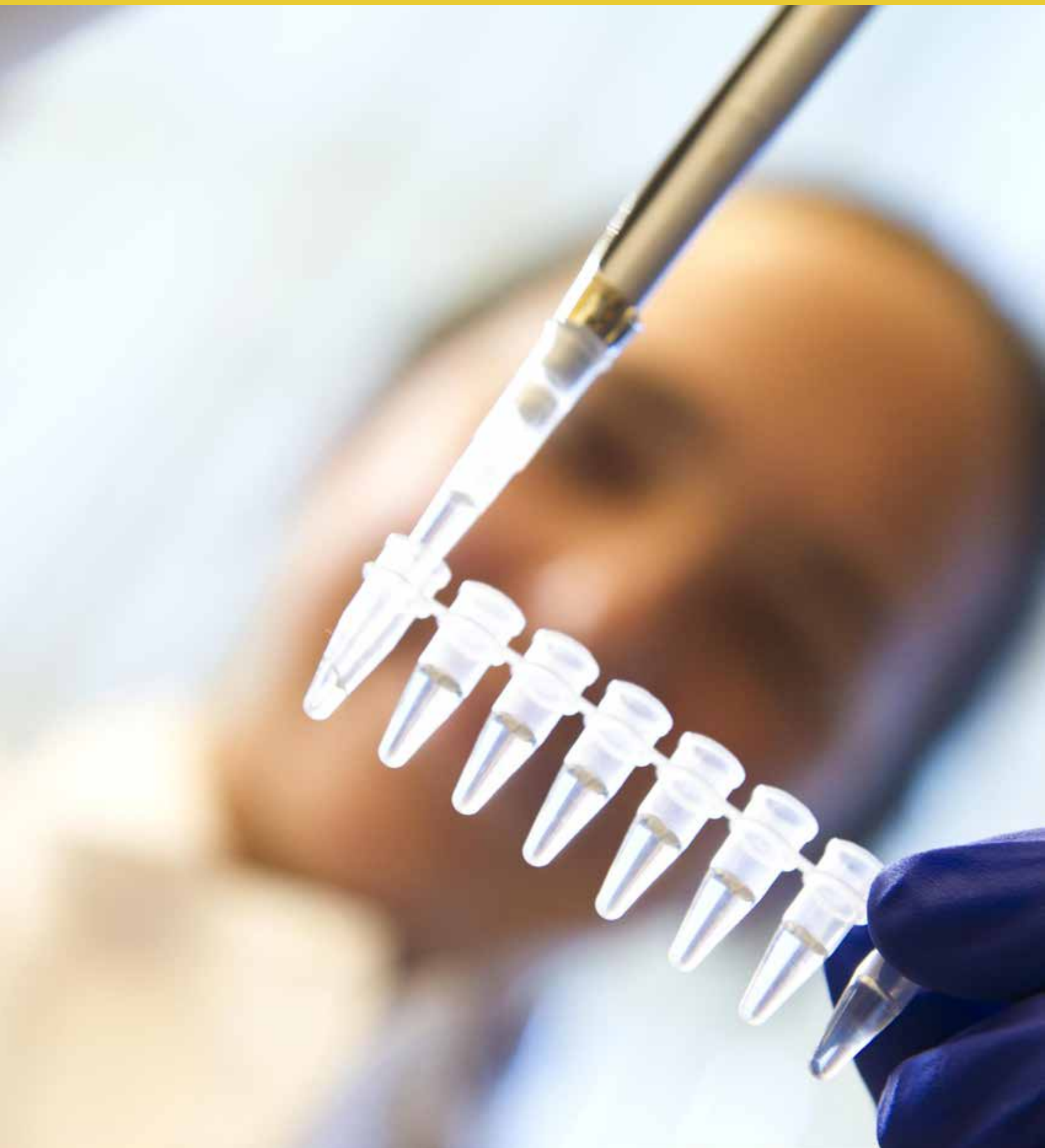
Biomedical Engineering

DESIGN FOR MOVEMENT



The interdisciplinary field of Biomedical Engineering (BME) combines elements of engineering (electronics, systems analysis, mechanics) with the life sciences (biology, physiology, biochemistry) to define and solve problems in biology and medicine.

MAJORS & AREAS OF EMPHASIS

- Biomedical Engineering
- Biomedical (Mollecular-Cellular) Engineering
- Biomedical (Electrical) Engineering
- Biomedical (Mechanical) Engineering

HELP OTHERS LIVE BETTER

Students choose this branch of engineering for the excitement of working with people and living systems, and for the opportunity to apply advanced technology to the complex problems of medical care.

Students can participate in a variety of directed study courses or classroom projects at facilities such as the Los Angeles County+USC Medical Center, the Biomedical Simulations Resource Center, the Medical Ultrasonic Transducer Resource Center, Rancho Los Amigos National Rehabilitation Center and Children's Hospital-Los Angeles (CHLA).

EMPHASES & OPTIONS

While many students choose a primary degree in Biomedical Engineering with no added specialization, we do offer the opportunity to deepen to your education in three separate emphasis programs: Molecular-Cellular (BMCE), Electrical (BMEN), and Mechanical (BMEL).

Biomedical (Molecular-Cellular) Engineering (BMCE) harnesses aspects on the nano, molecular, cellular, tissue, and organism level in order to explore biological and disease systems, often towards a healthcare need. As a BMCE student, you will take additional coursework in areas like Nanomedicine and Drug Delivery, Tissue Engineering, and Systems Biology.

Biomedical (Electrical) Engineering (BMEN) is for students interested in the building of electronic biomedical devices and the effects of electrical stimulation. As a BMEN student, you'll take additional coursework in areas like Linear Circuits, Digital Logic, Electromagnetics and Digital Electronic Circuit Design.

Biomedical (Mechanical) Engineering (BMEL) is for students interested in the mechanics and dynamics of medical devices and biological systems. As a BMEL student, you will take additional coursework in areas like Mechanics, Thermodynamics, Biomechanics, Materials Behavior and Processing, and Fluid Mechanics.

The BME programs are easily adapted to include the prerequisites for most medical schools, while also providing applied technical training beyond the basic life sciences. USC Pre-Med students are supported throughout the medical school application process by the Pre-Health Advisement office. Graduates go on to attend top medical, dental and pharmacy schools around the country, including the USC Keck School of Medicine.

RESEARCH HIGHLIGHTS

System Modeling And Simulation, Systems Biology, Systems Pharmacology, Microphysiological Systems, Tissue Engineering, Biomaterials, Nanomedicine, Cancer Microenvironment, Sensory Neurophysiology, Sensorimotor Control, Cardio-Respiratory Control And Dynamics, Computational Neurobiology, Mechanisms Of Memory And Learning, Ultrasonic Imaging, Laser Scanning And Light Sheet Imaging, Medical Imaging, Multimodal Imaging, Biomedical Photonics, Implantable And Wearable Biomedical Devices, Neural Prostheses, Retinal Prostheses, Cortical Prostheses.

COMPANIES HIRING YOU

Abbott Laboratories, Advanced Bionics, Alfred E. Mann Institute, Amgen, Applied Medical, Biosense Webster, Edwards Lifesciences, Lifescan, Medtronic, Neutrogena, Nike... And many more!

CAREER OPTIONS

- Build advanced therapeutic & surgical devices
- Create safe implantable artificial materials
- Become physicians or pharmacists
- Conduct biomedical research
- Develop artificial organs
- Design prosthetics
- Improve medical imaging devices

FACULTY HIGHLIGHTS

Professor Eun-Ji Chung's research group focuses on molecular design, nanomedicine, and biomaterial strategies to address the limitations of clinical solutions. In particular, the group is interested in self assembling micelle systems that can be designed to deliver molecular signals to report back on or influence the behavior of diseased tissue for drug delivery and diagnostic applications. In addition, the group is harnessing its expertise in combining biomimetic scaffolds with novel stem cell sources for complex regeneration of hierarchically-ordered tissues and organs. The group is highly interdisciplinary as its research is positioned at the intersection of engineering, biology, and medicine.

Professor Stacey Finley is answering unresolved questions about the way cells behave by applying a systems biology approach – she builds multiscale computational models and combines them with quantitative experimental studies to explore the emergent behaviors of biological systems. She is working to quantitatively understand the dynamics of key signaling and metabolic networks in cancer, providing detailed insight needed to answer outstanding questions in cancer. Her research group has made significant contributions in the study of new blood vessel formation (called "angiogenesis"), and cellular metabolism, and immune cell activation. Professor Finley's long-term mission is to translate a quantitative understanding of the biochemical reaction networks driving immune cell activation into strategies that can be used to modulate the cells' behavior and control tumor growth.

Prof. Megan L. McCain's Laboratory for Living Systems Engineering focuses on three research areas: (1) Microfabrication of surfaces and fluidic devices for engineering biomimetic models of cardiac and skeletal muscle tissues; (2) Development of assays to interrogate the structure and function of engineered cardiac and skeletal muscle tissues; (3) Implementation of engineered model tissues and assays to investigate mechanobiology and mechanisms of disease. The Laboratory for Living Systems Engineering also collaborates with several labs across USC to integrate additional technologies into their research, including bioelectronics, synthetic biology, and patient-derived stem cell derivatives.

Prof. Ellis Meng's Biomedical Microsystems Laboratory at the University of Southern California focuses on developing novel translational microtechnologies and microdevices for biomedical applications, in particular medical implants. Often the last line of defense for combating a wide range of challenging medical conditions, implants help extend and improve the quality of life for many. This industry continues to be fueled by the growing number of elderly and increased prevalence of chronic diseases. The application of microelectromechanical systems technology and medical polymer micromachining will enable the next generation of advanced medical implants that are needed to address urgent unmet clinical needs. In particular, we are interested in the integration of multiple modalities (e.g. electrical, mechanical, and chemical) in miniaturized devices measuring no more than a few millimeters for use in fundamental scientific research, biomedical diagnostics, and therapy. Projects in the lab include electrode-based neural interfaces for use in different parts of the nervous system and sensor technologies and systems for the monitoring of life-sustaining drainage shunts in hydrocephalus.

ALUMNI HIGHLIGHTS

Ruchie Bhardwaj | B.S. Biomedical Engr. '16

Ruchie is currently pursuing her MBA at MIT Sloan School of Management. After leaving USC, she worked as an Associate in Digital Health at Amgen where she assessed new technologies to transform the patient experience in areas that include Personalized Medicine, Clinical Trials, Electronic Health Records, Digital Marketing, Mobile Fitness Applications and Wearables. She later worked at 23andMe exploring uses of genetic data before returning to graduate work.

Gabriel Glasser | B.S. Biomedical Engr. '16

While at USC, Gabriel discovered his passion for sports medicine and biomechanics research at USC's Human Performance Lab studying gait mechanics of athletes recovering from ACL injuries. After graduation, he worked in the biomechanics lab of Motus Global alongside professional athletes to test and improve their performance. In this role, he worked on wearables technology aimed at reducing the prevalence of throwing injuries for MLB pitchers and NFL quarterbacks. More recently, he earned a Masters in Biomedical Engineering from USC and started working as a BIomedical Engineer at BTS Bioengineering in Boston.

Michael Maylahn & Dinesh Seemakurty | B.S. Biomedical Engr. '15 During their senior year, Michael and Dinesh tested the waters of a new medical device business through USC competitions. After receiving numerous accolades, the two of them started Stasis Labs where they are currently building an innovative health monitoring system for hospitals and clinics across the world.

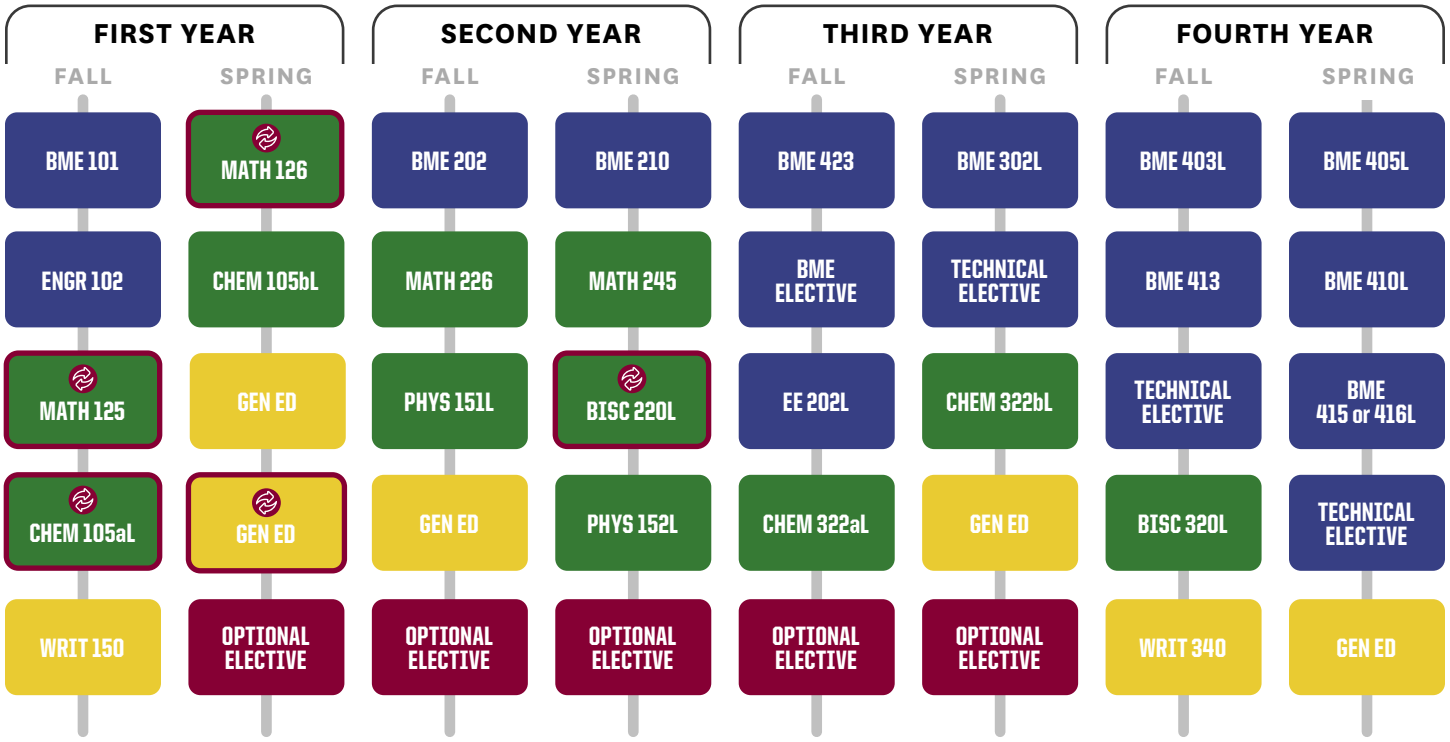
Nina Singh | B.S. Biomedical Engr. '19

While at USC, Nina enjoyed exploring the intersection of engineering and medicine by conducting research on modeling ciliary motion, co-founding a startup that built a new medication management app, and leading interdisciplinary student teams at medical device hackathons. She is currently pursuing her MD at New York University Grossman School of Medicine, where she is continuing to explore her interest in medical technology at the Tech4Health Institute. At this institute, she works on designing transplant rejection sensors and getting medical students involved in identifying engineering needs across the NYU Langone Medical Center.

Andrianna Ayiotis | B.S. Biomedical Engr. '17

Andrianna is currently a PhD Candidate in Biomedical Engineering at Johns Hopkins University where she works on a first-in-human clinical trial of an inner ear neural implant that restores balance function. She decided to pursue graduate school after participating in the USC-Tsinghua Summer Research Program and conducting research with multiple USC professors during her time on campus. At USC, Andrianna spent her time outside of class tutoring her peers through the Viterbi Academic Resource Center (VARC), the Navy ROTC program, and the Society of Hispanic Professional Engineers (SHPE) Study Nights.

Biomedical Engineering



ENGINEERING

BME 101: Introduction to Biomedical Engineering
BME 202: Control & Communication in the Nervous System
BME 210: Biomedical Computer Simulation Methods
BME 302L: Medical Electronics
BME 403L: Physiological Systems
BME 405L: Senior Projects: Measurements & Instrumentation
BME 410: Introduction to Biomaterials & Tissue Engineering
BME 413: Bioengineering Signals & Systems
BME 415: Regulation of Medical Products
BME 416L: Development and Regulation of Medical Products
BME 423: Statistical Methods in Biomedical Engineering
EE 202L: Linear Circuits
ENGR 102: Engineering Freshman Academy
BME & TECHNICAL ELECTIVES: Specialized upper division courses you choose for your major/specialization.

MATHEMATICS

MATH 125: Calculus I
MATH 126: Calculus II
MATH 226: Calculus III
MATH 245: Mathematics of Phys. & Engr.

SCIENCE

BISC 220L: Cell Biology & Physiology
BISC 320L: Molecular Biology
CHEM 105abL: General Chemistry
CHEM 322abL: Organic Chemistry
PHYS 151L: Mechanics & Thermodynamics
PHYS 152L: Electricity & Magnetism

GENERAL EDUCATION

As a USC Viterbi student your General Education (Gen Ed) curriculum will include courses in the Arts, Humanistic Inquiry and Social Analysis.

WRITING

WRIT 150: Writing & Critical Reasoning
WRIT 340: Advanced Writing

ELECTIVES

Your optional electives are one way to build engineering+ into your curriculum by choosing classes of interest to you.

Courses with this symbol may be satisfied with certain AP, IB or A-Level exams. With each requirement you replace with prior credit, you increase your optional electives, creating more flexibility for you to pursue additional electives and increase your engineering+ education.

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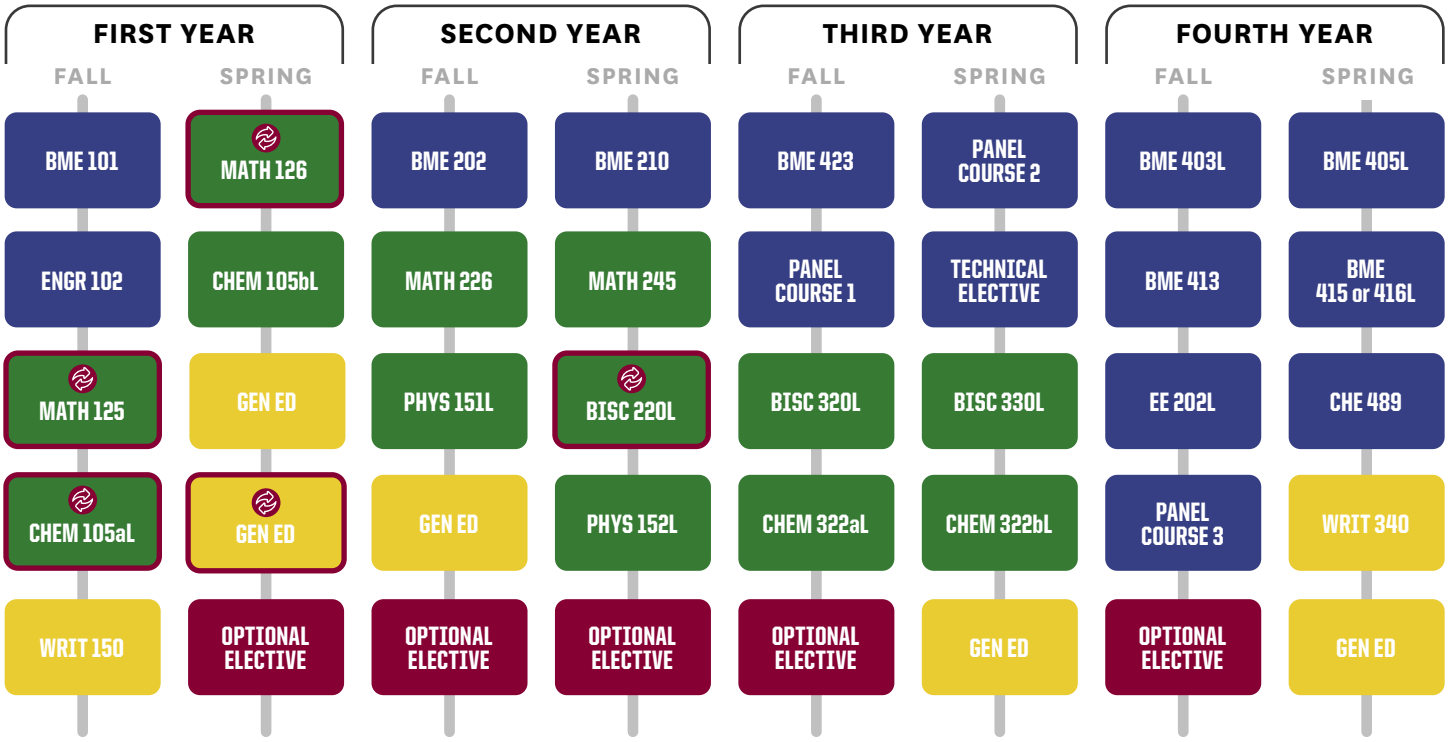
USC Viterbi
School of Engineering

Biomedical (Mollecular-Cellular) Engr.



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BME 210: Biomedical Comp. Simulation Methods
BME 403L: Physiological Systems
BME 405L: Senior Projects: Measurements & Instrumentation
BME 413: Bioengineering Signals & Systems
BME 415: Regulation of Medical Products
BME 416L: Development & Regulation of Medical Products
BME 423: Stat. Methods in Biomedical Engineering
CHE 489: Biochemical Engineering
EE 202L: Linear Circuits
ENGR 102: Engineering Freshman Academy
PANEL COURSES (CHOOSE 3):
- **BME 406:** Intro. to Bioengineering in Medicine
- **BME 410L:** Intro. to Biomaterials & Tissue Engr.
- **BME 430:** Principles and Apps. of Systems Biology
- **BME 459L:** Intro. to Nanomedicine & Drug Delivery

TECHNICAL ELECTIVES: Specialized upper division courses you choose for your major/ specialization.

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MATH 245: Mathematics of Phys. & Engr.

SCIENCE

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BISC 320L: Molecular Biology
BISC 330L: Biochemistry
CHEM 105abL: General Chemistry
CHEM 322abL: Organic Chemistry
PHYS 151L: Mechanics & Thermodynamics
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USC Viterbi
School of Engineering

Biomedical (Electrical) Engr.

FIRST YEAR		SECOND YEAR		THIRD YEAR		FOURTH YEAR	
FALL	SPRING	FALL	SPRING	FALL	SPRING	FALL	SPRING
BME 101	MATH 126	BME 202	BME 210	BME 423	EE 338 or 354L	BME 403L	BME 405L
ENGR 102	CHEM 105bL	ITP 165	EE 109L	EE 202L	TECHNICAL ELECTIVE	BME 413	BME 415 or 416L
MATH 125	GEN ED	MATH 226	MATH 245	EE 250L	BISC 220L	TECHNICAL ELECTIVE	EE 438L or 454L
CHEM 105aL	GEN ED	PHYS 151L	PHYS 152L	TEHCNICAL ELECTIVE	GEN ED	BISC 320L	TECHNICAL ELECTIVE
WRIT 150	OPTIONAL ELECTIVE	GEN ED	OPTIONAL ELECTIVE	WRIT 340	OPTIONAL ELECTIVE	GEN ED	CHEM 322aL

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BME 413: Bioengineering Signals & Systems
BME 415: Regulation of Medical Products
BME 416L: Development and Regulation of Medical Products
BME 423: Statistical Methods in Biomedical Engineering
EE 109L: Introduction to Embedded Systems
EE 202L: Linear Circuits
EE 250L: Distributed Systems for the Internet of Things
EE 338: Physical Electronics
EE 354L: Introduction to Digital Circuits
EE 438L: Electronic Circuits
EE 454L: Introduction to System-on-Chip
ENGR 102: Engineering Freshman Academy
ITP 165: Introduction to C++ Programming
TECHNICAL ELECTIVES: Specialized upper division courses you choose for your major/ specialization.

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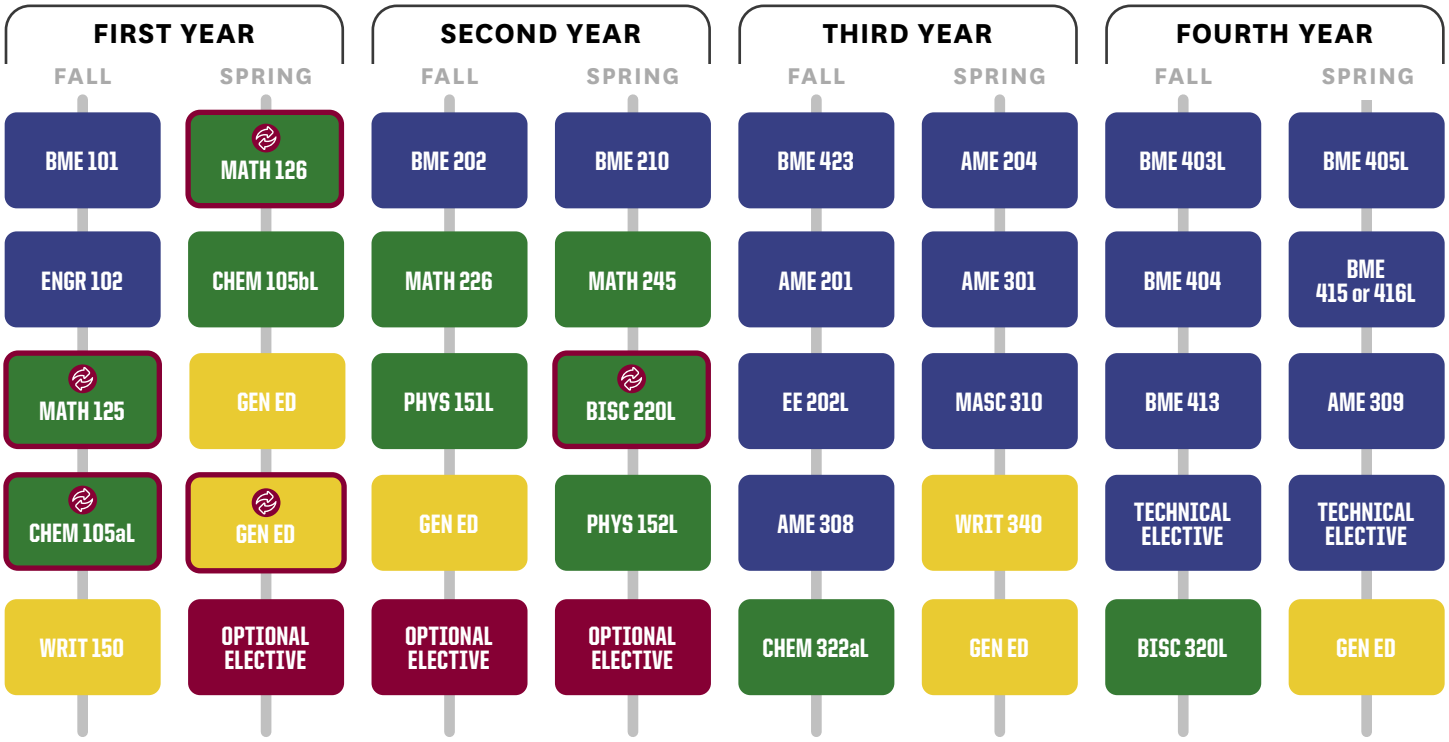
USC Viterbi
School of Engineering

Biomedical (Mechanical) Engr.



ENGINEERING

AME 201: Statics
AME 204: Strength of Materials
AME 301: Dynamics
AME 308: Computer-Aided Analyses for Aero-Mechanical Design
AME 309: Dynamics of Fluids
BME 101: Introduction to Biomedical Engineering
BME 202: Control & Comm. in the Nervous System
BME 210: Biomed. Computer Simulation Methods
BME 403L: Physiological Systems
BME 404: Orthopaedic Biomechanics
BME 405L: Senior Projects: Measurements & Instrumentation
BME 413: Bioengineering Signals & Systems
BME 415: Regulation of Medical Products
BME 416L: Development and Regulation of Medical Products
BME 423: Stat.Methods in Biomedical Engineering
EE 202L: Linear Circuits
ENGR 102: Engineering Freshman Academy
MASC 310: Materials Behavior & Processing
TECHNICAL ELECTIVES: Specialized upper division courses you choose for your major/ specialization.

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