Aerospace & Mechanical Engineering

DESIGN FOR MOVEMENT

Aerospace and Mechanical Engineers design and build unique, complex mechanical-optical-electronic (mechoptronic) systems, ranging in scale from the International Space Station (100 m) to microscale electrical power generators (< 0.001 m). During the last half century, the applications of mechoptronic systems have expanded to near-Earth, planetary and interplanetary space. There has been a parallel inward extension to the ocean depths, deep underground and intricacies inside human bodies.

MAJORS & AREAS OF EMPHASIS

- Aerospace Engineering
- Mechanical Engineering
- Mechanical (Petroleum) Engineering

DESIGN FOR MOVEMENT

Aerospace and Mechanical Engineering (AME) students conduct basic and applied research within and across the usual disciplinary boundaries. AME students develop core and valuable problem-solving skills in the areas of aerodynamics, mechanics, thermodynamics, fluid mechanics, heat transfer, materials and design. Our graduates are at the leading edge of academia and industry, tackling innovative, important, and exciting challenges. Aerospace and Mechanical Engineering students can choose from the following majors: Aerospace, Mechanical, and Mechanical (Petroleum).

Students who choose to study aerospace engineering learn what makes flight possible, how flight is controlled, and the principles of propulsion, structures, and materials. They take all the courses that form a foundation in these subjects along with additional courses in integrated aircraft design, experimental methods, and computer-aided design and simulation. Our graduates use their diverse skill sets to work on a wide range of projects including manned aircraft, drones, and autonomous vehicles.

Mechanical engineering students learn the principles of structures, dynamics of motion, materials, fluid and thermal systems and measurement and control. Our graduates are employed in a wide variety of industries including automotive, biomedical, construction, computers, electric power production, and robotic systems.

A mechanical engineering degree with an emphasis in petroleum allows students to gain a foundation in the core subjects of mechanical engineering while also honing a specialty in areas related to the exploration and production of petroleum by taking classes within the petroleum engineering group within the Mork Family Department of Chemical Engineering and Materials Science

AME students have the opportunity to work with world-renowned faculty on research projects including turbulence control, emerging fuel cell technologies, computational fluid mechanics, combustion, heat transfer, automatic control systems, biomechanics, robotics, nonlinear dynamics, and advanced manufacturing. Recent undergraduate research and student projects include the design of fixed and flapping wing systems for small unmanned aircraft, the search for low drag solutions for the global cargo shipping industry, sports injury and helmet design for shock reduction, and optimal control of wheelchairs for humans and hovering flight for animals. As an example, John Hochschild (B.S. AE '19) was an undergraduate research assistant in the aerodynamics lab, engaging in hands-on work alongside doctoral students on fascinating projects ranging from a bio-inspired morphing aircraft to a novel wing design that could significantly reduce aircraft drag.

RESEARCH

We advance and define research frontiers that shape the future of our life in the air, on the ground, and in space. We push forward the understanding of the natural environment such as the oceans and the atmosphere. Other efforts advance our understanding of control and dynamics of autonomous systems and robotics, advanced manufacturing technology, aircraft design and flight mechanics of very small and very fast flying machines, internal combustion engines, and biodynamical systems in medical devices, natural propulsion, and evolutionary system dynamics.

COMPANIES HIRING YOU

Aerospace Corporation, Aerovironment, Aerotek, Boeing, Honeywell, Jet Propulsion Laboratory, Lockheed Martin, NASA Facilities, Scaled Composites, SpaceX, US National Labs (Livermore, Sandia), Northrop Grumman, Tesla, U.S. government agencies, Virgin Orbit, Microsoft, Google X ... and many more

CAREER OPTIONS

- Design and build piloted or autonomous vehicles
- Develop entirely new devices including satellites, robots, micro-scale measurement and monitoring platforms
- Develop control and planning systems for robots, automated machinery and fleets of devices
- Produce the next generation of clean, fuel-efficient ground, sea, and air transportation systems

FACULTY HIGHLIGHTS

Dr. Ananya Renuka Balakrishna received her PhD in Solid Mechanics and Materials Engineering from the University of Oxford in 2016. Her research focuses on developing mathematical models to investigate the links between material microstructures and properties in energy-storage and functional materials. She is developing a physics based model that suggests new ways to crystallographically engineer battery electrodes with enhanced performance. These theoretical predictions would guide battery engineers to design electrodes with minimum volume changes, greater conductivity and enhanced lifespans. She is developing a theoretical framework that uses a combination of phase-field methods and data science to eliminate hysteresis in magnetic materials. The results from her research could potentially contribute to a new generation of energy storage and energy conversion materials that do not fade over time.

Dr. Paul Plucinsky received his Ph.D. in Mechanical Engineering at Caltech in 2017. His research interests lie at the interface of solid mechanics, materials science and mathematics. Broadly, he aims to develop theories that capture the interplay between geometry and complex (active and architectured) material behavior, and to use these theories to make predictions relevant to the design of new materials, structures and devices. He has applied this theory-guided approach to a range of topics, including nematic elastomer sheets, origami design, shape-memory alloys, and phase transitions in nano-structures.

Dr. Hangbo Zhao received his Ph.D. degree in the Department of Mechanical Engineering at MIT in 2017. He then worked as a postdoctoral fellow in the Center for Bio- Integrated Electronics at Northwestern University from 2017 to 2019. Hangbo's research aims to advance the science and technology of manufacturing through a combination of fundamental understanding of materials, mechanics, interfacial science, and multidisciplinary experimental approaches. Hangbo's focus areas include micro/nano manufacturing, mechanically guided assembly, engineered surfaces/interfaces, bio-integrated electronics, and active/smart materials.

Dr. Quan Nguyen received his Ph.D. from Carnegie Mellon University in 2017 with the Best Dissertation Award and recently was a Postdoctoral Associate in the Biomimetic Robotics Lab at MIT. His research interests span different control and optimization approaches for highly dynamic robotics including nonlinear control, trajectory optimization, real-time optimization based control, robust and adaptive control. His work on the bipedal robot ATRIAS walking on stepping stones was featured in the IEEE Spectrum, TechCrunch, TechXplore and Digital Trends. His work on the MIT Cheetah 3 robot leaping on a desk was widely featured in major media channels, including CNN, BBC, NBC, ABC, etc.

Dr. Carlos Pantano-Rubino joined the AME department in Spring 2019 as a Full Professor. He received his PhD from UCSD in 2000. His research uses computational approaches to elucidate flow physics that arise in many engineering and scientific areas that impact our everyday life, from transportation to planetary exploration. He is working on the modeling of turbulent reacting and nonreacting flows, on the development of novel numerical methods, and on fluid structure interaction of planetary decelerators used in human and robotic interplanetary missions.

ALUMNI HIGHLIGHTS

Dora Gerardo | B.S. Mechanical Engr. '17
After graduation, Dora joined Accenture's consulting practice where she's worked with California gas and electric utilities, social media companies, and technology companies. As a consultant, she focuses on transmission and distribution in the utility space with a focus on electric grid modernization. Simultaneously, she has returned to USC to pursue a masters in Mechanical Engineering with an Energy Conversion emphasis.

Johann Freeberg | B.S. Mechanical Engr. '18
Johann is working as a mechanical engineer at a USC alumni-founded launch provider, Relativity Space, which is reducing the cost and cadence of rocket manufacturing through additive manufacturing. He started as an intern working in engine manufacturing and converted to a full-time employee developing Relativity's large-scale printers, which aim to grow the rocket's propellant tanks and structures. Johann believes the combination of theory in the classroom and hands-on projects at USC were instrumental in preparing him well for the industry.

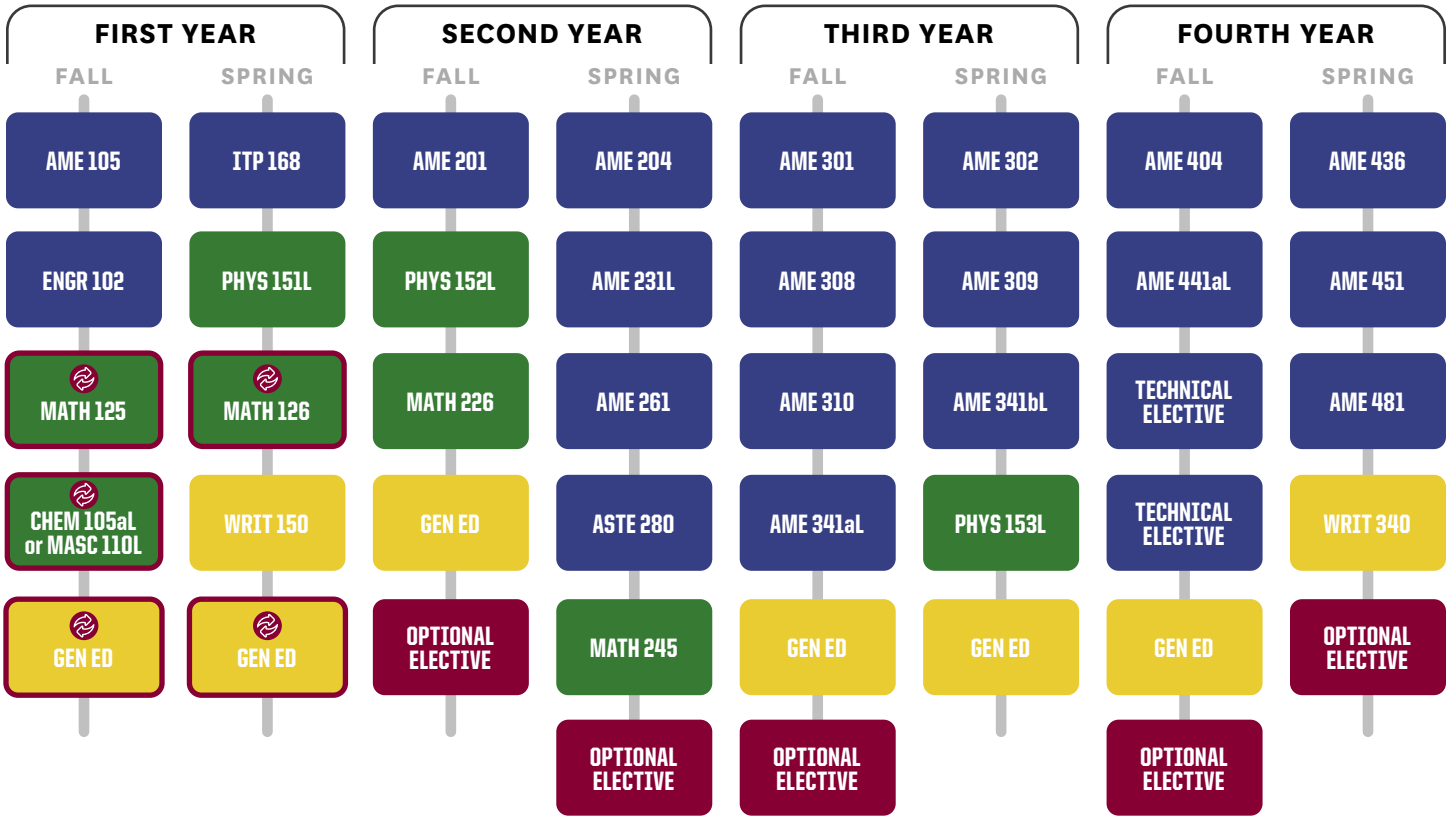
Ana Gabrielian | B.S. Aerospace Engr. '19
During her time at USC, Ana founded her own engineering diversity organization: Girls in Aerospace and Mechanical Engineering (GAME). She also performed experiments in the Dryden Wind Tunnel and Water Channel lab. She continues to study Aerospace as a Graduate Researcher at the Aerospace Systems Design Lab within Georgia Tech. As part of her research, Ana is exploring the implementation of biofuels and their impact on commercial aviation CO_2 emissions and noise generation with the use of the FAA's Aviation Environmental Design Tool.

Luke Stevens | B.S. Mechanical Engr. '19
Luke currently works at Northrop Grumman as a Composite Structures Design Engineer on the F-35 fighter jet. He works on design improvements for the outer skins and doors as well as directly supporting the production line. Luke loves working in sunny Redondo Beach with state-of-the-art hardware and a fast-paced production environment!

Bennett Hazelgrove | B.S. Mechanical Engr. '19
Following graduation, Bennett joined Raytheon Missile Systems, a major U.S. defense contractor and industrial corporation with core manufacturing in concentration in weapons and military as well as the world's largest producer of guided missiles. Bennett works as a Systems Engineering Lead at their Tucson, Arizona location.

Siena Applebaum | B.S Mechanical Engr. '20
As an undergraduate, Siena was involved in the Society of Women Engineers, the 3D printing design team, Freshmen Academy program, and various entrepreneurship competitions. She was a student researcher in Dr. Paul Ronney's combustion lab and earned a Distinguished Paper Award in the Laminar Flames Colloquium, International Symposium on Combustion. Siena has interned at Honeywell Aerospace, Microsoft, and Apple and currently works at Tesla as a program manager on the Connectivity team. She is finishing up her Master's Degree through the Progressive Degree Program at USC.

Aerospace Engineering



ENGINEERING

AME 105: Intro. to Aerospace Engineering
AME 201: Statics
AME 204: Strength of Materials
AME 231L: Mechanical Behavior of Materials
AME 261: Basic Flight Mechanics
AME 301: Dynamics
AME 302: Dynamic Systems
AME 308: Comp. Aided Analyses for Aero-Mechanical Design
AME 309: Dynamics of Fluids
AME 310: Engineering Thermodynamics I
AME 341aL: Mechoptronics Laboratory I
AME 341bL: Mechoptronics Laboratory II
AME 404: Comp. Solutions to Engr. Problems
AME 436: Energy and Propulsion
AME 441aL: Senior Projects Laboratory
AME 451: Linear Control Systems I
AME 481: Aircraft Design
ASTE 280: Foundations of Astronautical Engineering
ENGR 102: Engineering Freshman Academy
ITP 168: Introduction to MATLAB
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

CHEM 105aL: General Chemistry
or **MASC 110L:** Materials Science
PHYS 151L: Mechanics & Thermodynamics
PHYS 152L: Electricity & Magnetism
PHYS 153L: Optics & Modern Physics

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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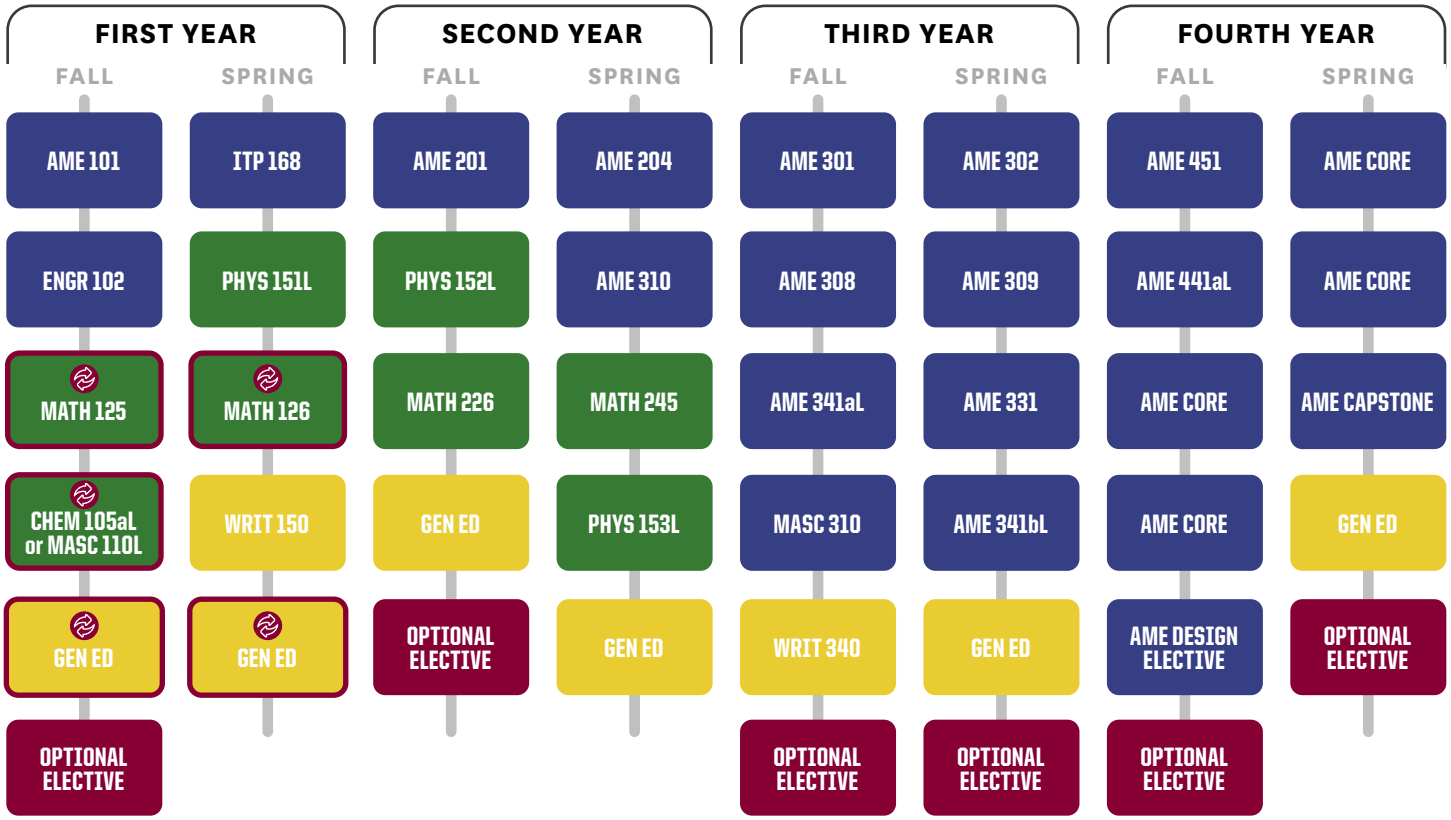
USC Viterbi
School of Engineering

Mechanical Engineering



ENGINEERING

AME 101L: Intro. to Mechanical Engr. & Graphics
AME 201: Statics
AME 204: Strength of Materials
AME 301: Dynamics
AME 302: Dynamic Systems
AME 308: Comp. Aided Analyses for Aero-Mechanical Design
AME 309: Dynamics of Fluids
AME 310: Engineering Thermodynamics I
AME 331: Heat Transfer
AME 341aL: Mechoptronics Laboratory I
AME 341bL: Mechoptronics Laboratory II
AME 441aL: Senior Projects Laboratory
AME CORE: Any upper division course in AME
AME DESIGN ELECTIVE: Any approved AME design course
AME CAPSTONE ELECTIVE: Any approved Capstone Elective Course
ENGR 102: Engineering Freshman Academy
ITP 168: Introduction to MATLAB
MASC 310: Materials Behavior & Processing

MATHEMATICS

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

SCIENCE

CHEM 105aL: General Chemistry
or **MASC 110L:** Materials Science
PHYS 151L: Mechanics & Thermodynamics
PHYS 152L: Electricity & Magnetism
PHYS 153L: Optics & Modern Physics

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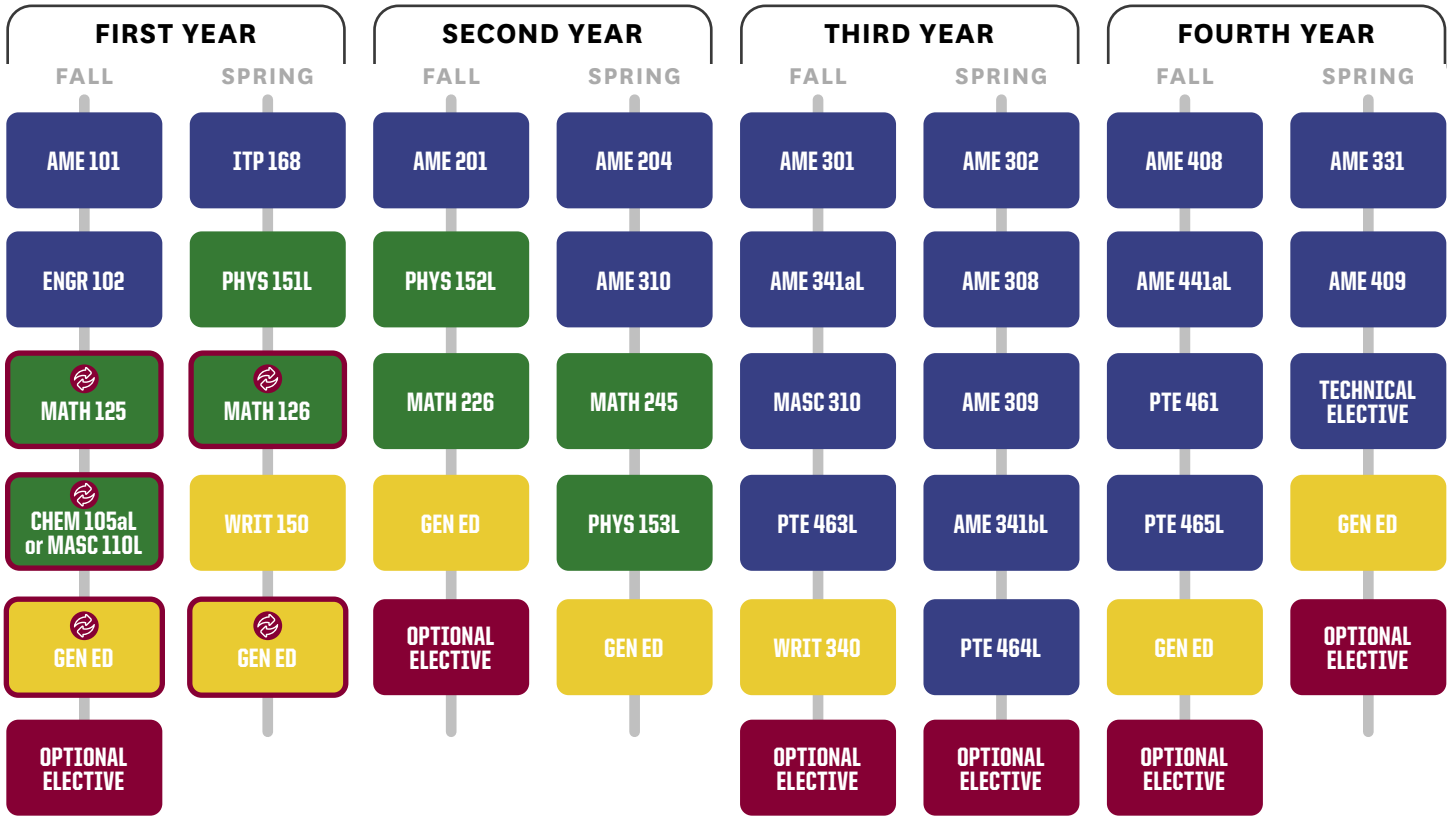
USC Viterbi
School of Engineering

Mechanical (Petroleum) Engineering



ENGINEERING

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AME 309: Dynamics of Fluids
AME 310: Engineering Thermodynamics I
AME 331: Heat Transfer
AME 341abL: Mechoptronics Laboratory I & II
AME 408: CAD of Mechanical Systems
AME 409: Senior Design Project
AME 441aL: Senior Projects Laboratory
ENGR 102: Engineering Freshman Academy
ITP 168: Introduction to MATLAB
PTE 461: Formation Data Sensing with Well Logs
PTE 463L: Intro. to Transport Process in Porous Media
PTE 464L: Modeling & Simulation of Subsurface Flow Systems
PTE 465L: Drilling Tech. & Subsurface Methods
MASC 310: Materials Behavior & Processing
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
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