ENGINEERING & APPLIED SCIENCE (ENAS)

* ENAS 050a / APHY 050a / PHYS 050a, 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 RP

* ENAS 100b / APHY 100b / EVST 100b / G&G 105 / PHYS 100b, Energy Technology and Society  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.  Q, SC

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.  Q, SC RP

* ENAS 118a, Introduction to Engineering, Innovation, and Design  Vincent Wilczynski and Lawrence Wilen
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  John Fortner
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.  Q, SC

ENAS 130b, 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 131a or b / APHY 131a or b / PHYS 131a 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 140a or b / APHY 140a 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 equivalent, and knowledge of matrix-based operations.  QR RP

ENAS 221a, The Materials Science of Art  Katherine Schilling
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 335a / EP&E 204a, Professional Ethics  Mercedes Carreras
A theoretical and case-oriented approach to ethical decision making. Concepts, tools, and methods for constructing and justifying solutions to moral problems that students may face as professionals.  SO

ENAS 345b / CENG 345b, Principles and Applications of Interfacial Phenomena  Kyle Vanderlick
This course covers the nature and consequences of both flexible and rigid interfaces, such as those associated with liquids and solids respectively. We examine the properties of interfaces as they exist alone, as a collective (e.g., colloids), and also as they interact demonstrably with one another. Examples of the latter include thin films, confined fluids and biological membranes. An integral part of this course is the introduction and application of engineering analysis (e.g., finite element analysis) to calculate and predict behaviors central to technological applications.  SC

ENAS 360b / ENVE 360b, Green Engineering and Sustainable Design  Julie Zimmerman
Study of green engineering, focusing on key approaches to advancing sustainability through engineering design. Topics include current design, manufacturing, and disposal processes; toxicity and benign alternatives; policy implications; pollution prevention and source
reduction; separations and disassembly; material and energy efficiencies and flows; systems analysis; biomimicry; and life cycle design, management, and analysis. Prerequisites: CHEM 161, 165 or 163, 167 (or CHEM 112, 113, or 114, 115), or permission of instructor.

**ENAS 397a / EENG 397a, Mathematical Methods in Engineering**  J Rimas Vaisnys
Exploration of several areas of mathematics useful in science and engineering; recent approaches to problem solving made possible by developments in computer software. Mathematica and Eureqa are used to investigate and solve problems involving nonlinear differential equations, complex functions, and partial differential equations. Prerequisites: MATH 222, and ENAS 194 or MATH 246, or equivalents; familiarity with computer programming.  QR

* **ENAS 400b, 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 440a / MENG 440a, Applied Numerical Methods for Algebraic Systems, Eigensystems, and Function Approximation**  Beth Anne Bennett
The derivation, analysis, and implementation of various numerical methods. Topics include root-finding methods, numerical solution of systems of linear and nonlinear equations, eigenvalue/eigenvector approximation, polynomial-based interpolation, and numerical integration. Additional topics such as computational cost, error analysis, and convergence are studied in several contexts throughout the course. Prerequisites: MATH 115, and 222 or 225, or equivalents; ENAS 130 or some experience with Matlab, C++, or Fortran programming.  QR

* **ENAS 450b / APHY 450b / MENG 450b, Advanced Synchrotron Techniques and Electron Spectroscopy of Materials**  Charles Ahn
Introduction to concepts of advanced x-ray and electron-based techniques used for understanding the electronic, structural, and chemical behavior of materials. Students learn from world-leading experts on fundamentals and practical applications of various diffraction, spectroscopy, and microscopy methods. Course highlights the use of synchrotrons in practical experiments. Prerequisites: physics and quantum mechanics/physical chemistry courses for physical science and engineering majors, or by permission of instructor.  QR, SC