UNIVERSITY OF CALIFORNIA, IRVINE
DEPARTMENT OF BIOMEDICAL ENGINEERING

UNDERGRADUATE STUDENT HANDBOOK
2004

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BIOMEDICAL ENGINEERING

Biomedical engineering (BME) combines engineering expertise with medical needs for the enhancement of health care. It is a branch of engineering in which knowledge and skills are developed and applied to define and solve problems in biology and medicine. Students choose the biomedical engineering field to be of service to people, for the excitement of working with living systems, and to apply advanced technology to the complex problems of medical care. Biomedical engineers may be called upon to design instruments and devices, to bring together knowledge from many sources to develop new procedures, or to carry out research to acquire knowledge needed to solve new problems.

During the last 20 years, we have witnessed unprecedented advances in engineering, medical care, and the life sciences. The combination of exploding knowledge and technology in biology, medicine, the physical sciences, and engineering, coupled with the changes in the way health care will be delivered in the next century, provide a fertile ground for biomedical engineering. Biomedical engineering, at the confluence of these fields, has played a vital role in this progress. Traditionally, engineers have been concerned with inanimate materials, devices, and systems, while life scientists have investigated biological structure and function. Biomedical engineers integrate these disciplines in a unique way, combining the methodologies of the physical sciences and engineering with the study of biological and medical problems. The collaboration between engineers, physicians, biologists, and physical scientists is an integral part of this endeavor and has produced many important discoveries in the areas of artificial organs, artificial implants, and diagnostic equipment.

UCI BME DEPARTMENT FOCUS

The research focus areas of the BME Department capitalize on existing strengths within the Henry Samueli School of Engineering, the College of Medicine, the School of Biological Sciences, the School of Physical Sciences, and the Department of Information and Computer Science. Those areas include: (1) biophotonics, (2) biomedical nanoscale systems, (3) biomedical computational technologies, and (4) tissue engineering.

Biophotonics

Biophotonics involves the development and use of optical technologies to examine and manipulate biological systems on the sub-cellular, cellular, tissue and organ levels. The properties of photons and the systems that generate, deliver, and detect them will be the basis for much of the diagnostic, analytical, and therapeutic systems of the 21st century. The ability to design, build and miniaturize non- and minimally-invasive systems will require a concerted interdisciplinary effort.

The biomedical engineering efforts will be focused on the research and development necessary to: (1) produce the next generation of photonics-based medical devices, and (2) train biomedical engineers capable of spearheading such efforts. These efforts are divided into three general core areas defined by photophysical mechanisms of light interaction with biological cells and tissues: (1) high-intensity interactions, (2) coherent interactions, and (3) diffuse interactions.

Biomedical Nanoscale Systems

Much as microfabrication techniques have revolutionized the electronics industry, these same techniques are now poised to revolutionize the biotechnology and biomedical device industries. Photolithography, etching techniques, and deposition methods can create large numbers of microscopic features on silicon or glass substrates with areas of $<2\ cm^2$. Among these features are reaction chambers, separation channels, arrays of molecules, microelectronics, pumps, valves, and many other components. These features can be combined to create fully integrated devices that perform sample preparation, separation, detection and/or analysis, as well as drug delivery and in-situ mechanical sensors. The benefits of these integrated, miniaturized systems are their high-throughput screening capabilities, smaller required volumes of samples and reagents, and potential for automation with a consequent increase in reliability and decrease in costs.

The existing research strengths at UCI in genomics, cancer research, and protein technologies will be combined with those in MEMS (Micro-Electro-Mechanical Systems), microelectronics, and microelectrophoresis to develop new microdevices for biomedicine. Nanoscale technologies such as “lab-on-a-chip” devices, DNA array chips, chromosome microdissection/micromanipulation, and protein microanalysis techniques will be key technologies in the next century of biomedicine.

Biomedical Computational Technologies

Biomedical computation in biomedical engineering will consist of three components: (1) image processing and pattern analysis, (2) data and knowledge base management, and (3) high-speed distributed computing of large data sets. These components will interact with one another while providing the enabling technologies for the analysis and utilization of the data produced by biomedical applications. Much of the data generated by biomedical systems appears in the form of signals (symbolic strings and waveforms), images, and, in general, arrays of vectors.

Part of the research effort required by biophotonics and nanoscale systems is in the area of computational models for the physical processes that generate the data. Research at UCI on computational models includes methods based on cubic and generalized spline approximation. Complementing the research on computational models for data generation is the UCI focus on pattern analysis. The objective is to develop application-specific algorithms for capturing and interpreting various complex patterns in the data.

Most biocomputational methods need to access and analyze large amounts of data. The data and information generated by such methods need to be tracked as time evolves. The nature of such scientific data/information demands the use of a powerful and intelligent database management system. Areas of current and future investigation include advanced data modeling, knowledge management, data mining, query optimization, and parallel/distributed processing of transactions.

Tissue Engineering

The term *tissue engineering* was officially coined at a National Science Foundation workshop in 1988 to mean “the application of principles and methods of engineering and life sciences toward fundamental understanding of structure-function relationships in normal and pathological mammalian tissues and the development of biological substitutes to restore, maintain or improve tissue function.” Tissue engineering draws on experts from chemical engineering, materials science, surgery, genetics, and related

disciplines from engineering and the life sciences.

Much of the current research in the field involves growing cells in three-dimensional structures instead of in laboratory dishes. For the most part, cells grown in a flat dish tend to behave as individual cells. But grown a cell culture in a three-dimensional structure, the cells begin to behave as they would in a tissue or organ. Tissue engineers are testing different methods of growing tissue and organ cells in three-dimensional scaffolds that dissolve once the cells reach a certain mass. The hope is that these cell cultures will mature into fully functional tissues and organs

UNDERGRADUATE PROGRAM

At the undergraduate level, the department offers a four-year engineering curriculum leading to a B.S. in Biomedical Engineering (BME), which prepares students for a wide variety of careers in biomedical engineering; including, industry, hospitals, research laboratories, or for further education in graduate school.

Also available is a four-year engineering curriculum which, together with required premedical courses, leads to the B.S. degree in Biomedical Engineering: Premedical. It is one of many majors that can serve as preparation for further training in medical, veterinary, or allied health professions. It is also suitable for students interested in pursuing graduate work in biomedical engineering and other biomedical areas such as physiology, neurosciences, and bioinformatics. The curriculum has less engineering content but more biological sciences than the Biomedical Engineering major.

Undergraduate Major in Biomedical Engineering

The program objective is to prepare students for careers in the biomedical industry or for further education in graduate school. Biomedical Engineering students learn engineering and principles of biology, physiology, chemistry and physics. They may go on to design devices to diagnose and treat disease, engineer tissues to repair wounds, develop cutting-edge genetic treatments, or create computer programs to understand how the human body works. The curriculum emphasizes education in the fundamentals of engineering sciences that form the common basis of all engineering subspecialties. Education with this emphasis is intended to provide students with a solid engineering foundation for a career in which engineering practice may change rapidly. In addition, elements of bioengineering design are incorporated at every level in the curriculum. This is accomplished by integration of laboratory experimentation, computer applications, and exposure to real bioengineering problems throughout the program. Students also work as teams in senior design project courses to solve multidisciplinary problems suggested by industrial and clinical practitioners.

Planning a Program of Study

The sample program of study chart shown is typical for the major in Biomedical Engineering. Students should keep in mind that this program is based upon a sequence of prerequisites, beginning with adequate preparation in high school mathematics, physics, and chemistry. Students who are not adequately prepared, or who wish to make changes in the sequence for other reasons, must have their program approved by their faculty advisor.

Biomedical Engineering majors must consult at least once every year with the academic counselors in the Student Affairs Office and with their faculty advisors.

Sample Program of Study — Biomedical Engineering

Year	Fall	Winter	Spring
Freshman	Math 2A (4) CHEM 1A (4) PHYS 7A, LA (5) Breadth (4)	Math 2B (4) CHEM 1B, LB (6) PHYS 7B, LB (5) BME 1 (3)	Math 2D (4) CHEM 1C, LC (6) PHYS 7D, LD (5)
Sophomore	Math 2J (4) PHYS 7E (4) CBEMS 40A (5) Breadth (4)	Math 3D (4) ECE 12 (4) BME 50A (4) Breadth (4)	BioSci 7 Math 2E (4) CEE 20 (4) BME 50B (4)
Junior	BME 110A (4) BME 120 (4) BME 130 (4) Breadth (4)	BME 110B (4) BME 121 (4) BME 140 (4) Breadth (4)	BME 111 (4) BME 150 (4) BioSci 194S (1) Breadth (4) Breadth (4)
Senior	BME 170 (4) BME 180A (4) Technical Elective (4) Breadth (4)	BME 180B (4) Technical Elective (4) Breadth (4) Breadth (4)	BME 160 (4) Technical Elective (4) Breadth (5)

Undergraduate Major in Biomedical Engineering: Premedical

The major program objective is to prepare students for medical school. The curriculum is designed to meet the requirements for admission to medical schools, but is also suitable for those planning to enter graduate school in biomedical engineering, physiology, biology, neurosciences, or related fields. It has less engineering content and more biological sciences than the accompanying Biomedical Engineering major. It is one of many majors that can serve as preparation for further training in medical, veterinary, or allied health professions.

The Biomedical Engineering: Premedical curriculum provides future physicians with a quantitative background in biomechanics, bioelectronics, and biotransport. Such a background is increasingly important because of the heavy utilization of biomedical technology in modern medical practice. The curriculum includes courses in the sciences that satisfy the requirements of most medical schools. The education experience is enriched through a design course where students work as teams to solve biomedical engineering problems inspired by the clinical arena at the UCI Medical Center.

Planning a Program of Study

The sample program of study chart shown is typical for the major in Biomedical Engineering Premedical. Students should keep in mind that this program is based upon a sequence of prerequisites, beginning with adequate preparation in high school mathematics,

physics, and chemistry. Students who are not adequately prepared, or who wish to make changes in the sequence for other reasons, must have their program approved by their faculty advisor. Biomedical Engineering Premedical majors must consult at least once every year with the academic counselors in the Student Affairs Office and with their faculty advisors.

Sample Program of Study — Biomedical Engineering: Premedical

Year	Fall	Winter	Spring
Freshman	Math 2A (4) CHEM 1A (4) PHYS 7A, LA (5) Breadth (4)	Math 2B (4) CHEM 1B, LB (6) PHYS 7B, LB (5) BME 1 (2)	Math 2D (4) CHEM 1C, 1LC (6) PHYS 7D, LD (5)
Sophomore	Math 2J (4) CHEM 51A,LA (6) PHYS 7E (4) Breadth (4)	Math 3D (4) CHEM 51B, 51LB (6) BME 50A (4) Breadth (4)	CHEM 51C (4) BME 50B (4) Breadth (4) Breadth (4)
Junior	BioSci 97 (4) BME 110A (4) BME 120 (4) BME 130 (4)	BioSci 98 (4) BME 110B (4) BME 121 (4) Technical Elective	BioSci 99 (4) BME 111 (4) BME 150 (4) Breadth (4)
Senior	BioSci 103 or 104 (4) Bio Sci 194S (1) Technical Elective Breadth (4)	Bio Sci 100L (4) Technical Elective Breadth (4) Breadth (4)	Bio Sci 111L (3) BME 160 (4) Breadth (4) Breadth (5)

Minor in Biomedical Engineering

The minor in Biomedical Engineering requires a total of nine courses — two advanced mathematics courses, five core Biomedical Engineering courses, and two Biomedical Engineering electives. Some of these courses may include prerequisites that may or may not be part of a student's course requirements for their major.

Private biomedical industry has indicated a keen interest in engineers that have a more traditional engineering degree (i.e. electrical engineering), but also possess some in-depth knowledge of biomedical systems. Hence, the minor in Biomedical Engineering is designed to provide a student with the introductory skills necessary to perform as an engineer in the biomedical arena.

Admissions: Students interested in the minor in Biomedical Engineering must apply through The Henry Samueli School of Engineering Student Affairs Office and must have a UCI cumulative GPA of 2.5 or higher.

NOTE: Students may not receive both a minor in Biomedical Engineering and a specialization in Biochemical Engineering within the Chemical Engineering major.

Requirements for the Minor in Biomedical Engineering

Mathematics Courses: Mathematics 2J, 3D.

Engineering Topics Courses: BME1, BME50A-B, BME120, BME121.

Technical Electives: Students select, with the approval of a faculty advisor, two technical elective courses: BME110A, BME110B, BME130, BME135 (same as Biological Sciences 130), BME136, BME140, BME160, BME199, CBEMS124, CBEMS126, CBEMS154, EECS179, EECS188.

COMMONLY ASKED QUESTIONS ABOUT BIOMEDICAL ENGINEERING

1. What does a Biomedical Engineer do?

Students who are interested in service-oriented careers in medicine and allied health care fields go on to further training. Students interested in research and development either enter the medical device industry or go on to further training in a specialty area.

2. If I do not get into Medical School, what can I do with my Biomedical Engineering Premedical degree?

Premedical Biomedical Engineering graduates who are not admitted to medical school find jobs in a variety of areas or go on to graduate school. As there are substantive differences in the two degrees, students are encouraged to select a compatible track as early as possible.

3. How do I get admitted to the Biomedical Engineering Department?

High school students wishing to enter the UCI Engineering program must have completed four years of mathematics and are advised to have completed one year each of physics and chemistry. That preparation, along with honors courses and advanced placement courses, is fundamental to success in the Engineering program and is vital to receiving first consideration for admittance to an Engineering major during periods of restricted enrollments. Special attention will also be given to applicants who have submitted their SAT I and three SAT II examination scores by mid-January. Applicants must apply for admission to a specific Engineering major.

4. How are transfer students admitted to the Biomedical Engineering Department?

Preference will be given to junior-level applicants with the highest grades overall, and who have satisfactorily completed the following required courses: one year of calculus, one year of engineering physics (with laboratory), one year of chemistry, and one additional approved course for the major.

Students are encouraged to complete as many of the lower-division degree requirements as possible prior to transfer. Students who enroll at UCI in need of completing lower division course work may find that it will take longer than two years to complete their degrees.

Contact Mr. Robert Cassidy [rmcassid@uci.edu, (949) 824-5480], Manager of the Undergraduate Student Affairs office for an advising appointment. This appointment will include completing a change of major form. The Undergraduate Student Affairs office is located in the Engineering and Computing Trailer (ECT 103). For further information, contact The Henry Samueli School of Engineering at (949) 824-4334.

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WELCOME FROM THE BMES SOCIETY

For the students by the students
provided by BMES

Welcome to the University of California at Irvine and more specifically to the Biomedical Engineering Program. Whether you are here for your Masters, your Ph.D. or just a good time, I am sure you will enjoy it all.

This handbook will probably answer most of your questions regarding your stay here at UCI. For the other questions you have, chances are Dee Pleasant can help you, Prof. William Tang the undergraduate advisor can help you, or we can help you. Below is a list of Answers, Tips, and Hints compiled by the current BME students that you will hopefully find helpful if not amusing. If you have any questions, please feel free to contact us at: bmesuci@yahoo.com

STUDENT ID

Find the student center, go to *UCItems*. There is no charge for your first ID, but if lost, there is a replacement fee.

UCINETID/EMAIL ACCOUNT

Go to the computer center in Engineering Gateway. There are several PC rooms on this basement level. Ask the attendant in there how to set up a new account, and they will direct you to line of computers on the wall that have detailed instructions on how to obtain an account. You can access your email via the web http://webmail.uci.edu, via telnet using pine, or set up a mail server to get your mail (Entourage, Mail, etc.)

PARKING

If you live off campus – Irvine is a commuter school and parking is a problem, learn to deal with it now. Note: get on campus housing if you can, apply for it now if you have not already. Parking permits can be purchased in bldg. 7, second floor. Get the annual pass instead of the quarter by quarter as it is a little cheaper, it was a lot cheaper before but they altered their prices this year to further gouge you. If you supply your employee ID number (which you can get from Irma after you fill out your W-4) and pay an some additional money you will have your own personal parking space on campus, and unofficially have access to any spot on campus labeled AR/Staff. Best bet is to buy the academic preferred for $450 and then summer separate for $99 for a total of $550. Otherwise you can pay $396 (student rate) for the whole year or $297 for just the academic year. As you can see an additional $150 makes a big difference when you are driving and looking for a spot daily.

If you live on campus – Did you know that you get PAID to live on campus? Go to bldg.7, second floor to the parking office to collect your UCI dollars for not bringing a car to campus. Even if you have a car in Verano or Palo Verde, UCI Parking will pay you about $90 a year. Simply say that you live on campus and would like to collect your UCI dollars. They will ask for your student ID and will pay you in $UCI. You can use your UCI dollars at the bookstore and at any of the eateries on campus. Remember to do this at the beginning of the quarter, as the parking office will not retrospectively refund you. The earlier you go the more you get.

DMV/DRIVERS LICENSE

Department of Motor Vehicles – If you are out of state / country, then part of getting residency requires that you get a driver's license. Even if you are not going to drive here for a while, get a drive license. Closest locations are 650 W 19th, CM – 73N to 55S, Right on 19th. It will be on your right in a couple of blocks or 23535 Moulton Pkway, Laguna Hills or 1330 E. 1st. St., Santa Ana. MAKE AN APPOINTMENT unless you want to wait 1– 2 hours. Go to `https://eg.dmv.ca.gov/foAppt/Welcome.jsp` for an appointment. Go to the DMV in Laguna Beach not the one in Costa Mesa (Costa Mesa is much more crowded, and people are not as friendly. It is rumored that the rate of behind the wheel failure is higher at Costa Mesa!). Those of you from abroad may drive a vehicle in CA for one year if you have the license from your country but you have to first clear a written test.

SOCIAL SECURITY

For international students, one of the first things you need is a social security number. Without it, you will not be able to do anything official, from filing payment records or registration. The nearest social security office is near the John Wayne Airport (5 minutes from campus). Ask Nishant.

GROCERY

For those on campus, there is an Albertsons on Campus Drive between Berkeley/Peltason and California directly across from Verano housing. There is a Trader Joes, also on Campus Drive in the mini mall between Bridge and Berkeley. You will also find a Post Office in this parking lot. Two Ralph's: Harvard & Main, University between Culver & 405.

For those of you who have a car or can hitch a ride and wish to save some money, there is a Persian store on Culver and Walnut by the name of Super Irvine. Fruits and vegetables are about 1/3rd of the price at Albertsons. Also you can find lots of exquisite food there.

Additionally, there are two less expensive supermarkets in Santa Ana called Crawfords Mercado and Super Saver (Owned by Albertsons), on the corner of Harbor and Fairview. It's a 20-minute drive depending on traffic but might be worth your while. Over here you also have the new Ikea (405 and Harbor, great to buy house accessories) and Walmart (right next to Crawfords Mercado).

BANK ACCOUNT

Most people open a bank account in Washington Mutual. It's very convenient. But if you think at some point you might need to lend money, open an account with the Credit Union. And if you have $1500 to put in an account for just a couple of days you might consider opening an account with Citibank (the nearest one is again near John Wayne). They have a promotion in which they are giving either $100 credit (promotion code: CC12), or a free Sony DVD player (promotion code: CC1D) for just opening an account and making two bill payments online, and this all free!

For convenience there is a row of ATMs near the student center with all of the major banks represented: Bank of America, Wells Fargo, Washington Mutual, and Credit Union.

HELPFUL HINTS

1. Learn to use *Matlab*. You will use it later and be glad that you know it.
2. Farmer's Market on Saturday morning (9 am to 1 pm) in the parking lot on the corner of Campus and Bridge. Fresh fruits, vegetables, and nuts. Crazy people too. At noon they have a free raffle, so if you show up around this time, get a raffle ticket and you might just get something for free. Even if you don't win anything, at the end of the raffle they hand out a $1 discount coupon on a purchase of $5 or more.
3. Get in your car or borrow a car and drive around. Irvine and the surrounding cities are minutes away and offer spectacular views, stores, meals, etc. Learn the area well as this is your new home for a while and you will need to know how to get around.
4. John Wayne International Airport is about 10 minutes away up Campus Drive. Right on MacArthur and the entrance will be on your left. If you fly to anywhere in the country, try to arrange to fly out of here. Airport Code is SNA if you are looking at flights on *Expedia* or *Travelocity*. LAX is about an hour from Irvine depending on how fast you drive.
5. Webpages are provided by AGS. Email root@ags.sga.uci.edu with your full name, UCInet ID, and your school/department affiliation. You will receive 10MB of space and instructions on how to upload your webpage. Your webpage will be: www.ags.uci.edu/~username
6. Utilize the Anteater Recreation Center (ARC). Remember to bring your ID or you will not be able to get in. Not only do they have a weight room, pool, and racquetball courts, but they also have roller hockey, basketball, tennis, badminton, and volleyball courts. Best is that you can check out equipment, including rock climbing shoes and harness, racquetball racquets,

etc. for free. The ARC also offers a variety of classes ranging from dance, yoga, spinning, martial arts, and massage.

7. Crystal Cove is a great place to go running, hiking or exploring. Located just south of Corona Del Mar, it offers a spectacular coastline, with decent cliffs. It has Restroom/showers every ¼ mile or so and is free if you get there before 7:00am, else it is $4-5/day.

8. Learn the Science Library and AntPac system. They offer tours at the beginning of the year. It is kind of slow but well worth your time.

9. Los Angeles (LA) is about an hour north, San Diego is about 1.25 hours south. Both have their perks.

10. Avoid the 5 freeway like the plaque if you are going any farther north than Beach Blvd. Be prepared to sit in so cal traffic, regardless of the time of day. Regarding traffic, avoid the 73N, 55N, or 405N between 4-5:30pm.

11. If you go to Huntington Beach, park on 6th street, which is the second street north of Main (the street that dead ends into the pier). You will find free parking on either side of the street. You can also park in the parking lots west of PCH at a charge of $5-8/car/day. Huntington is a great place for barbeques and bonfires. The Corona Del Mar beach is another good place for bbqs and fires.

12. Don't go south on the 73 south of Bison unless you have some spare change. 73 is a toll road south of Bison.

13. San Onofre State Beach has one of the best long board breaks in So Cal. South on the 405/5 past San Clemente. Exit Basilone, follow signs. $5 to get in. Drive down to Dogpatch (near the end). Wetsuits optional in the summer, full suits in winter.

14. Smile, it is the second best thing you can do with your lips.

15. Regarding health care: choose a primary care doctor and make an appointment to meet the physician and have a check up / physical. This way, you will already be in the system, know the procedures and where to go if and when you get sick or injured. That and your doctor will already have a baseline record on you.

16. The RiteAid on Culver is open 24 hours and has ice cream for .99 cents.

17. The IHOP near the airport is open 24 hours and is a quiet place to study.

18. The 6th floor of the science library is probably the best place to study. Close seconds are the graduate reading rooms on the 4th, 5th and 6th floors of the science library. Other study areas include the first floor of the main library.

HELPFUL WEBSITES

www.ags.uci.edu/~bmes
This is our student organization website, on which you will find much of this information, information about professors, organizations, links, etc.

http://www.bme.uci.edu/
Department Homepage: Good for general information regarding the department.

http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?otool=cdlotool
PubMed journal article search engine, you will use this whenever you do journal searches.

http://isi4.newisiknowledge.com/portal.cgi
Web of Science article search engine, same as above. Just another method that finds slightly different articles given the same search request.

http://www.lib.uci.edu/online/journals.html
University of California, Online journal database

http://www.srh.noaa.gov/data/forecasts/CAZ042.php?warncounty=CAC059&city=Irvine
Local weather and three day forecast. It is pretty much sunny and nice everyday, but does rain occasionally.

http://biomail.sourceforge.net/biomail/
A program that searches PubMed regularly and send the references of new papers on a particular subject directly to your e-mail.

BUYING STUFF

There are four huge shopping centers within minutes of UCI, all of which have a movie theatre, a number of restaurants and your usual (and unusual) department, book and novelty stores. Chances are if you are looking for something, your will find it at one of these locations. Go and check them out.

Fashion Island, Newport Beach (NB) – Take the Bison exit out of campus. Left on MacArthur. Fashion Island will be on your right after a couple lights, before you get to Pacific Coast Highway (PCH). If you hit PCH, go right and then take the Fashion Island entrance on your right.

South Coast Plaza, Irvine/Costa Mesa (CM) – Take Bison to 73 North. Exit Bear, go right at bottom of onramp and over the 405. Malls will be on your left and right. You can also take Campus east to Culver to 405 N, or Campus west, go right on Jamboree, and then 405 N. You will see the malls on your right and exits for them. – Sport Chalet, Best Buy, Linen n' Things, Barnes n Noble, Borders, to name a few.

Irvine Spectrum, Irvine – Take Campus east to Culver. Go left. Right on University, right on onto southbound 405. Exit Irvine Center Drive. Left at light at end of on ramp.
Spectrum will be on your right.

Tustin Market Place, Tustin – Take Campus west to Jamboree. Go right. Cross over 405 and 5. It will be on both sides once you cross over the 5.

RESTUARANTS

Taco Mesa, 19th CM, across from DMV – Incredible Mexican food
Cest si Bon, Riverside off PCH, NB – French deli with awesome sandwiches
Coyote Grill, Carlsbad. Delectable New Mexican food and live music nightly. South 405/5. Exit Carlsbad Village, go West. Go right after a couple streets and then make your first left. You will see it on the left hand corner.
Tacos & Co. – not sure of directions, but 50% off Tuesdays & Thursdays

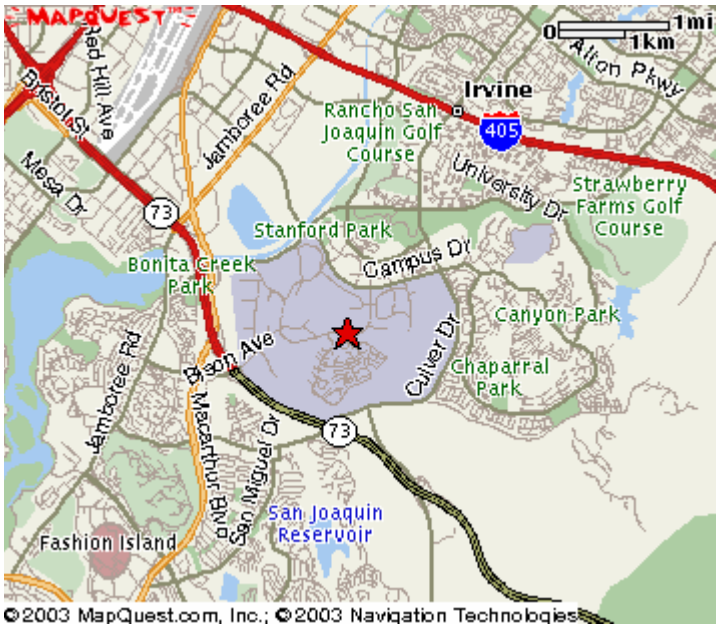
BARS

Pierce Street, Sharks Club, Detroit Bar, La Cava, CM
Dave & Busters, Yardhouse, Spectrum
Home Depot, 2300 S Harbor, CM, 73N-55S-right on 19th, right on Harbor, on your right after a couple of blocks. Lumber, tools, lights, etc.
Fry's Electronics, 73N-405N, Exit Euclid, Left on Euclid, Left on Kalama River, just after the 405N on ramp. Fry's will be on your left just before the curve 20in the road. If you can plug it in, they have it. Superstore for all of your new and spare parts.
Costco, 73N-405N, Exit Euclid, Left on Euclid, Right on Southpark. Bulk market with everything from rice to fruit to meat to tires to paper. Annual Fee is $45 and worth it if you buy stuff in bulk. They will print your digital pictures for $0.19.
REI, 1411 Village Way (McFadden Place) Santa Ana, 73N-55N, Exit McFadden, circle around up and over the bridge, left on Village Way, into the parking lot and then left. Awesome outdoor store if you are not already familiar with this place.
IKEA, 73N-405N, It will be on your left, you won't miss it, big blue bldg. Think the exit is Harbor.

GENERAL MAP OF THE AREA

Welcome to Irvine. To the southwest are the beach cities (south to north) Laguna Beach, Corona Del Mar, Newport Beach, Huntington Beach, Sunset Beach and then Long Beach. Just inland from Newport Beach is Costa Mesa. Due north is Santa Ana. Mission Viejo and Laguna Hills are south on the 405/5.

A bit closer look. The Star demarks campus. To leave campus you will either take Bison to the 73, Bison to MacArthur or Jamboree, Campus west to Jamboree, or Campus east to Culver to 405.



http://www.bmes.org/careers.asp

BMES *"To promote the increase of biomedical engineering knowledge and its utilization"*

"Planning a Career in Biomedical Engineering"

(Published in 1999 by the Biomedical Engineering Society)

What is a Biomedical Engineer?

A Biomedical Engineer uses traditional engineering expertise to analyze and solve problems in biology and medicine, providing an overall enhancement of health care. Students choose the biomedical engineering field to be of service to people, to partake of the excitement of working with living systems, and to apply advanced technology to the complex problems of medical care. The biomedical engineer works with other health care professionals including physicians, nurses, therapists and technicians. Biomedical engineers may be called upon in a wide range of capacities: to design instruments, devices, and software, to bring together knowledge from many technical sources to develop new procedures, or to conduct research needed to solve clinical problems.

What are Some of the Specialty Areas?

In this field there is continual change and creation of new areas due to rapid advancement in technology; however, some of the well established specialty areas within the field of biomedical engineering are: bioinstrumentation; biomaterials; biomechanics; cellular, tissue and genetic engineering; clinical engineering; medical imaging; orthopaedic surgery; rehabilitation engineering; and systems physiology.

Bioinstrumentation is the application of electronics and measurement techniques to develop devices used in diagnosis and treatment of disease. Computers are an essential part of bioinstrumentation, from the microprocessor in a single-purpose instrument used to do a variety of small tasks to the microcomputer needed to process the large amount of information in a medical imaging system.

Biomaterials include both living tissue and artificial materials used for implantation. Understanding the properties and behavior of living material is vital in the design of implant materials. The selection of an appropriate material to place in the human body may be one of the most difficult tasks faced by the biomedical engineer. Certain metal alloys, ceramics, polymers, and composites have been used as implantable materials. Biomaterials must be nontoxic, non-carcinogenic, chemically inert, stable, and mechanically strong enough to withstand the repeated forces of a lifetime. Newer biomaterials even incorporate living cells in order to provide a true biological and mechanical match for the living tissue.

Biomechanics applies classical mechanics (statics, dynamics, fluids, solids, thermodynamics, and continuum mechanics) to biological or medical problems. It includes the study of motion, material deformation, flow within the body and in devices, and transport of chemical constituents across biological and synthetic media and membranes. Progress in biomechanics has led to the development of the artificial heart and heart valves, artificial joint replacements, as well as a better understanding of the function of the heart and lung, blood vessels and capillaries, and bone, cartilage, intervertebral discs, ligaments and tendons of the musculoskeletal systems.

Cellular, Tissue and Genetic Engineering involve more recent attempts to attack biomedical problems at the microscopic level. These areas utilize the anatomy, biochemistry and mechanics of cellular and sub-cellular structures in order to understand disease processes and to be able to intervene at very specific sites. With these capabilities, miniature devices deliver compounds that can stimulate or inhibit cellular processes at precise target locations to promote healing or inhibit disease formation and progression.

Clinical Engineering is the application of technology to health care in hospitals. The clinical engineer is a member of the health care team along with physicians, nurses and other hospital staff. Clinical engineers are responsible for developing and maintaining computer databases of medical instrumentation and equipment records and for the purchase and use of sophisticated medical instruments. They may also work with physicians to adapt instrumentation to the specific needs of the physician and the hospital. This often involves the interface of instruments with computer systems and customized software for instrument control and data acquisition and analysis. Clinical engineers are involved with the application of the latest technology to health care.

Medical Imaging combines knowledge of a unique physical phenomenon (sound, radiation, magnetism, etc.) with high-speed electronic data processing, analysis and display to generate an image. Often, these images can be obtained with minimal or completely noninvasive procedures, making them less painful and more readily repeatable than invasive techniques.

Orthopaedic Bioengineering is the specialty where methods of engineering and computational mechanics have been applied for the understanding of the function of bones, joints and muscles, and for the design of artificial joint replacements. Orthopaedic bioengineers analyze the friction, lubrication and wear characteristics of natural and artificial joints; they perform stress analysis of the musculoskeletal system; and they develop artificial biomaterials (biologic and synthetic) for replacement of bones, cartilages, ligaments, tendons, meniscus and intervertebral discs. They often perform gait and motion analyses for sports performance and patient outcome following surgical procedures. Orthopaedic bioengineers also pursue fundamental studies on cellular function, and mechano-signal transduction.

Rehabilitation Engineering is a growing specialty area of biomedical engineering. Rehabilitation engineers enhance the capabilities and improve the quality of life for individuals with physical and cognitive impairments. They are involved in prosthetics, the development of home, workplace and transportation modifications and the design of assistive technology that enhance seating and positioning, mobility, and communication. Rehabilitation engineers are also developing hardware and software computer adaptations and cognitive aids to assist people with cognitive difficulties.

Systems Physiology is the term used to describe that aspect of biomedical engineering in which engineering strategies, techniques and tools are used to gain a comprehensive and integrated understanding of the function of living organisms ranging from bacteria to humans. Computer modeling is used in the analysis of experimental data and in formulating mathematical descriptions of physiological events. In research, predictor models are used in designing new experiments to refine our knowledge. Living systems have highly regulated feedback control systems that can be examined with state-of-the-art techniques. Examples are the biochemistry of metabolism and the control of limb movements.

These specialty areas frequently depend on each other. Often, the biomedical engineer who works in an applied field will use knowledge gathered by biomedical engineers working in other areas. For example, the design of an artificial hip is greatly aided by studies on anatomy, bone biomechanics, gait analysis, and biomaterial compatibility. The forces that are applied to the hip can be considered in the design and material selection for the prosthesis. Similarly, the design of systems to electrically stimulate paralyzed muscle to move in a controlled way uses knowledge of the behavior of the human musculoskeletal system. The selection of appropriate materials used in these devices falls within the realm of the biomaterials engineer.

Examples of Specific Activities

Work done by biomedical engineers may include a wide range of activities such as:

Artificial organs (hearing aids, cardiac pacemakers, artificial kidneys and hearts, blood oxygenators, synthetic blood vessels, joints, arms, and legs).

Automated patient monitoring (during surgery or in intensive care, healthy persons in unusual environments, such as astronauts in space or underwater divers at great depth).

Blood chemistry sensors (potassium, sodium, O_2, CO_2, and pH).

Advanced therapeutic and surgical devices (laser system for eye surgery, automated delivery of insulin, etc.).

Application of expert systems and artificial intelligence to clinical decision making (computer-based systems for diagnosing diseases).

Design of optimal clinical laboratories (computerized analyzer for blood samples, cardiac catheterization laboratory, etc.).

Medical imaging systems (ultrasound, computer assisted tomography, magnetic resonance imaging, positron emission tomography, etc.).

Computer modeling of physiologic systems (blood pressure control, renal function, visual and auditory nervous circuits, etc.).

Biomaterials design (mechanical, transport and biocompatibility properties of implantable artificial materials).

Biomechanics of injury and wound healing (gait analysis, application of growth factors, etc.).

Sports medicine (rehabilitation, external support devices, etc.).

Where do Biomedical Engineers Work?

Biomedical engineers are employed in universities, in industry, in hospitals, in research facilities of educational and medical institutions, in teaching, and in government regulatory agencies. They often serve a coordinating or interfacing function, using their background in both the engineering and medical fields. In industry, they may create designs where an in-depth understanding of living systems and of technology is essential. They may be involved in performance testing of new or proposed products. Government positions often involve product testing and safety, as well as establishing safety standards for devices. In the hospital, the biomedical engineer may provide advice on the selection and use of medical equipment, as well as supervising its performance testing and maintenance. They may also build customized devices for special health care or research needs. In research institutions, biomedical engineers supervise laboratories and equipment, and participate in or direct research activities in collaboration with other researchers with such backgrounds as medicine, physiology, and nursing. Some biomedical engineers are technical advisors for marketing departments of companies and some are in management positions.

Some biomedical engineers also have advanced training in other fields. For example, many biomedical engineers also have a M.D. degree, thereby combining an understanding of advanced technology with direct patient care or clinical research.

How Should I Prepare for a Career in Biomedical Engineering?

The biomedical engineering student should first plan to become a good engineer who then acquires a working understanding of the life sciences and terminology. Good communication skills are also important, because the biomedical engineer provides a vital link with professionals having medical, technical, and other backgrounds.

High school preparation for biomedical engineering is the same as that for any other engineering discipline, except that life science course work should also be included. If possible, Advanced Placement courses in these areas would be helpful. At the college level, the student usually selects engineering as a field of study, then chooses a discipline concentration within engineering. Some students will major in biomedical engineering, while others may major in chemical, electrical, or mechanical engineering with a specialty in biomedical engineering. As career plans develop, the student should seek advice on the degree of specialization and the educational levels appropriate to his or her goals and interests. Information on sources of financial aid for education and training should also be sought. Many students continue their education in graduate school where they obtain valuable biomedical research experience at the Masters or Doctoral level. When entering the job market, the graduate should be able to point to well defined engineering skills for application to the biomedical field, with some project or in-the-field experience in biomedical engineering.

For More Information

Accredited Programs: Accreditation Board for Engineering & Technology (ABET), 111 Market Place, Suite 1050, Baltimore, MD 21202-4012, 410-347-7700 or www.abet.org/accredited_prgs.html

Graduate Programs: Available on the Internet at www.bmenet.org and Peterson's Guide to Graduate Programs at http://iiswinprd01.petersons.com/gradchannel/

Academic Programs in Biomedical Engineering: Available on the Internet at www.whitaker.org/academic/

Biomedical Engineering Academic Program Annual Report. Available on the Internet at www.bmenet.org