**ENGINEERING & APPLIED SCIENCE (ENAS)**

* **ENAS 050a or b / APHY 050a or b, Science of Modern Technology and Public Policy**  
  Daniel Prober  
  Examination of the science behind selected advances in modern technology and implications for public policy, with focus on the scientific and contextual basis of each advance. Topics are developed by the participants with the instructor and with guest lecturers, and may include nanotechnology, quantum computation and cryptography, renewable energy technologies, optical systems for communication and medical diagnostics, transistors, satellite imaging and global positioning systems, large-scale immunization, and DNA made to order. Enrollment limited to first-year students. Preregistration required; see under First-Year Seminar Program.  
  SC, QR

* **ENAS 100b / APHY 100b / EPS 105b / EVST 100b / PHYS 100b, Energy, Environment, and Public Policy**  
  Daniel Prober  
  The technology and use of energy. Impacts on the environment, climate, security, and economy. Application of scientific reasoning and quantitative analysis. Intended for non-science majors with strong backgrounds in math and science.  
  SC, QR

**ENAS 110b / APHY 110b, The Technological World**  
Owen Miller  
An exploration of modern technologies that play a role in everyday life, including the underlying science, current applications, and future prospects. Examples include solar cells, light-emitting diodes (LEDs), computer displays, the global positioning system, fiber-optic communication systems, and the application of technological advances to medicine. For students not committed to a major in science or engineering; no college-level science or mathematics required. Prerequisite: high school physics or chemistry.  
SC, QR

* **ENAS 118a, Introduction to Engineering, Innovation, and Design**  
  Vincent Wilczynski  
  An introduction to engineering, innovation, and design process. Principles of material selection, stoichiometry, modeling, data acquisition, sensors, rapid prototyping, and elementary microcontroller programming. Types of engineering and the roles engineers play in a wide range of organizations. Lectures are interspersed with practical exercises. Students work in small teams on an engineering/innovation project at the end of the term. Priority to freshmen.  
  RP

* **ENAS 120b / CENG 120b / ENVE 120b, Introduction to Environmental Engineering**  
  Jordan Peccia  
  Introduction to engineering principles related to the environment, with emphasis on causes of problems and technologies for abatement. Topics include air and water pollution, global climate change, hazardous chemical and emerging environmental technologies. Prerequisites: high school calculus and chemistry or CHEM 161, 165 or CHEM 163, 167 (may be taken concurrently) or permission of instructor.  
  SC, QR

**ENAS 123a, You, Your Planet, and A Sustainable Future**  
Aaron Dollar  
This course attempts to give a holistic view of the major inter-relationships between humans and our planet, along with an examination of options for paths to a future that is more sustainable. It seeks to be personal and practical where possible, with a strong focus on ways that individuals can make a difference in their daily lives to the pressing issues around the climate and biodiversity crises. We examine concepts primarily through simple, fundamental physical principles which help to “see the forest for the trees” without getting bogged down by complex details.  
SC

* **ENAS 130a or b, Introduction to Computing for Engineers and Scientists**  
  Beth Anne Bennett  
  An introduction to the use of the C and C++ programming languages and the software packages Mathematica and MATLAB to solve a variety of problems encountered in mathematics, the natural sciences, and engineering. General problem-solving techniques, object-oriented programming, elementary numerical methods, data analysis, and graphical display of computational results. Prerequisite: MATH 115 or equivalent. Recommended preparation: previous programming experience.  
  QR

**ENAS 151a or b / APHY 151a or b / PHYS 151a or b, Multivariable Calculus for Engineers**  
Staff  
An introduction to multivariable calculus focusing on applications to engineering problems. Topics include vector-valued functions, vector analysis, partial differentiation, multiple integrals, vector calculus, and the theorems of Green, Stokes, and Gauss. Prerequisite: MATH 115 or equivalent.  
QR

* **ENAS 194a or b / APHY 194a or b, Ordinary and Partial Differential Equations with Applications**  
  Staff  
  Basic theory of ordinary and partial differential equations useful in applications. First- and second-order equations, separation of variables, power series solutions, Fourier series, Laplace transforms. Prerequisites: ENAS 151 or MATH 120 or equivalent, and knowledge of matrix-based operations.  
  QR

**ENAS 221a, The Materials Science of Art**  
Staff  
Exploration of some fundamental scientific principles underlying the engineering of material works of art. The origins of appearance and physical properties, the materials science involved in the fabrication of art works, and the technical analysis of these properties, are discussed in lectures, demonstrated in labs, and illustrated with objects in the Yale museums. This course may be of interest to Art and Architecture majors.  
SC

* **ENAS 400a, Making it**  
  Joseph Zinter  
  Positioned at the intersection of design, technology, and entrepreneurship, students are introduced to the many facets of product design and development while simultaneously working to conceive and develop a marketable product and business.  

**ENAS 441b / MENG 441b, Applied Numerical Methods for Differential Equations**  
Beth Anne Bennett  
The derivation, analysis, and implementation of numerical methods for the solution of ordinary and partial differential equations, both linear and nonlinear. Additional topics such as computational cost, error estimation, and stability analysis are studied in several contexts.
throughout the course. Prerequisites: MATH 115, and 222 or 225, or equivalents; ENAS 130 or some knowledge of Matlab, C++, or Fortran programming; ENAS 194 or equivalent. ENAS 440 is not a prerequisite.