Course Descriptions and Syllabi

Descriptions of undergraduate courses on engineering for non-engineers and technological literacy.

Engineering and the Modern World: A First Year Course on Engineering and History”
David Billington, Michael Littman and others
Princeton University

This course looks at works of concern to engineering including bridges, railroads, power plants, highways, airports, harbors, automobiles, aircraft, computers, and microchips. Historical analysis provides a basis for studying urban problems by focusing on scientific, political, ethical, and aesthetic aspects in the evolution of engineering over the pasts two centuries. The precepts and the papers focus historically on the social and political issues raised by these innovations and how they were shaped by society as well as how they helped shape culture.

The class attracts many first and second year students. Engineering students can take the course to satisfy a “historical analysis” graduation requirement. The course is conducted using the language of science and mathematics, including use of formulas.


Designing People
James Baish,
Bucknell University

In this foundation seminar, students explore the design process. They study the elements of past designs and engage in design themselves. They work as individual designers and as part of a design team. They undertake a design project to address an important human need in today’s society. A major segment of the course focuses upon the evolution of the automobile as an example of human design. Questions about the real versus created needs are asked. The interaction of design with economics, social structure, politics and engineering capabilities is studied. The elements of style and aesthetics are assessed including the presence of gender differences. Several field trips are held to museums in order to see and evaluate past designs, and to modern manufacturing facilities to see how design is employed today.

It was found that design projects were technically accessible to all types of students without the need for highly specialized quantitative methods. Rule-of-thumb techniques made the design process accessible to math-averse students. While a challenge, limited mathematics background was not a barrier. The course appealed to a broad range of students. Meeting a university degree requirement was found to be an important element in establishing enrollments.

How Things Work, Physics 105 and 106  
Louis Bloomfield  
University of Virginia

This course for non-science majors introduces physics and science in everyday life. It considers objects from our daily environment and focuses on their principles of operation, histories, and relationships to one another. Physics 105 is concerned primarily with mechanical and thermal objects, while Physics 106 emphasizes objects involving electromagnetism, light, special materials, and nuclear energy. They may be taken in either order.

The course was designed for non-scientists and built around everyday objects. The course has been exceptionally popular. For more than a decade, 500 students took the course each semester, however enrollment is now capped at 200 students.


Science at Work: Technology in the Modern World  
Kate Disney  
Mission College

This course is designed for students of all disciplines who are interested in principles and applications of science. Students experiment with technological applications to discover scientific principles. Concepts of science discovered through experimentation and observation include: force, work, and power; the conversion of energy and the transmission of power; Newton’s Laws; thermodynamics and heat engines; Faraday’s Law of induction; Radiation; atomic mass energy; and materials science. Students dissect an engineering system after the instructor provides a presentation and/or demonstration or the related scientific theory. Experiments enable students to verify or disprove their initial hypothesis as to how the system functions and employs science. There is a Credit/ No Credit option

Fuel Cell Systems  
Camille George  
University of St. Thomas

A discovery-oriented pedagogy devoted to all aspects of fuel cells: types, operation, design, safety, economics, policy & implementation. The class examines the chemistry, physics, design, system integration, energy analysis and cost of fuel cells. Considerable time is spent on hydrogen generation, storage & distribution. Class follows the ‘inquiry- based learning’ pedagogy, not the traditional lecture/exam model. Anyone interested in energy policy & the new hydrogen
The economy is invited to participate. No prerequisites. All interested students are encouraged to enroll.


The Hidden World of Engineering
William Hammack
University of Illinois at Urbana-Champaign

Simple objects shape our lives, yet are engineering masterpieces. To unveil this hidden world, the course uses a humanistic approach. Designed to appeal to all majors, it uses human stories - filled with failures and triumphs - to reveal the methods of engineers. The course enchants with tales of ancient steel making, today's pop cans, huge stone monuments, and salt. The course seeks to change how a student looks at his or her world. Several sessions focus on women engineers and the environment.

This course for non-engineers attracts 60% business majors and 40% from other majors. An emphasis is placed on engineering decisions or choices: Why did an engineer decide to design an object in a particular way? Bill Hammack also created the Engineering and Life program on public radio which reaches beyond the classroom to a mass audience.


Science and Technology of Everyday Life
John Krupczak
Hope College

This course studies the wide variety of technology used in everyday life. Modern society would not exist without the aid of technology. We depend upon technological devices for communication, food production, transportation, health care and even entertainment. The course objectives are to develop a familiarity with how various technological devices work and to understand the scientific principles underlying their operation. Topics covered include the automobile, radio, television, personal electronics, microwave ovens, computers, ultrasound, and x-ray imaging. Concepts from basic science are introduced as they appear in the context of technology. Laboratory projects include construction of simple objects such as radios, electric motors, and a musical keyboard.

The courses satisfies a laboratory science requirement.


The Digital Information Age
Roman Kuc
Yale University

An introduction to information transmission and storage and their impact on society. Technological issues and trade-offs that affect the design of communication systems. The binary number system, elementary computer logic; digital speech and image coding on compact disks; information transmissions-from touch-tone telephones to modems and faxes to World Wide Web; UPC bar codes, and a glimpse into the future. Projects include implementing a single digital system and Web pages. Intended for students in the humanities and social sciences and for freshmen considering an electrical engineering major. No prerequisites other than a working knowledge of elementary algebra.

Course enrollment reached 500 students per year making this one of the largest and most popular classes at Yale. Positive student response includes a sense of empowerment through having developed an understanding of how information systems work. Many of the students reported this the most worthwhile course they had taken at the University.


The Engines of Our Ingenuity
John H. Lienhard,
University of Houston

The Engines of Our Ingenuity was originally a course at the University of Houston and is now a daily radio program that is carried nationally on some 46 Public Radio stations as well as other markets. Associated with it is a website that gets approximately third of a million page hits per week and is widely used in schools. The radio program that tells the story of how our culture is formed by human creativity.

The Engines of Our Ingenuity, www.uh.edu/engines.


Electrical Machines and Information Technology Systems
Deborah Mechtel, and others
Modeling and analysis techniques are applied to rotating electric machinery. Basic principles of digital logic circuitry and computer architecture are introduced. The principles of analog and digital communications are presented, including common digital modulation techniques. Link budget analysis and satellite communications principles are presented. Other topics include network topology, connectivity, routing, queuing, bandwidth, spectrum utilization, the OSI Modele, TCP/IP, and the Internet.

All students at the Naval Academy, regardless of their major, must take two electrical engineering courses. These courses are taught to more than 600 students each year. The results show that students across range of majors can achieve level of knowledge comparable to engineering students. Because the material is strongly related to naval applications, midshipmen see this knowledge as important to them. All students have necessary prerequisite material since all students also have three semesters of calculus before taking class. Success is also based on a supportive laboratory environment and class sizes that facilitate individual attention if needed. Students respond positively to obtaining an in-depth understanding of electrical engineering topics. A non-engineering student learning about radar remarked that: “I have been wanting to know this for so long,” a not infrequent student response.


Technological Literacy: How Things Work
David Ollis,
North Carolina State University

Lecture survey on evolution and current status of thirteen modern technologies involving electricity, information, sound, light, imaging, recording, engines, materials, and language codes. The laboratory allows both lecture-demonstrations and team-based explorations of modern technologies. Lab topics include cell phones, electric and acoustic guitar, FAX machines, optical fibers, engines, Internet search engines, DVD systems, photocopiers, video cameras and digital cameras, satellite TV, and water purifiers. Lectures and labs together provide context, content, and contraption. Case examples reported as written papers.

The course attracted students from Colleges of Humanities and Social Sciences, Art and Design, Education, and Management. Organization of the laboratory portion of the course demonstrated how to effectively share equipment between a technological literacy course and engineering department use. This sharing of resources increased the use efficiency of both space and equipment. The course demonstrated a novel, multi-dimensional approach to technology literacy as a new format for delivery of this topic: each topic is approached through study of device historical origin and technical evolution, description of principles and key operations of the modern device, and the opportunity to use, dissect and reassemble the device at a basic level, sufficient to encounter major process paths.
Technology 21
Albert J. Rosa
University of Denver

This is a course for leadership in the new millennium. It prepares students to make wise technological decisions. Decisions on technology that affect all of us are rarely made by scientists or engineers, but rather by business people and politicians who often are swayed by emotion, popular opinion, misconceptions and/or mistrust of technology. This course provides students with sufficient background to help them make smart technological decisions. The first two quarters help students understand the basic resources available to develop technology: energy, materials and information. These resources comprise the fundamental building blocks of a modern technological society. The last quarter allows students to practice making smart technological decisions on a national or global issue.

This course has been taught successfully for 14 years. Initially an experiment, the course became fully institutionalized and seen as an important offering by the Department of Engineering. A variety of different instructors have taught the course with success. The course is able to attract students from liberal arts, business, law, and other non-technical disciplines. Enrollment is capped at 90 students with a considerable waiting list. The department has also been successful in attracting a diverse array of experts from outside the university to assist in their areas of expertise.


Innovation, Invention, and Technology
Tarek Shraibati
California State University Northridge

The course is an exploration of the history, processes, methods, and creators of technological innovations and invention. Global contributions, creator diversity, and technological failures are addressed. Critical assessments of technological innovation and invention are developed.


Introduction to Computer-Aided Graphics Tools
Tarek Shraibati
California State University Northridge
Introduction to the use of computer-aided (CA) graphics tools. Development of skills and techniques in graphical, pictorial and rotational representation. Students work on an individual project tailored to meet the needs of their field of study, and post their project on the Web. Satisfies University General Education, Section E, Applied Arts and Sciences; not available for credit towards an engineering degree.

This course has been successful at a culturally diverse, comprehensive regional university in which many of the students are the first members of their families to attend college. The course was successfully established as a regular offering at the university. Students taking the course are drawn from a variety of majors including: graphic design, art, math, urban studies, journalism, biology, health science, English, history, speech communications. Many of the students in the class are freshmen. In one survey, 41% of the students indicate they would be interested in taking another course of this type.


Technology and the Human Built World
Krishna Vedula
University of Massachusetts-Lowell.

Humans have been called the animals which make things and at no time in history has that been so apparent as the present. Today, every human activity is dependent upon various tools, machines and systems, from growing food and providing shelter to communication, healthcare, entertainment and security. The average citizen, therefore, needs to be more knowledgeable of the history and nature of technology that sustains the modern world. This will ensure that the public is engaged with the decisions that help shape its technological future.

In this course, students develop an understanding of the Nature of Technology including relationships among technologies and the connections between technology and other fields. Students develop an understanding of Technology and Society including the cultural, social, economic and political effects of technology; effects of technology on the environment; role of society in the development and use of technology; and influence of technology on history. Students develop the abilities to apply the design process, use and maintain technology and assess the impact of products and systems. Students develop an understanding of the designed world including selecting and using medical technologies, agricultural and biotechnologies, energy and power technologies, information and communication technologies, transportation technologies, manufacturing technologies and construction technologies.

Engineering for Non-Engineers
Larry Whitman
Wichita State University
An introduction to the engineering discipline using hands-on exercises and demonstrations using LEGO Mindstorms. Technical and practical aspects of aerospace, computer, electrical, industrial, manufacturing, and mechanical engineering are presented. Intended for freshman and sophomore non-engineering students who want to understand how engineering impacts their lives.

The class targets students who are not “techies” and are not intending to become engineers. The versatility of LEGO Mindstorms is exploited to serve as a common platform to carry out projects representative of several different engineering fields including: mechanical, electrical, industrial, aerospace, and programming.