DEPARTMENT OF APPLIED PHYSICAL SCIENCES

The Department of Applied Physical Sciences combines applied science and engineering to solve real problems for North Carolina and the world through technology, innovation, and partnerships, and the preparation of knowledgeable and responsible students, citizens, and researchers. The department expands interdisciplinary research and teaching by strengthening an intellectual climate in which science is collaborative and focused on applications.

The department houses an undergraduate major in applied sciences, an undergraduate minor in applied sciences and engineering, and a doctoral graduate program in materials science. APS is also home to BeAM (https://beam.unc.edu) (Be A Maker), the UNC network of makerspaces.

Minor

- Applied Sciences Major, B.S. (https://catalog.unc.edu/undergraduate/programs-study/applied-sciences-major-bs/)
- Applied Sciences and Engineering Minor (https://catalog.unc.edu/undergraduate/programs-study/applied-sciences-engineering-minor/)

Graduate Programs

- Ph.D. in Materials Science (https://catalog.unc.edu/graduate/schools-departments/applied-physical-sciences/#programstext)

Professors

Theo J. Dingemans (APS), High-Performance Polymers and (Nano)composites
Greg Forest (Mathematics), Flow and Structure of Complex Polymeric Fluids
Jinsong Huang (APS), Perovskite Solar Cells, Photodetectors, X-ray Imaging, Radiation Detectors, Electronic Devices
Rene Lopez (Physics and Astronomy – APS), Optical Materials, Photonic Structures, Photovoltaics
Richard Superfine (APS), Biological Physics, Soft Matter, Biomedical Device Technologies

Associate Professors

Ronit Freeman (APS), Development of Novel Designer Materials Using Self-Assembling Biological Components
Daphne Klotsa (APS), Computational Soft and Active Matter

Assistant Professors

Wubin Bai (APS), Bioelectronics, Soft Materials, Advanced Manufacturing, Microsystems, Electronic Materials, Photonic Materials, and Biomaterials
Ehssan Nazockdast (APS), Modeling/Simulation of Biophysical Phenomena
Nico Pegard (APS), Computational Optics, Imaging Systems, Optical Instrumentation and Digital Interfaces for Systems Biology and Neuroscience

Teaching Associate Professor

Richard Goldberg (APS), Assistive Technology, Rehabilitation Engineering, Engineering Education.

Professor of the Practice

Glenn Walters (APS), Instrumentation for Innovation, BeAM Design and Innovation Hub, Engineering Education

Affiliated Faculty

Michael Bakas, Program Manager Army Research Office, Synthesis and Processing
James Cahoon (Chemistry), Nanoparticle Synthesis and Characterization
Orlando Coronell (Environmental Sciences and Engineering), Wet Chemistry, Polymer Synthesis, Membrane Systems
Boyce Griffith (Mathematics and Biomedical Engineering), Cardiovascular Modeling and Simulation
Yun Li (Genetics and Biostatistics), Statistical Methods and Computational Tools and Applications to Genetic Dissection of Complex Diseases
Jianping Lu (Physics), Nanotechnology, Carbon Nanotube X-rays, Tomosynthesis and Computed Tomography
Gerald Meyer (Chemistry), Inorganic Materials, Spectroscopy, and Electrochemistry
Cass T. Miller (Environmental Science and Engineering), Environmental Physics, Soft Matter, Continuum Mechanics, Applied Mathematics, Computational Science
J. Michael Ramsey (Chemistry), Analytical Chemistry, Microfabricated Chemical Instrumentation, Microfluidics, Nanofluidics
Jose Rodríguez-Romaguera (Neuroscience Center), Neuronal Circuits, Imaging, Optogenetics
Edward T. Samulski (Chemistry – APS), Liquid Crystals and Liquid Crystal Polymers
Alexander Tropsha (Eshelman School of Pharmacy), Computational Chemistry, Cheminformatics and Structural Bioinformatics
Scott Warren (Chemistry), 2D Materials, Energy Storage, Solar Energy, Nanoelectronics, Supramolecular and Solid-State Chemistry for Materials Design
Yue Wu (Physics and Astronomy), Water and Gas Configuration at a Nanometric Level
Wei You (Chemistry), Organic and Polymer Synthesis, Organic Solar Cells, Molecular Electronics, Organic Spintronics

Advanced Undergraduate and Graduate-level Courses

APPL 405. Convergent Engineering: Team-Science Approaches to Discovery and Innovation. 3 Credits.
Students will participate in activities, group discussion, and problem-solving coaching to understand how chemistry, physics, materials science, and biology are applied to engineering. Topics are introduced through discussing relevant scientific literature, and guest lecturers and faculty discuss expertise in fields like mathematical modeling, mechanical engineering, or circuit design. Guest lecturers can provide new perspective on the problems, so students gain an interdisciplinary view of the subject.

Rules & Requirements
Grading Status: Letter grade.

APPL 412. Turning Your Entrepreneurial Ideas Into Reality. 3 Credits.
Students will work in groups on a semester project to turn their entrepreneurial ideas into reality.

Rules & Requirements

IDEAs in Action Gen Ed: FC-CREATE.
Making Connections Gen Ed: EE- Field Work.
Requisites: Prerequisite, APPL 110; permission of the instructor for students lacking the prerequisite.
Grading Status: Letter grade.

APPL 430. Optoelectronics from Materials to Devices. 3 Credits.
At the intersection between electrical engineering, optics, and computer science, this course explores how optoelectronic materials can be turned into optoelectronic devices to build high performance optical instruments. The course features many hands-on activities that include electronics, with the study of sensors operating under low light and high noise conditions, custom optical system design, imaging and holography systems, as well as computational imaging techniques using MATLAB (basic programming experience in any language is sufficient).

Rules & Requirements
Requisites: Prerequisite, MATH 383.
Grading Status: Letter grade.

APPL 435. Nanophotonics. 3 Credits.
This course introduces the principles of nanophotonics - an emerging frontier at the nexus of nanotechnology and photonics that deals with light-matter interactions at the nanometer scale. The course will cover the theoretical foundations of nanoscale materials and optics, fabrication and characterization of optical nanostructures, plasmonics, nanomanipulation by optical tweezers, electrodynamic simulations, nanoscale light emitters, and applications of nanophotonics.

Rules & Requirements
Requisites: Prerequisite, PHYS 117 or 119.
Grading Status: Letter grade.

APPL 462. Engineering Materials: Properties, Selection and Design. 3 Credits.
This course will cover both fundamental and applied aspects of modern materials science. We will discuss how to select materials based on their properties and how they can be processed into products that you encounter in everyday life. A strong focus will be on the relationship between processing, structure (development), and properties of solid materials, such as metals, ceramics, and polymers.

Rules & Requirements
Requisites: Prerequisite, CHEM 102; or PHYS 116 or PHYS 118.
Grading Status: Letter grade.

APPL 463. Bioelectronic Materials. 3 Credits.
Developing electronic systems that can seamlessly integrate with biological systems represents a pivotal foundation for building a smart healthcare platform, advanced clinical technology, and beyond. Through multiple hands-on projects, this course will explore and discuss: 1) electronic materials, mechanisms, and designs at the biotic-abiotic interface, 2) their impacts for a wide range of applications ranging from medicine, robotics, to human augmentation, and 3) the associated ethics that aim to harmonize the development pathways.

Rules & Requirements
Requisites: Prerequisites, BMME 209 or APPL 260 or CHEM 102 and PHYS 115 or PHYS 119 and permission of the instructor.
Grading Status: Letter grade.

APPL 465. Engineering of Soft Materials: SpongeBob Squarepants and Other Squishy Things. 3 Credits.
What kind of material is Sponge Bob? What about his pet snail, Gary? We are taught that there are solids, liquids, and gases. However, some materials challenge this description, such as foams, plastics, pastes, skin, hair, and nails. These are soft materials, and they are everywhere: sunscreen, insulation, and car tires. In this course, we will learn about soft materials' properties, how they are processed in industry, and how to design novel soft materials.

Rules & Requirements
Grading Status: Letter grade.

APPL 467. Materials Design for Biomedicine. 3 Credits.
The 21st century has already been marked with substantial discoveries in the interface of materials science, biology, and medicine that have a profound effect on our future. The course will focus on all classes of biological materials such as: biologically derived materials, natural and synthetic biomaterials, and bioinspired materials. In addition, the course will highlight the use of nanoscale materials and techniques to rapidly advance our understanding of human biology and the practice of medicine.

Rules & Requirements
Requisites: Prerequisite, CHEM 102.
Grading Status: Letter grade.

APPL 490. Special Topics. 1-3 Credits.
Topics vary from semester to semester.

Rules & Requirements
Repeat Rules: May be repeated for credit; may be repeated in the same term for different topics; 9 total credits. 9 total completions.
Grading Status: Letter grade.

APPL 493. Internship in Applied Physical Sciences. 3 Credits.
An ideal internship provides students with practical experience in an organization outside of UNC, doing work that is relevant to their UNC education. The internship should develop and enhance the students' professional skill sets and involve experiences that allow students to have responsibility for results that are of value to the organization.

Rules & Requirements

IDEAs in Action Gen Ed: HI-INTERN.
Making Connections Gen Ed: EE- Academic Internship.
Grading Status: Letter grade.

APPL 495. Mentored Research in Applied Sciences and Engineering. 3 Credits.
Students undertake independent research with a faculty mentor. In order to register for this class, students must submit a learning contract and research proposal for approval. At the end of the semester, students submit a final report that describes their research. Students are encouraged to present their work either internally at UNC or externally at a conference or symposium.

Rules & Requirements

IDEAs in Action Gen Ed: RESEARCH.
Making Connections Gen Ed: EE- Mentored Research.
Grading Status: Letter grade.

APPL 496. Independent Study in Applied Sciences and Engineering. 1-3 Credits.
Permission of the director of undergraduate studies is required. Independent study under a member of the applied physical sciences faculty. Approved learning contract required.

Rules & Requirements
Repeat Rules: May be repeated for credit. 6 total credits. 6 total completions.
Grading Status: Letter grade.

APPL 590. Special Topics in Applied Physical Sciences. 3 Credits.
Advanced specialty topics in applied physical sciences for undergraduates and graduates.

Rules & Requirements
Repeat Rules: May be repeated for credit. 12 total credits. 4 total completions.
Grading Status: Letter grade.

APPL 690. Special Topics in Applied Physical Sciences. 3 Credits.
Advanced specialty topics in applied physical sciences for undergraduate and graduates.

Rules & Requirements
Repeat Rules: May be repeated for credit. 12 total credits. 4 total completions.
Grading Status: Letter grade.

Material Science (MTSC)

Advanced Undergraduate and Graduate-level Courses

MTSC 615. Structure of Solids. 3 Credits.
Crystallography, reciprocal lattices, Bloch waves, band structure, electronic wave functions, phonons, thermal expansion. Superlattice structures, including liquid crystals. Overview of properties of ceramic, amorphous, polymeric, and composite materials.

Rules & Requirements
Grading Status: Letter grade.

Contact Information

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