Applied Science and Technology

The Applied Science and Technology graduate group is administered by the College of Engineering. The program is aimed at students with research interests that are truly interdisciplinary. Faculty members associated with the program are drawn from several departments within the College of Engineering, as well as from the departments of Physics, Chemistry, Chemical and Biomolecular Engineering, Statistics, and Mathematics. Topics of interest include the properties and applications of nanostructures; thin-film and interface science; microelectromechanical systems (MEMS); short-wavelength coherent radiation; X-ray micro-imaging for the life and physical sciences; plasma physics and plasma-assisted materials processing; laser-induced chemical processes; laser probing of complex reacting systems; ultrafast phenomena; particle accelerators; nonlinear dynamics; chaotic systems; numerical methods; and computational fluid mechanics and reacting flows, etc.

Within the program students design their own course of study in consultation with their advisors, choosing from the vast array of technical offerings throughout the campus. The chosen coursework should prepare the student for interdisciplinary research. Students in the PhD program may pursue a Designated Emphasis (DE) such as the DE in Nanoscale Science and Engineering (DE NSE); Energy, Science, and Technology (DE EST); and Computational Science and Engineering (DE CSE).

Graduate research in the AS&T Program benefits from state-of-the-art experimental facilities on the Berkeley campus and at the Lawrence Berkeley National Laboratory. Among these facilities is the National Center for Electron Microscopy, which has the world's highest resolution high-voltage microscope; a microfabrication lab for student work involving lithography; MEMS ion-implantation and thin-film deposition; an integrated sensors laboratory, femtosecond laser laboratories; optical, electrical, and magnetic resonance spectroscopies; short-wavelength laser and Xray research laboratories; an unparalleled variety of material, chemical, and surface science analytic equipment; and a soft X-ray synchrotron dedicated to materials, chemical, and biological research using high-brightness and partially coherent X-rays. The interdisciplinary collaborative nature of the AS&T Program provides ample opportunity to develop new research directions by making the best use possible of these facilities and the other research instrumentation available to AS&T faculty.

Admission to the University

Applying for Graduate Admission

Thank you for considering UC Berkeley for graduate study! UC Berkeley offers more than 120 graduate programs representing the breadth and depth of interdisciplinary scholarship. The Graduate Division hosts a complete list (https://grad.berkeley.edu/admissions/choosing-your-program/list/) of graduate academic programs, departments, degrees offered, and application deadlines can be found on the Graduate Division website.

Prospective students must submit an online application to be considered for admission, in addition to any supplemental materials specific to the program for which they are applying. The online application and steps to take to apply can be found on the Graduate Division website (https://grad.berkeley.edu/admissions/steps-to-apply/).

Admission Requirements

The minimum graduate admission requirements are:

1. A bachelor's degree or recognized equivalent from an accredited institution;
2. A satisfactory scholastic average, usually a minimum grade-point average (GPA) of 3.0 (B) on a 4.0 scale; and
3. Enough undergraduate training to do graduate work in your chosen field.

For a list of requirements to complete your graduate application, please see the Graduate Division's Admissions Requirements page (https://grad.berkeley.edu/admissions/steps-to-apply/requirements/). It is also important to check with the program or department of interest, as they may have additional requirements specific to their program of study and degree. Department contact information can be found here (https://guide.berkeley.edu/graduate/degree-programs/).

Where to apply?

Visit the Berkeley Graduate Division application page (http://grad.berkeley.edu/admissions/apply/).

Course Requirements

A minimum of 32 semester units of letter-graded coursework is required, exclusive of seminars and research. Of these 32 units, at least 24 units must be graduate level (200 series) courses, and the remaining 8 units may be upper division or graduate level courses. The student's program is developed in consultation with the faculty research advisor and faculty academic advisor to suit his/her individual needs. The interdisciplinary nature of the group makes it particularly important that the student discuss all coursework with the faculty research advisor, who is most familiar with the skills and knowledge necessary to complete the dissertation. The student is required to complete at least 18 semester units relating to the student's major research field. In addition, a minor must be established by taking 8 semester units in the chosen minor emphasis area with appropriate technical content to prepare the student for the Qualifying examination and the dissertation.

Major and Minor Area Unit Requirements

Of the 32 required units, 26 are taken in establishing the major area and minor areas, leaving 6 discretionary units.

- **18 major area units:** This will be specific to the students primary research concentration. Units must be graduate and letter graded.
- **8 minor area units:** Student will select emphasis area with appropriate technical content to prepare the student for the Qualifying examination and the dissertation. Units can be a combination of graduate and upper division courses and must be letter-graded.
- **6 discretionary units:** technical graduate or upper division letter graded units.

Of these 32 units, at least 24 units must be graduate level (200 series) courses, and the remaining 8 units may be upper division or graduate level courses. Faculty research advisor and faculty academic advisor approval required for all units taken.

Preliminary Exam

All students who enter the PhD program must take a one and a half hour oral AS&T preliminary examination based upon basic courses in their field of expertise. The exam must be taken no later than the second semester of the first academic year within the program (typically in late spring semester). Students who fail to pass the exam are allowed one more attempt, to be taken no later than the end of their third semester. A selection of courses to be covered in each of the examination areas will be established, and an oral examination will be arranged.

Qualifying Exam

By the requirements of the Graduate Division, students enrolled in the PhD program must pass an oral qualifying examination in subjects appropriate to their approved areas of study. The examination will test the student's broad knowledge of areas related to his or her chosen areas of emphasis, as well as the depth of understanding in the areas in which the student anticipates undertaking research. The oral qualifying examination can be scheduled at any time mutually agreeable to the student and his or her graduate advisor, but in no case later than the third year after passing the AS&T preliminary examination. Students are urged to check the general University requirements for this examination.

Dissertation

The dissertation, the product of independent investigation under faculty supervision, is the final requirement for the doctoral program. The student's research adviser is the chair of the dissertation committee, who is joined by two (2) other Academic Senate members. The dissertation committee must be approved by both the head graduate advisor and the Dean of the Graduate Division.

Curriculum

Electives per approved study list, according to highly individualized study along such major AS&T areas of concentration, such as applied physics, engineering sciences, and mathematical sciences

Applied Science and Technology

AST C210 X-rays and Extreme Ultraviolet Radiation 3 Units

Terms offered: Spring 2025, Spring 2022, Spring 2021, Fall 2019
This course explores modern developments in the physics and applications of x-rays and extreme ultraviolet (EUV) radiation. It begins with a review of electromagnetic radiation at short wavelengths including dipole radiation, scattering and refractive index, using a semi-classical atomic model. Subject matter includes the generation of x-rays with synchrotron radiation, high harmonic generation, x-ray free electron lasers, laser-plasma sources. Spatial and temporal coherence concepts are explained. Optics appropriate for this spectral region are described. Applications include nanoscale and astrophysical imaging, femtosecond and attosecond probing of electron dynamics in molecules and solids, EUV lithography, and materials characteristics.
Rules & Requirements

Prerequisites: Physics 110, 137, and Mathematics 53, 54 or equivalent

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Applied Science and Technology/Graduate

Grading: Letter grade.

Instructor: Attwood

Also listed as: EL ENG C213

AST C225 Thin-Film Science and Technology 3 Units

Terms offered: Fall 2025, Fall 2024, Fall 2023
Thin-film nucleation and growth, microstructural evolution and reactions. Comparison of thin-film deposition techniques. Characterization techniques. Processing of thin films by ion implantation and rapid annealing. Processing-microstructure-property-performance relationships in the context of applications in information storage, ICs, micro-electromechanical systems and optoelectronics.
Rules & Requirements

Prerequisites: Graduate standing in engineering, physics, chemistry, or chemical engineering

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Applied Science and Technology/Graduate

Grading: Letter grade.

Instructors: Wu, Dubon

Also listed as: MAT SCI C225

AST C239 Partially Ionized Plasmas 3 Units

Terms offered: Spring 2010, Spring 2009, Spring 2007
Introduction to partially ionized, chemically reactive plasmas, including collisional processes, diffusion, sources, sheaths, boundaries, and diagnostics. DC, RF, and microwave discharges. Applications to plasma-assisted materials processing and to plasma wall interactions.
Rules & Requirements

Prerequisites: An upper division course in electromagnetics or fluid dynamics

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Applied Science and Technology/Graduate

Grading: Letter grade.

Formerly known as: 239

Also listed as: EL ENG C239

AST C295R Applied Spectroscopy 3 Units

Terms offered: Fall 2023, Spring 2009, Spring 2007, Spring 2002
After a brief review of quantum mechanics and semi-classical theories for the interaction of radiation with matter, this course will survey the various spectroscopies associated with the electromagnetic spectrum, from gamma rays to radio waves. Special emphasis is placed on application to research problems in applied and engineering sciences. Graduate researchers interested in systematic in situ process characterization, analysis, or discovery are best served by this course.
Rules & Requirements

Prerequisites: Graduate standing in engineering, physics, chemistry, or chemical engineering; courses: quantum mechanics, linear vector space theory

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Applied Science and Technology/Graduate

Grading: Letter grade.

Instructor: Reimer

Also listed as: CHM ENG C295R

AST 299 Individual Study or Research 1 - 12 Units

Terms offered: Fall 2025, Summer 2025 8 Week Session, Summer 2025 First 6 Week Session
Investigations of advanced problems in applied science and technology. Sponsored by Engineering Interdisciplinary Studies Center.
Rules & Requirements

Prerequisites: Consent of instructor; graduate standing

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 1-12 hours of independent study per week

Summer:
3 weeks - 5-60 hours of independent study per week
8 weeks - 1-12 hours of independent study per week

Additional Details

Subject/Course Level: Applied Science and Technology/Graduate

Grading: Offered for satisfactory/unsatisfactory grade only.