

ENGINEERING & APPLIED SCIENCE (EAS)

EAS 091 Chemistry Advanced Placement/International Baccalaureate Credit (Engineering Students Only)

One-term course offered either term

Activity: Lecture

1 Course Unit

EAS 097 Embed Controlled Gardening

A service course intended to integrate concepts of basic physics, biology and electronics and systems engineering for the benefit of Penn engineering students, teachers and students from two minority centered community public schools. The course will engage the participants in the design and implementation of indoors cultivating systems using photo-voltaic (PV) technology to energize LED emulating the needed solar radiation for plant growth, a liquid nutrient distribution system, sensors / actuators capable of selecting the harvestable plants and keeping track of overall system parameters.

One-term course offered either term

Activity: Lecture

1 Course Unit

EAS 203 Engineering Ethics

In this course, students will study the social, political, environmental and economic context of engineering practice. Students will develop an analytical toolkit to identify and address ethical challenges and opportunities in the engineering profession, including studies of risk and safety, professional responsibility, and global perspectives. The course will begin with a foundation in the history of engineering practice and major Western ethical and philosophical theories. Students will then apply this material to both historical case studies, such as Bhopal, the NASA Shuttle Program, and Three Mile Island, as well as contemporary issues in big data, artificial intelligence, and diversity within the profession. Students will consider how engineers, as well as governments, the media, and other stakeholders, address such issues.

One-term course offered either term

Activity: Lecture

1 Course Unit

EAS 205 Applications of Scientific Computing.

This course will discuss a number of canonical problems and show how numerical methods are used to solve them. Lectures will introduce the underlying theory and the relevant numerical methods. Students will be expected to implement solutions to the problems using MATLAB. The course will use the visualization capabilities of MATLAB to provide students with a geometric interpretation of the key ideas underlying the numerical methods. Topics to be covered will include: The solution of systems of linear systems equations with application to problems such as force balance analysis and global illumination computation. Representing and computing coordinate transformations with applications to problems in graphics, vision and robotics. Transform Coding with applications to the analysis of audio signals and image compression. Analysis of variance and the search for low dimensional representations for high dimensional data sets egs. Google's PageRank algorithm. Least Squares model fitting with applications to data analysis. Analysis of linear dynamical systems with applications to understanding the modes of vibration of mechanical systems. The analysis of stochastic systems governed by state transition matrices.

One-term course offered either term

Prerequisites: Prior exposure to computing via courses such as EAS 105, CIS 110, or ESE 112. MATH 114, Sophomore standing.

Activity: Lecture

1 Course Unit

EAS 244 Curiosity: Anc&Modern

Also Offered As: CLST 344, INTG 344

Activity: Seminar

1 Course Unit

EAS 261 Emerg Tech & the Future

One-term course offered either term

Also Offered As: INTG 261, PSCI 261

Activity: Seminar

1 Course Unit

EAS 301 Climate Policy and Technology

The course will exam Pacala and Socolow's hypothesis that "Humanity already possesses the fundamental scientific, technical and industrial know-how to solve the carbon and climate problem for the next half-century." Fifteen "climate stabilization wedges" i.e., strategies that each have the potential to reduce carbon emissions by 1 billion tons per year by 2054, will be examined in detail. Technology and economics will be reviewed. Socio-political barriers to mass-scale implementation will be discussed. Pacala and Socolow note "Every element in this portfolio has passed beyond the laboratory bench and demonstration project; many are already implemented somewhere at full industrial scale".

One-term course offered either term

Also Offered As: EAS 505

Activity: Lecture

1 Course Unit

EAS 306 Electricity and Systems Markets

The course discusses the existing electricity system from technical, economic, and policy perspectives. Basic power system engineering will be reviewed early in the course. Generation, transmission, distribution, and end-use technologies and economics will be discussed. Additional topics will include system operation, industry organization, government regulation, the evolution of power markets, environmental policy, and emerging technologies.

One-term course offered either term

Also Offered As: EAS 506

Activity: Lecture

1 Course Unit

EAS 401 Energy and Its Impacts: Technology, Environment, Economics, Sustainability

The objective is to introduce students to one of the most dominating and compelling areas of human existence and endeavor: energy, with its foundations in technology, from a quantitative sustainability viewpoint with its association to economics and impacts on environment and society. This introduction is intended both for general education and awareness and for preparation for careers related to this field, with emphasis on explaining the technological foundation. The course spans from basic principles to applications. A review of energy consumption, use, and resources; environmental impacts, sustainability and design of sustainable energy systems; introductory aspects of energy economics and carbon trading; methods of energy analysis; forecasting; energy storage; electricity generation and distribution systems (steam and gas turbine based power plants, fuel cells), fossil fuel energy (gas, oil, coal) including nonconventional types (shale gas and oil, oil sands, coalbed and tight-sand gas), nuclear energy wastes: brief introduction to renewable energy use: brief introduction to solar, wind, hydroelectric, geothermal, biomass; energy for buildings, energy for transportation (cars, aircraft, and ships); prospects for future energy systems: fusion power, power generation in space. Students interested in specializing in one or two energy topics can do so by choosing them as their course project assignments.

Course usually offered in fall term

Also Offered As: EAS 501

Activity: Lecture

1 Course Unit

Notes: Any University student interested in energy and its impacts, who is a Junior or Senior. Students taking the course as EAS 501 will be given assignments commensurate with graduate standing.

EAS 402 Renewable Energy and Its Impacts: Technology, Environment, Economics, Sustainability.

The objective is to introduce students to the major aspects of renewable energy, with its foundations in technology, association to economics, and impacts on ecology and society. This introduction is intended both for general education and awareness and for preparation for careers related to this field. The course spans from basic principles to applications. A review of solar, wind, biomass, hydroelectric, geothermal energy, and prospects for future energy systems such as renewable power generation in space.

Course usually offered in spring term

Also Offered As: EAS 502

Prerequisite: Junior Standing

Activity: Lecture

1 Course Unit

EAS 403 Energy Systems and Policy

This is a survey course that will examine the current U.S. energy industry, from production to consumption, and its impacts on local, regional, and the global environment. The course will seek to provide a fuller understanding of existing energy systems, ranging from technical overviews of each, a review of industry organization, and an exploration of the well-established policy framework each operates within. Near-term demands upon each energy supply system will be discussed, with particular focus on environmental constraints. Policy options facing each energy industry will be reviewed.

One-term course offered either term

Also Offered As: EAS 503

Activity: Lecture

1 Course Unit

EAS 449 Product Development in Entrepreneurial Ventures

A product is any artifact, service or experience for which a buyer is willing to pay. Product Design & Development is at the core of entrepreneurship. Though in modern mythology it is a solitary effort by a passionate individual, entrepreneurship is frequently more successful when pursued in an interdisciplinary environment. Though it rarely requires the greatest time investment, concentration of personnel, the majority of the funding or even the greatest depth of expertise to accomplish, excellent product design can be the difference between a successful and failed venture. A poorly designed "product" can prevent a venture from being successful. An excellently designed product can make a competent business plan much more successful. A well defined and designed product solution will create differentiation, and can not only meet customer expectation but can create desirability. Through the review and discussion of case studies, lecture subjects, guest lecturers, field trips, and a semester long interdisciplinary team project, this class will provide insight into the problem identification and product design processes, user needs research, intellectual property research, experience design, Industrial Design, Interface Design, brand development and product centric fundraising processes.

Course usually offered in spring term

Also Offered As: IPD 549

Activity: Lecture

1 Course Unit

EAS 499 Senior Capstone Project

The Senior Capstone Project is required for all BAS degree students, in lieu of the senior design course. The Capstone Project provides an opportunity for the student to apply the theoretical ideas and tools learned from other courses. The project is usually applied, rather than theoretical, exercise, and should focus on a real world problem related to the career goals of the student. The one-semester project may be completed in either the fall or spring term of the senior year, and must be done under the supervision of a sponsoring faculty member. To register for this course, the student must submit a detailed proposal, signed by the supervising professor, and the student's faculty advisor, to the Office of Academic Programs two weeks prior to the start of the term.

One-term course offered either term

Activity: Independent Study

1 Course Unit

EAS 501 Energy and its Impacts: Technology, Environment, Economics, Sustainability.

The objective is to introduce students to one of the most dominating and compelling areas of human existence and endeavor: energy, with its foundations in technology, from a quantitative sustainability viewpoint with its association to economics and impacts on environment and society. This introduction is intended both for general education and awareness and for preparation for careers related to this field, with emphasis on explaining the technological foundation. The course spans from basic principles to applications. A review of energy consumption, use, and resources; environmental impacts, sustainability and design of sustainable energy systems; introductory aspects of energy economics and carbon trading; methods of energy analysis; forecasting; energy storage; electricity generation and distribution systems (steam and gas turbine based power plants, fuel cells), fossil fuel energy (gas, oil, coal) including nonconventional types (shale gas and oil, oil sands, coalbed and tight-sand gas), nuclear energy wastes: brief introduction to renewable energy use: brief introduction to solar, wind, hydroelectric, geothermal, biomass; energy for buildings, energy for transportation (cars, aircraft, and ships); prospects for future energy systems: fusion power, power generation in space. Students interested in specializing in one or two energy topics can do so by choosing them as their course project assignments.

Course usually offered in fall term

Also Offered As: EAS 401

Activity: Lecture

1 Course Unit

Notes: Any university student interested in energy and its impacts, who is a graduate student or who is an undergraduate Junior or Senior seeking graduate course credit. Students taking the course as EAS 501 will be given assignments commensurate with graduate standing.

EAS 502 Renewable Energy and Its Impacts: Technology, Environment, Economics, Sustainability.

The objective is to introduce students to the major aspects of renewable energy, with its foundations in technology, association to economics, and impacts on ecology and society. This introduction is intended both for general education and awareness and for preparation for careers related to this field. The course spans from basic principles to applications. A review of solar, wind, biomass, hydroelectric, geothermal energy, and prospects for future energy systems such as renewable power generation in space.

Course usually offered in spring term

Also Offered As: EAS 402

Activity: Lecture

1 Course Unit

EAS 503 Energy Systems and Policy

This is a survey course that will examine the current U.S. energy industry, from production to consumption, and its impacts on local, regional, and the global environment. The course will seek to provide a fuller understanding of existing energy systems, ranging from technical overviews of each, a review of industry organization, and an exploration of the well-established policy framework each operates within. Near-term demands upon each energy supply system will be discussed, with particular focus on environmental constraints.

One-term course offered either term

Also Offered As: EAS 403

Activity: Lecture

1 Course Unit

EAS 505 Climate Policy and Technology

The course will exam Pacala and Socolow's hypothesis that "Humanity already possesses the fundamental scientific, technical and industrial know-how to solve the carbon and climate problem for the next half-century." Fifteen "climate stabilization wedges" i.e., strategies that each have the potential to reduce carbon emissions by 1 billion tons per year by 2054, will be examined in detail. Technology and economics will be reviewed. Socio-political barriers to mass-scale implementation will be discussed. Pacala and Socolow note "Every element in this portfolio has passed beyond the laboratory bench and demonstration project; many are already implemented somewhere at full industrial scale".

One-term course offered either term

Also Offered As: EAS 301

Activity: Lecture

1 Course Unit

EAS 506 Electricity and Systems Markets

The course discusses the existing electricity system from technical, economic, and policy perspectives. Basic power system engineering will be reviewed early in the course. Generation, transmission, distribution, and end-use technologies and economics will be discussed. Additional topics will include system operation, industry organization, government regulation, the evolution of power markets, environmental policy, and emerging technologies.

Course usually offered in spring term

Also Offered As: EAS 306

Activity: Lecture

1 Course Unit

EAS 507 Intellectual Property and Business Law for Engineers

Engineers are often on the front line of innovation. The goal of this course is to introduce engineering students to the basics of Intellectual property (IP) and business laws that they will encounter throughout their careers. Understanding these laws is critical for the protection of IP and for the creation and success of high-tech start-up ventures. Market advantage in large part springs from a company's IP. Without legal protection and correct business formation, proprietary designs, processes, and inventions could be freely used by competitors, ruining market advantage. A basic understanding of IP laws, contractual transactions, employment agreements, business structures, and debt-equity financing will help engineering students to become effective employees or entrepreneurs, to acquire investors, and to achieve success. Though open to students of all disciplines, the course will use case studies particular relevance to students of engineering and applied science.

One-term course offered either term

Activity: Lecture

1 Course Unit

EAS 510 Technical Communication and Academic Writing for Non-native Speakers of English

Students will improve the grammar, word choice and organization of their professional writing by completing weekly writing assignments and a full-length research paper. Students will also give short oral presentations and receive feedback on pronunciation, wording, grammar and organization.

Course usually offered in spring term

Activity: Lecture

1 Course Unit

Notes: Graduate students whose native language is English, but who would benefit from a course in Technical Communication, should take EAS 500.

EAS 512 Engineering Negotiation

The goal of this course is to teach students of engineering and applied science to be effective negotiators. It aims to improve the way these students communicate in virtually any human interaction. The course intends to improve the ability of engineers and other technology disciplines to gain more support more quickly for projects, research product and services development, and marketing. For those wanting to be entrepreneurs or intrapreneurs, the course is designed essentially to find the most value possible in starting up and running companies. Based on Professor Diamond's innovative and renowned model of negotiation, it is intended to assist those for whom technical expertise is not enough to persuade others, internally and externally, to provide resources, promotions and project approvals; or to resolve disputes, solve problems and gain more opportunities. Rejecting the 40-year-old notions of power, leverage and logic, the course focuses on persuasion by making better human connections, uncovering perceptions and emotions, and structuring agreements to be both collaborative and fair. This course is entrepreneurial in nature and can provide many times more value than traditional persuasion. The *Getting More* book has sold more than 1 million copies around the world and is also used by universities, corporations (Google), and U.S. Special Operations (SEALs, Green Berets, Special Forces, Marines) to save lives and reduce conflict. From the first day, students will do interactive cases based their own engineering-related problems and based on current problems in the news. There will be diagnostics enabling every student to assess his/her skill and improvements.

One-term course offered either term

Activity: Lecture

1 Course Unit

EAS 545 Engineering Entrepreneurship I

Engineers and scientists create and lead great companies, hiring managers when and where needed to help execute their vision. Designed expressly for students having a keen interest in technological innovation, this course investigates the roles of inventors and founders in successful technology ventures. Through case studies and guest speakers, we introduce the knowledge and skills needed to recognize and seize a high-tech entrepreneurial opportunity - be it a product or service - and then successfully launch a startup or spin-off company. The course studies key areas of intellectual property, its protection and strategic value; opportunity analysis and concept testing; shaping technology driven inventions into customer-driven products; constructing defensible competitive strategies; acquiring resources in the form of capital, people and strategic partners; and the founder's leadership role in an emerging high-tech company. Throughout the course emphasis is placed on decisions faced by founders, and on the sequential risks and determinants of success in the early growth phase of a technology venture. The course is designed for, but not restricted to, students of engineering and applied science and assumes no prior business education.

One-term course offered either term

Also Offered As: IPD 545

Prerequisite: Third or Fourth year or Graduate standing

Activity: Lecture

1 Course Unit

EAS 546 Engineering Entrepreneurship II

This course is the sequel to EAS 545 and focuses on the planning process for a new technology venture. Like its prerequisite, the course is designed expressly for students of engineering and applied science having a keen interest in technological innovation. Whereas EAS 545 investigates the sequential stages of engineering entrepreneurship from the initial idea through the early growth phase of a startup company, EAS 546 provides hands-on experience in developing a business plan for such a venture. Working in teams, students prepare and present a comprehensive business plan for a high-tech opportunity. The course expands on topics from EAS 545 with more in-depth attention to: industry and marketplace analysis; competitive strategies related to high-tech product/service positioning, marketing, development and operations; and preparation of sound financial plans. Effective written and verbal presentation skills are emphasized throughout the course. Ultimately, each team presents its plan to a distinguished panel of recognized entrepreneurs, investors and advisors from the high-tech industry.

One-term course offered either term

Prerequisite: EAS 545

Activity: Lecture

1 Course Unit

EAS 549 Engr Entrepreneurship Lab

One-term course offered either term

Activity: Lecture

1 Course Unit

EAS 590 Commercializing Information Technology

EAS 590 provides real world, hands-on learning on what it's like to actually start a high-tech company. We do that by using the Lean LaunchPad framework for Web start-ups. This class is not about how to write a business plan. Instead you will be getting your hands dirty talking to customers, partners, competitors, as you encounter the chaos and uncertainty of how a start-up actually works. EAS 590 provides real world, hands-on learning on what it's like to actually start a high-tech company. We do that by using the Lean LaunchPad framework for Web start-ups. This class is not about how to write a business plan. Instead you will be getting your hands dirty talking to customers, partners, competitors, as you encounter the chaos and uncertainty of how a start-up actually works.

One-term course offered either term

Activity: Lecture

1 Course Unit

EAS 591 Leading Technology Teams

Engineers routinely work in teams collaborating with experts from multiple fields to address increasingly large complex problems/opportunities. EAS 591, Leading Technology Teams, focuses on the dynamics of innovative, interdisciplinary, cross-functional teams. We examine ways to improve team performance by exploring technology leadership issues from multiple perspectives (i.e., the individual, the team, and the organization). Developing skills to be an effective technology team member, leader, and/or sponsor will provide you with a competitive advantage, not only for getting your first job but also for success throughout your career.

Activity: Lecture

0.5 Course Units

EAS 595 Foundations of Leadership

The goal of EAS 595 is to increase your capacity to effectively lead throughout your career and wherever you find yourself in an organization.

This involves understanding and learning about yourself and about working effectively with others. The course starts with an identification of values, strengths, preferences and passions. It then proceeds with the personal and interpersonal and moves through the strategic aspects of leadership by bringing together aspects of management science, social psychology, psychology of personality and behavioral economics. Topics include teamwork and team dynamics, identifying life's goals and dreams, decision making, valuing differences, understanding the dynamics of influence, using power with integrity, giving and receiving feedback, leading change, and discovering where we can make our contribution.

One-term course offered either term

Activity: Lecture

1 Course Unit

EAS 898 CPT Research Practicum.

One-term course offered either term

Activity: Lecture

1 Course Unit

EAS 900 Responsible Conduct for Research in Engineering

One-term course offered either term

Activity: Seminar

1 Course Unit