradients in physical systems. The focus is on biomedical applications of transport - hence the title Biotransport. Fluid dynamics is one part of what we study here and blood vessel flow is the perfect example of this for them. But the mass transfer area is important in areas such as drug delivery and nutrient delivery to tissue engineered constructs. Heat transfer is important in areas such as cryoprotection of tissues. You must apply fluid dynamics principles to solve problems concerning drug delivery, blood vessel transport, etc.

**The tip:** There are only a few variations to the problems, learn them.

**Recall:** Differential Equations

**Spend your time...** doing all the problems you can get your hands on, including homework, samples from lecture, and recitation. Understand all of the problems and approaches very well.

**Take Home:** Understanding of fluid dynamic problems as they relate to bodily functions.

## BMED 3400: Introduction to Biomechanics

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**Prerequisites:** MATH 2403 and COE 2001

**Credit Hours:** 4

**Average GPA:** 2.90

This course is based on statics and dynamics. The problems in the course are not that difficult and have very common themes, so work out the homework and understand the few key concepts.

**THE tip:** Pay attention in class and go to recitation – it is really easy to get behind and miss out on an important concept. It's important to solve the problems like your professors want (first draw free body diagrams, sum the forces, find continuous regions over material, "cut" intersection to analyze internal forces, etc).

**Recall:** Statics – half this class is being competent in statics

**Spend your time...** working on problems from homework and class and working practice tests.

**Take Home:** Better understanding of modeling the body for biomechanics problems necessary for designing biomedical devices and implants.

## BMED 3510: Biomedical Systems and Modeling

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**Prerequisites:** PHYS 2212 and MATH 2403 and BMED 3100

**Credit Hours:** 4

**Average GPA:** 3.02

This course is different from many courses that are offered. There is a lecture section and a studio section. In lecture, you learn about the concept and the math that is behind modeling a system, mainly differential equations. In studio the class is divided into groups of 4 and you use those concepts and math to actually model systems. Simulink is used to model the more complicated systems.

**THE Tip:** Go to class and take notes. Ask questions. The better you understand the concept, the easier the studio section is.

**Recall:** DSP and differential equations, Laplace transforms

**Spend your time...** Working on the studio section and reviewing your notes

**Take Home:** The modeling concepts and how general or specific your model needs to be.

## BMED 3600: Physiology of Cellular & Molecular Systems

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**Prerequisites:** BMED 3100

**Credit Hours:** 3

**Average GPA:** 2.78

This class teaches you basic mammalian cell anatomy and cellular level mechanisms. A few of the topics covered in this class include transcription/translation, cell growth and death, structure and function of cell membranes, cytoskeleton, and extra-cellular matrix.

**THE tip:** Test material comes nearly 100% from lecture, so you don't have to read all of the textbook pages assigned, just read what you don't know or understand. Don't wait until the night before to review the journal articles and finish your group papers, (the teacher can tell and your grade will suffer). Keep up with the content covered in class – attend lectures and make sure do most of the learning in class. Work on your writing skills; you will be expected to write research proposals and weekly paper reviews. Hone your group working skills – a positive, hard-working, meticulous, and cooperative attitude will take you a long way.

**Recall:** BMED 1300, Biology

**Spend your time...** reviewing lecture slides for the tests and finding sources for the two group projects.

**Take Home:** Important cell biology concepts (of course); writing grants; reading, reviewing, critiquing papers and capturing only what's necessary in them.

## BMED 3610: Quantitative Engineering Physiology Lab II

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**Prerequisites:** BMED 2300 and 3300 and 3110 and 3600

**Credit Hours:** 2

**Average GPA:** 3.31

This course is the second of the two lab classes that are required for all BMEs. Class is divided into groups of 3-4 in a lab of about 20-30 people. The team is given several problems to solve throughout the semester, each of which contains a scientific component and an engineering component. This is one of the most critical courses for those wishing to enter the industry as it gives hands on engineering experience.

**THE Tip:** Make sure that your group is composed of people you want to work with (A LOT) and make sure that their schedules match yours enough to put in the lab time.

**Recall:** Problem solving skills... BMED 2300 provides good experience for this type of thinking.

**Spend your time...** in the lab, in the lab, in the lab...

**Take Home:** This class teaches problem solving which can be applied to most classes, but is especially useful from an engineering standpoint and those interested in a career in industry.

## BMED 4602: Senior Design Project I

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**Prerequisites:** BMED 3610 and 2300

**Credit Hours:** 2

**Average GPA:** 3.40

This class involves picking a project idea and mentor in the first week and then spending the semester designing the project. The course focuses on engineering design specifications, initial prior art, design concepts and a plan of action for 4601. This course serves as the planning and initial design stage for a complete biomedical design project. You'll work in groups of 3-4 students and have a project adviser. You will develop a project plan and, eventually, a design for a device that fills a need in the biomedical industry. You will write several papers outlining your objectives, needs, and plans.

**THE tip:** Find motivated teammates prior to the beginning of the class who have similar interests, but different skill sets and points of view so that you can find a project you are all passionate about.

**Recall:** EVERYTHING! Technical instruction is minimal; classroom-based instruction is focused on the real-world, professional aspects of project development most students are unfamiliar with.

**Spend your time...** talking with your mentor about ideas and formulating realistic plans for the next semester. Do not waste time during group meetings. Meet 2-3 hours a week with your group and work on the next assignment. Planning and working closely with your team to define and develop goals now will REALLY help during 4601.

**Take Home:** This class gives a great idea of team work, the design iteration process, and a glimpse at what industry might be like for you... it also lays the necessary foundation for work in 4601.

## BMED 4603: Senior Design Project II

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**Prerequisites:** BMED 4602

**Credit Hours:** 3

**Average GPA:** 3.29

This course is the second half of the project began in 4600. Each team will prototype the design, test it, and write a 510(k), among others things. At the end of the course, you will present a functional prototype to your classmates, instructors, advisors, and maybe even potential future instructors!

**THE tip:** Make a cardboard model and order what you need at the end of 4600. Prepare for group meetings. Make a Gantt chart for the components of the design to ensure everything gets finished.

**Recall:** 4600, BMED 2300, BMED 3110, and any other relevant course that pertains to your design

**Spend your time...** prototyping! The more iteration you do, the better your design becomes. Also, write everything in your lab notebook. If something bad happens (ie your prototype doesn't work, your team stops working), you have proof of what you did, and will hopefully earn a higher grade. Talking through complications during the prototyping phase is a must. The dry-erase walls and the senior design lab will be your favorite places in the building.

**Take Home:** A great background on product design and development and some great contacts with other group members and advisors.

## BMED 4400: Neuroengineering Fundamentals

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**Prerequisites:** BMED 3110 and 4752

**Credit Hours:** 2 hours lecture, 6 in lab

**Average GPA:** 3.0

This is a unique lab+lecture course that allows you to enhance your problem-based learning (PBL) skills by designing your own cutting-edge experiments with advanced ideas and equipment identical to those used in the Laboratory for Neuroengineering and elsewhere at Georgia Tech. Emphasis will be on teamwork, thinking, and self-directed inquiry. You will learn all about where brain tissue and technology meet. The course is designed to give you skills useful in the Real World.

**THE tip:** Start on your project early and plan on putting a good deal of time/effort into it. Don't underestimate the data analysis required for your project; it is just as important as the experiment. Ask for help early and often.

**Recall:** Intro Neuro topics and basic circuits

**Spend your time...** In Class... take awesome, detailed notes. Don't be fooled into thinking the powerpoint is enough to study from. If you review your notes and readings, the test doesn't have to be stressful. Out of Class ...Keep up with your notebook, seriously. Get the kinks worked out of your experiment early. And don't forget the quizzes!

**Take Home:** Great experience taking a problem from conception to conclusion. Also a good introduction to the amazing technologies used in neuroscience.

## BMED 4500: Cell & Tissue Engineering Lab

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**Prerequisites:** BMED 3610

**Credit Hours:** 2

**Average GPA:** 3.56 \*2008

The principles of cell and tissue engineering will be presented in a hands-on laboratory experience. Cell engineering topics include receptor/ligand interactions, cell cycle/metabolism, cell adhesion, cellular mechanics, cell signal transduction, and cell transfection. Tissue engineering topics include applications, biomaterials/scaffolds and cells for reparative medicine, bioreactors and bioprocessing, functional assessment, and in vivo issues. It's a 6 hour lab component, and you can finish everything in lab if you come prepared, but you may be surprised to spend a few hours outside of class for some labs.

**THE tip:**

**Recall:**

**Spend your time...**

**Take Home:**

## BMED 4750: Diagnostic Imaging Physics

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**Prerequisites:** BMED 3110

**Credit Hours:** 3

**Average GPA:** 2.63

Physics and image formation methods for conventional X-ray, digital X-ray CT, nuclear medicine, and magnetic resonance and ultrasound imaging.

**THE tip:** Attend every class and study the lectures and assignments. Ask lots of questions to the professor and other students about the class material you don't understand.

**Recall:** Everything in this class was based on general knowledge regarding physics and image formation methods for conventional imaging systems.

**Spend your time...** studying lecture notes and assignments and asking questions.

**Take Home:** If you're interested in the field of medical imaging, this class will help you gain basic knowledge about the various imaging systems. It's also good for premed students to learn.

## BMED 4751: Introduction to Biomaterials

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**Prerequisites:** MSE 2001

**Credit Hours:** 3

**Average GPA:** 2.71

Introduction to different classes of biomaterials (polymers, metals, ceramics) and physiological responses to biomaterial implantation. Topics include material properties, host response, and biomaterial characterization techniques. This class focuses on memorizing facts and graphs about different materials used in the body for engineering and healthcare purposes. Dr. Milam hand writes her notes on the board and erases them after a while, making prompt class attendance very important. Exam format is free response (short answer) very similar to the format seen in MSE 2001.

**THE tip:** Memorization, memorization, memorization. Attend class every day, take notes extensively and diligently, ask questions at review sessions prior to exams. Reading the book is not as helpful as lecture notes from class.

**Recall:** MSE 2001

**Spend your time:** Working on group projects and memorizing your class notes.

**Take Home:** This class is critical for anyone planning to work in the medical device industry. Understanding the clinical impact of the materials you select is extremely important.

## BMED 4752: Introduction to Neuroscience

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**Prerequisites:** BMED 3600 or BIOL 3340

**Credit Hours:** 3

**Average GPA:** 2.96

Dr. Potter tells you up front that “introduction” does not mean “easy”. A lot of material is encompassed, including motor and visual systems, memory, and even sex and dreams. Dr. Potter assumes that you are very motivated as this is an elective you chose to take. He assigns projects and presents copious amounts of materials in accordance with this assumption.

**THE tip:** You can find tons of neuro-related video lectures online to write 1 page reports. Each counts for one extra credit point

**Recall:** psychology, electrophysiology, ionic channels (although this course is not heavily chemistry-based)

**Spend your time...** working on the various long-term projects, such as your wikipedia article and amazon book review.

**Take Home:** background and understanding of neuroscience and the brain

## BMED/ME 4757: Biofluid Mechanics

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**Prerequisites:** BMED 3300

**Credit Hours:** 3

**Average GPA:** 3.20

Introduction to the study of blood flow in the cardiovascular system. Emphasis on modeling and the potential of flow studies for clinical research application. Become well versed in heart physiology and flow and attempts to current technology to improve weak or diseased hearts/vessels. Class format was loose and Dr. Y often relegates lectures to the TAs, so be prepared to handle last minute changes in organizations and assignments.

**THE tip:** Attend recitation and lecture. Read the text and similar texts. Learn heart anatomy and blood flow early on... it will help you picture everything from the start.

**Recall:** Fluids, calculus, and physiology

**Spend your time...** Review lecture notes, heart anatomy, and reading the text. Start early on the final project

**Take Home:** Knowledge on the cardiovascular system... great for premeds and those interested in medical device industry.

## BMED 4758: Biosolid Mechanics

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**Prerequisites:** BMED 3400

**Credit Hours:** 3

**Average GPA:** 2.99

The mechanics of living tissue, e.g., arteries, skin, heart muscle, ligament, tendon, cartilage, and bone. Constitutive equations and some simple mechanical models. Mechanics of cells.

**THE tip:** Take good, legible, and organized notes in class. Do the homework assignments carefully. When studying for the exam, try redoing the homework problems and in-class examples.

**Recall:** BMED 3400 and matrix algebra

**Spend your time...** Doing problems and in-class examples

**Take Home:** What viscoelasticity is and how to approach analyzing the mechanical properties of soft tissues (both experimentally and analytically).

## BMED 4765: Drug Design Development & Delivery

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**Prerequisites:** CHEM 3511 or 4511

**Credit Hours:** 3

**Average GPA:** 3.05

Introduction to the pharmaceutical development process, including design of new drugs, synthesis and manufacturing issues, and methods for delivery into the body. There are 5-6 homeworks, a few exams, and a final presentation on a drug design/development/delivery system assigned to you.

**THE tip:** Success is highly dependent on the final exam which is solely based on the presentation section by the student projects at the end of the semester. The homeworks and exams are not too tricky and are written so that if you pay enough attention in class you should ace them.

**Recall:** Biochemistry

**Spend your time:** Reviewing lecture notes & working on the final presentations

**Take Home:** You learn a lot about the pharmaceutical industry and the professors, there is a spring break trip to Puerto Rico to visit Pharma plants... a huge asset for job searches because of the networking. HIGHLY recommend interacting with the professors and attending the Puerto Rico trip.

## BMED 4781: Bioinstrumentation

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**Prerequisites:** ECE 3710 or 3040

**Credit Hours:** 3

**Average GPA:** 3.30

A survey of the types of instruments used to measure and record biological signals from the brain, heart, skeletal muscles, and eye. Instruments range from simple impedance electrodes to EEGs and MRIs. In Dr. Benkeser's class, there are 3-4 low-key group projects.

**THE tip:** Practice measuring biological systems in the projects.

**Recall:** electrophysiology, biology, BMED 3110

**Spend your time:** Working on group projects

**Take Home:** Fundamentals of instrumentation necessary to intersect machinery and the human body. Hands-on knowledge of basic measuring of biological signals.

## BMED 4783: Introduction to Medical Image Processing

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**Prerequisites:** ECE 2025 and (MATH 3770 or ISYE 3770 or CEE 3770 or BMED 2400)

**Credit Hours:** 3

**Average GPA:** 2.53

A study of mathematical methods used in medical image acquisition and processing. Concepts, algorithms, and methods associated with acquisition, processing, and display of two- and three-dimensional medical images are studied. Learn tips and tricks for manipulating images with a focus on MRI and CAT scan data. With Dr. Skrinjar the format was theoretical homework every week with an associated MATLAB assignment.

**THE tip:** Pay heavy attention & take great notes. Tests come from problems he works during class.

**Recall:** CS 1371 and DSP

**Spend your time:** Reviewing problems from class

**Take Home:** general computer programming skills, refresh & solidify DSP, & a great prep for 3510.

## BMED 4784: Engineering Electrophysiology

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**Prerequisites:** ECE 3040 or BMED 3510

**Credit Hours:** 3

**Average GPA:** 3.50

Basic concepts of electrophysiology from an engineering perspective. Students learn the function of relevant organs and systems and the instrumentation tools which monitor electrophysiological function.

**THE tip:** Take good notes, and do the homework. Test material is based on what is taught in lecture.

**Recall:** ECE 2025, ECE 3740, and ECE 3741

**Spend your time...** Working homework problems.

**Take Home:** a good foundation in cardiology and a tie in biological & electrical aspects.