**ENGINEERING AND APPLIED SCIENCE**

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Courses in Engineering and Applied Science fall into three categories: those intended primarily for students majoring in one of the several engineering and applied science disciplines; those designed for students majoring in subjects other than engineering, the applied sciences, and the natural sciences; and those designed to meet common interests of students majoring in engineering, the applied sciences, or the natural sciences.


The School of Engineering and Applied Science (http://seas.yale.edu) is responsible for courses in the other two categories: technology for students majoring in subjects other than engineering, the applied sciences, and the natural sciences; and topics common to students majoring in engineering, the applied sciences, and the natural sciences. Courses for non-science majors are intended for all students seeking a broad perspective on issues of scientific and technological import, and they introduce students who may be planning careers in law, business, or public service to concepts and methods of engineering and applied science. Courses for science and engineering majors include topics in applied mathematics and computation.

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Courses without Prerequisites in Engineering

* ENAS 100a / APHY 100a / EVST 100a / G&G 105a / PHYS 100a, 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. Enrollment limited to 24. For application instructions, visit the course site on Classes*v2 (http://classesv2.yale.edu).  
  Q8, SC

ENAS 110b / APHY 110b, The Technological World  
  Victor Henrich  
  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.  
  Q8, SC

* ENAS 118a, Introduction to Engineering, Innovation, and Design  
  Eric Dufresne 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  
  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.  
  Q8, SC

ENAS 135a / EPSE 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 344b / MUSI 371b, Musical Acoustics and Instrument Design  
  Lawrence Wilen and Konrad Kaczmarek  
  Practical study of musical acoustics. The physics and design of musical instruments, with attention to all aspects of sound, from the origin of the vibration in the instrument to the perception by the listener. Student teams design and construct novel instruments and produce relevant applications. Requires a basic knowledge of physics, including concepts of kinetic and potential energy and Newton’s laws.  
  Q8, HU, SC, RP
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 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.

Applied Mathematics and Computation Courses

ENAS 130b, Introduction to Computing for Engineers and Scientists  Marshall Long
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, Multivariable Calculus for Engineers  Staff
An introduction to multivariable calculus focusing on applications to engineering problems. Topics include vector-valued functions,
vectory analysis, partial differentiation, multiple integrals, vector calculus, and the theorems of Green, Stokes, and Gauss. Prerequisite:
MATH 115 or equivalent.  QR RP

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 equivalent, and knowledge of matrix-
based operations.  QR RP

ENAS 397b / EENG 397b, Mathematical Methods in Engineering  J. Rimas Vaišnys
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 440a / MENG 440a, Applied Numerical Methods I  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 RP

ENAS 441b / MENG 441b, Applied Numerical Methods II  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.  QR RP

ENAS 467a / EENG 467a, Computer Organization and Architecture  Jakub Szefer
Introduction to computer architecture, including computer organization, microprocessors, caches and memory hierarchies, I/O, and
storage. Issues surrounding performance, energy, and security; processor benchmarking. Selected readings from current academic
literature. Prerequisite: EENG 201, or with permission of instructor.  QR

ENAS 490b / MATH 25b / STAT 25b, Stochastic Processes  Amin Karbasi
Introduction to the study of random processes including linear prediction and Kalman filtering, Poison counting process and renewal
Applications chosen from communications, networking, image reconstruction, Bayesian statistics, finance, probabilistic analysis of
algorithms, and genetics and evolution. After STAT 241 or equivalent.  QR