

Preparing for Transfer

College of Engineering
Cornell University

Majors:

Biological Engineering
Civil Engineering
Chemical Engineering
Computer Science
Electrical & Computer Engineering
Engineering Physics
Environmental Engineering
Science of Earth Systems
Information Science, Systems, &
Technology
Materials Science & Engineering
Mechanical Engineering
Operations Research & Engineering

Minors:

Aerospace Engineering
Applied Mathematics
Biological Engineering
Biomedical Engineering
Civil Infrastructure
Computer Science
Electrical & Computer Engineering
Engineering Management
Engineering Statistics
Environmental Engineering
Game Design
Industrial Systems & Information
Technology
Information Science
Materials Science & Engineering
Mechanical Engineering
Operations Research & Management
Science
Science of Earth Systems

**COLLEGE OF
ENGINEERING**

**Cornell University
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Ithaca, NY 14853-3501**

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Accelerating Innovation.

With a dozen engineering majors, state-of-the-art facilities, and bright innovative people to work with, you'll find that the College of Engineering is where intellect translates into innovation and ideas become reality.

Becoming a Cornell engineer means tapping your expertise in science and math to be challenged in ways you've never imagined, while engaging the world of the other six undergraduate colleges on Cornell's campus. Get involved in undergraduate research, either on a team or with your own project. Half of our undergraduate engineering students will participate in research during their time at Cornell, brainstorming problems with some of the world's premier research minds. Balance the theoretical with the practical by getting involved with one of our project teams. Design a satellite or an autonomous aircraft, build and race a Formula One racecar, or create a fully functional solar house with other students across the university. With our blend of theoretical and practical education, you'll be prepared to accelerate innovation into the next millennium.

Admissions Requirements

The two most important criteria for admission to the College of Engineering are:

- The content and rigor of the college-level courses you have taken. This is absolutely critical for Engineering transfers so you can transition seamlessly into our program at the sophomore or junior level.
- How well you have performed in these courses. The majority of our successful transfer applicants have a grade-point average equivalent to B+/A- or higher in a rigorous, accredited engineering, engineering science, or pre-engineering program.

Plan!

Transferring takes planning! It is critical for you to have completed the prerequisite courses listed in this flyer, and we encourage you to visit our website for further information. Transfer applicants must select one or two of the majors listed on the left of the page, and must submit an interest statement for each major. We do not permit transfer applicants to apply as undecided students, so you must select a major when you submit your application. *Applicants must be prepared to demonstrate the content covered in their prerequisite courses by submitting detailed course descriptions along with their application.*

Engineering Curriculum Overview & Requirements

The following is an overview of the minimum academic requirements for prospective transfer students to the College of Engineering. To achieve sophomore standing in a particular major, applicants must have completed *at least* the equivalent of all Cornell courses listed in the “sophomore standing” column. For junior standing, applicants must have completed the equivalent of all Cornell courses listed in the “junior standing” column, *as well as* those listed in the “sophomore standing” column. **Please use this chart and the accompanying Cornell course descriptions as a guide when choosing courses at your current institution**, and feel free to contact Engineering Admissions if you have any specific questions or concerns. *Note: Most transfer students will be required to complete an additional 1-credit CS course, either CS 1130 or CS 1132, upon matriculating at Cornell Engineering. Details on those two courses can be found in the Engineering Undergraduate Handbook or in the university Courses of Study.*

Engineering Major	Academic Requirements For Sophomore Standing	Academic Requirements For Junior Standing
<p>Biological Engineering <i>Note: Biology and chemistry sequence can be taken in either order for this major.</i></p>	MATH 1910 & 1920 C S 1112 (or BEE 1510) CHEM 2090 & 1570 PHYS 1112 2 First-Year Writing Seminars	MATH 2930 & 2940 ENGRD 2020 ENGRD 2600 or 2210 PHYS 2213 BIO G 1101, 1102, 1103 & 1104 2 Liberal Studies Courses
<p>Civil Engineering <i>Note: Students can substitute CHEM 2080 for PHYS 2214 in this major.</i></p>	MATH 1910 & 1920 C S 1110 CHEM 2090 PHYS 1112 2 First-Year Writing Seminars	MATH 2930 & 2940 ENGRD 2020 PHYS 2213 & 2214 2 Liberal Studies Courses
<p>Chemical Engineering <i>Note: Students are encouraged to apply to enter as sophomores because some required sophomore courses do not have equivalents at many other institutions.</i></p>	MATH 1910 & 1920 C S 1110 or 1112 CHEM 2090 & 2080 PHYS 1112 2 First-Year Writing Seminars	MATH 2930 & 2940 ENGRD 2190 CHEM 2900, 3890 & 3900 CHEM 3230 PHYS 2213 2 Liberal Studies Courses Biology Elective (recommended)
<p>Computer Science</p>	MATH 1910 & 1920 C S 1110 CHEM 2090 PHYS 1112 ENGRD 2110 2 First-Year Writing Seminars	MATH 2940 C S 2800 & 3110 CHEM 2080 PHYS 2213 2 Liberal Studies Courses
<p>Electrical & Computer Engineering <i>Note: Successful transfer applicants to this major will generally have completed introductory coursework in digital logic design, fundamental properties of circuits, or signal processing before applying for admission.</i></p>	MATH 1910 & 1920 One of: (ENGRD/ECE 2100, ENGRD 2300, ECE 2200) C S 1110 or 1112 CHEM 2090 PHYS 1112 2 First-Year Writing Seminars	MATH 2930 & 2940 Two of: (ENGRD/ECE 2100, ENGRD 2300, ECE 2200) PHYS 2213 & 2214 2 Liberal Studies Courses
<p>Engineering Physics <i>Note: Students are encouraged to apply to enter this major as juniors. For more information on ENGRI and ENGRD courses, visit the online Courses of Study and search by department for “ENGRI” or “ENGRD”.</i></p>	MATH 1910 & 1920 C S 1110 CHEM 2090 PHYS 1112 Any ENGRI course 2 First-Year Writing Seminars	MATH 2930 & 2940 A&EP 3630 (recommended) Any ENGRD course PHYS 2213 & 2214 2 Liberal Studies Courses

(continued on next page)

Engineering Major	Academic Requirements For Sophomore Standing	Academic Requirements For Junior Standing
Environmental Engineering	MATH 1910 & 1920 C S 1110 (or BEE 1510) CHEM 2090 & 1570 PHYS 1112 2 First-Year Writing Seminars	MATH 2930 & 2940 ENGRD 2020 PHYS 2213 2 Liberal Studies Courses BIO G 1109 or 1102 + 1104 One of: (ENGRD 2210, ENGRD 2510, ENGRD 3200)
Information Science, Systems, & Technology <i>Note: If MATH 2930 is not taken, then CHEM 2080 must replace PHYS 2214 for this major.</i>	MATH 1910 & 1920 C S 1110 CHEM 2090 INFO 2300 PHYS 1112 2 First-Year Writing Seminars	MATH 2940 MATH 2930 or one of: (MATH 3040, C S 2800) ENGRD 2110 & 2700 PHYS 2213 & 2214 INFO 3300 2 Liberal Studies Courses
Materials Science & Engineering	MATH 1910 & 1920 C S 1110 CHEM 2090 ENGRD 2610 or 2620 PHYS 1112 2 First-Year Writing Seminars	MATH 2930 & 2940 ENGRD 2610 & 2620 MS&E 2060 PHYS 2213 & 2214 2 Liberal Studies Courses
Mechanical Engineering <i>Note: If current institution does not offer MAE 2120 or 2250 equivalents, students should take PHYS 2214 or ENGRD/ECE 2100 instead.</i>	MATH 1910 & 1920 C S 1110 CHEM 2090 PHYS 1112 2 First-Year Writing Seminars	MATH 2930 & 2940 ENGRD 2020, 2030, & 2210 PHYS 2213 M&AE 2120 & 2250 2 Liberal Studies Courses
Operations Research & Engineering <i>Note: If MATH 2930 is not taken, then CHEM 2080 must replace PHYS 2214 for this major.</i>	MATH 1910 & 1920 C S 1110 or 1112 CHEM 2090 PHYS 1112 2 First-Year Writing Seminars	MATH 2940 MATH 2930 or one of: (MATH 3040, C S 2800) ENGRD 2110 & 2700 PHYS 2213 & 2214 2 Liberal Studies Courses
Science of Earth Systems	MATH 1910 & 1920 C S 1110 CHEM 2090 PHYS 1112 2 First-Year Writing Seminars	MATH 2930 & 2940 PHYS 2213 CHEM 2080 or CHEM 1570 BIO G 1109 2 Liberal Studies Courses

Visit our website for more information on courses,
curricula for all majors and minors, and more!
www.engineering.cornell.edu/transfer

Descriptions For Courses Listed On Pages 2-3

For complete course descriptions, see the Cornell Courses of Study at: <http://www.cuinfo.cornell.edu/Academic/Courses/>

A&EP 3630 Electronic Circuits

4 credits. Students analyze, design, build, and experimentally test circuits used in scientific and engineering instrumentation (with discrete components and integrated circuits). Analog circuits: resistors, capacitors, operational amplifiers (linear amplifiers with feedback, oscillators, comparators), filters, diodes, and transistors. Digital circuits: combinatorial (gates) and sequential (flip-flops, counters, shift registers) logic. Computer interfacing introduced and used to investigate digital to analog (DAC) and analog to digital conversion (ADC) and signal averaging.

BEE 1510 Introduction to Computer Programming

4 credits. Introduction to computer programming and concepts of problem analysis, algorithm development and data structure in an engineering context. The structured programming language MATLAB is used, implemented on interactive personal computers, and applied to problems of interest in biological and environmental engineering.

BIO G 1101-1102 Biological Sciences, Lectures

2 credits each course. Designed for students who intend to specialize in biological sciences. The fall semester [1101] covers the chemical and cellular basis of life, energy transformations, physiology, neurobiology, and behavior. The spring semester [1102] covers genetics, development, evolution, and ecology. Each topic is considered in terms of modern evolutionary theory, and discussions of plant and animal systems are integrated.

BIO G 1103-1104 Biological Sciences, Laboratory

2 credits each course. First-semester [1103] topics include biochemistry, physiology, plant biology, and behavior. In the second semester [1104], laboratory experience is provided in genetics, biotechnology, invertebrate diversity, plant and animal development, and ecology.

BIO G 1109 Biological Principles

3 credits. This course is intended to appeal to anyone who seeks an overview of general biology topics and current biological issues. BIO G 1109 is offered during fall semester and introduces students to the diversity of biological organisms, Mendelian genetics, behavior, and ecology and culminates by tying together the information covered during the semester with current issues involving global climate change and biomimetic research. (Course includes a laboratory component.)

Biology Elective

See the Undergraduate Engineering Handbook (<http://www.engineering.cornell.edu/student-services/academic-advising/engineering-handbook/index.cfm>) for more details on this requirement.

CHEM 1570 Intro to Organic & Biological Chemistry

3 credits. Introduction to organic chemistry with an emphasis on those structures and reactions of organic compounds having particular relevance to biological chemistry.

CHEM 2080 General Chemistry II

4 credits. Covers fundamental chemical principles, with considerable attention given to the quantitative aspects and techniques important for further work in chemistry. (Course includes a laboratory component.)

CHEM 2090 Engineering General Chemistry I

4 credits. Covers fundamental chemical principles, with considerable attention given to the quantitative aspects and techniques important for further work in chemistry. (Course includes a laboratory component.)

CHEM 2900 Introductory Physical Chemistry Laboratory

2 credits. Survey of the methods basic to the experimental study of physical chemistry, with a focus on the areas of kinetics, equilibrium, calorimetry, and molecular spectroscopy.

CHEM 3890-3900 Honors Physical Chemistry I & II

4 credits each. CHEM 3890 is primarily an introduction to the quantum mechanics of atoms and molecules. The behavior of ensembles of quantum mechanical particles (statistical mechanics) is introduced near the end of the semester. Rotational, vibrational and electronic spectroscopy are covered in detail. CHEM 3900 is a continuation of CHEM 3890 and discusses the thermodynamic behavior of macroscopic systems in the context of quantum and statistical mechanics. Kinetic theory and the laws of thermodynamics are covered in detail.

CHEM 3230 Fluid Mechanics

3 credits. Fundamentals of fluid mechanics. Macroscopic and microscopic balances. Applications to problems involving viscous flow.

C S 1110 Introduction to Computing Using Java

4 credits. Programming and problem solving using Java. Emphasizes principles of software development, style, and testing. Topics include object-oriented concepts, procedures and functions, iteration, arrays, strings, algorithms, exceptions, GUIs (graphical user interfaces). Weekly labs provide guided practice on the computer, with staff present to help. Assignments use graphics and GUIs to help develop fluency and understanding. (Similar courses in C++ are also acceptable.)

C S 1112 Introduction to Computing Using MATLAB

4 credits. Programming and problem solving using MATLAB. Emphasizes the systematic development of algorithms and programs. Topics include iteration, functions, arrays, and MATLAB graphics. Assignments are designed to build an appreciation for complexity, dimension, fuzzy data, inexact arithmetic, randomness, simulation, and the role of approximation.

C S 2800 Discrete Structures

3 credits. Covers the mathematics that underlies most of computer science. Topics include mathematical induction; logical proof; propositional and predicate calculus; combinatorics and discrete mathematics; basic probability theory; basic number theory; sets, functions, and relations; partially ordered sets; and graphs. These topics are discussed in the context of applications to many areas of computer science, including game playing, the RSA cryptosystem, data mining, load balancing in distributed systems, properties of the Internet and World Wide Web, and web searching.

C S 3110 Data Structures & Functional Programming

4 credits. Advanced programming course that emphasizes functional programming techniques and data structures. Programming topics include recursive and higher-order procedures, models of programming language evaluation and compilation, type systems, and polymorphism. Data structures and algorithms covered include graph algorithms, balanced trees, memory heaps, and garbage collection. Also covers techniques for analyzing program performance and correctness.

ECE 2200 Signals & Information

4 credits. Introduction to signal processing. Topics include frequency based representations: Fourier series and discrete Fourier transform; discrete time linear systems: input/output relationships, filtering, spectral response; analog-to-digital and digital-to-analog conversion; continuous time signals and linear time invariant systems: frequency response and continuous-time Fourier transform.

ENGRD 2020 Mechanics of Solids

4 credits. Covers principles of statics, force systems, and equilibrium; frames; mechanics of deformable solids, stress, strain, statically indeterminate problems; mechanical properties of engineering materials; axial force, shearing force, bending moment, thermal stress, stretching; bending and torsion of bars. Laboratory experiments demonstrate basic principles of solid mechanics.

ENGRD 2030 Dynamics

3 credits. Newtonian dynamics of a particle, systems of particles, a rigid body. Kinematics, motion relative to a moving frame. Impulse, momentum, angular momentum, energy. Rigid-body kinematics, angular velocity, moment of momentum, the inertia tensor. Euler equations, the gyroscope. Laboratory experiments demonstrate basic principles of dynamics.

ENGRD/ECE 2100 Intro to Circuits for Elec. & Comp. Engrs

4 credits. First course in electrical circuits and electronics that establishes the fundamental properties of circuits with application to modern electronics. Topics include circuit analysis methods, operational amplifiers, basic filter circuits, and elementary transistor principles. The laboratory experiments are coupled closely with the lectures.

ENGRD 2110 Object-Oriented Programming and Data Structures

3 credits. Intermediate programming in a high-level language and introduction to computer science. Topics include program structure and organization, object-oriented programming (classes, objects, types, sub-typing), graphical user interfaces, algorithm analysis (asymptotic complexity, big "O" notation), recursion, data structures (lists, trees, stacks, queues, heaps, search trees, hash tables, graphs), simple graph algorithms. Java is the principal programming language.

ENGRD 2190 Mass & Energy Balances

3 credits. Engineering problems involving material and energy balances. Batch and continuous reactive systems in the steady and unsteady states. Introduction to phase equilibria for multicomponent systems. Examples drawn from a variety of chemical and biomolecular processes.

ENGRD 2210 Engineering Thermodynamics

3 credits. Presents the definitions, concepts, and laws of thermodynamics. Topics considered include the first and second laws, thermodynamic property relationships, and applications to vapor and gas power systems, refrigeration, and heat pump systems. Examples and problems are related to contemporary aspects of energy and power generation and to broader environmental issues.

ENGRD/ECE 2300 Introduction to Digital Logic Design

4 credits. Introduction to the design and implementation of practical digital circuits. Topics include transistor network design, Boolean algebra, combinational circuits, sequential circuits, finite state machine design, and analog and digital converters. Design methodology using both discrete components and hardware description languages is covered in the weekly laboratory portion of the course.

ENGRD 2510 Engineering for a Sustainable Society

3 credits. Case studies of contemporary environmental issues including pollutant distribution in natural systems, air quality, hazardous waste management and sustainable development. Emphasis is on the application of math, physics and engineering sciences to solve energy and mass balances in environmental sciences. Introduces students to the basic chemistry, ecology, biology, ethics and environmental legislation relevant to the particular environmental problem.

ENGRD 2600 Principles of Biological Engineering

3 credits. Focuses on the integration of biological principles with engineering, math and physical principles. Students learn how to formulate equations for biological systems in class and practice in homework sets. Topics range from molecular principles of reaction kinetics and molecular binding events to macroscopic applications such as energy and mass balances of bioprocessing and engineering design of implantable sensors.

ENGRD 2610 Mechanical Properties of Materials: from Nanodevices to Superstructures

3 credits. Examines the mechanical properties of materials (e.g., strength, stiffness, toughness, ductility) and their physical origins. Topics include the relationship of elastic, plastic, and fracture behavior to microscopic structure in metals, ceramics, polymers, and composite materials. Effects of time and temperature on materials properties, and considerations for design and optimal performance of materials in engineered objects and biological tissues.

ENGRD 2620 Elec. Materials for the Information Age

3 credits. Examines the electrical and optical properties of materials. Topics include the mechanism of electrical conduction in metals, semiconductors and insulators, the tuning of electrical properties in semiconductors, the transport of charge across metal/semiconductor and semiconductor/semiconductor junctions, and the interaction of materials with light. Applications in electrophotography, solar cells, electronics, and display technologies are discussed.

ENGRD 2700 Engineering Probability & Statistics

3 credits. Gives students a working knowledge of basic probability and statistics and their application to engineering. Includes computer analysis of data and simulation. Topics include random variables, probability distributions, expectation, estimation, testing, experimental design, quality control, and regression.

ENGRD 3200 Engineering Computation

3 credits. Introduction to numerical methods, computational mathematics, and probability and statistics. Development of programming and graphics proficiency with MATLAB and spreadsheets. Topics include: Taylor-series approximations, numerical errors, condition numbers, operation counts, convergence, and stability, probability distributions, hypothesis testing. Included are numerical methods for solving engineering problems that entail roots of functions, simultaneous linear equations, statistics, regression, interpolation, numerical differentiation and integration, and solution of ordinary and partial differential equations, including an introduction to finite difference methods. Applications are drawn from different areas of engineering. A group project uses these methods on a realistic engineering problem.

First-Year Writing Seminars

3 credits. More than 125 different writing-intensive courses in the liberal arts. Seminars require six to twelve writing assignments on different topics, totaling a minimum of 30 pages. For other courses to be substituted, students must demonstrate that they have done similar writing in a formal course. (It is not sufficient to write, for example, one 30-page paper.) For more information, see: http://www.arts.cornell.edu/knight_institute/fws/credit.htm

INFO 2300 Intermediate Design & Programming for the Web

3 credits. The main emphasis in CS 2300 is learning about server side processing. Students begin by looking at interactions with databases, learning about querying both on paper and via SQL, and then, through a succession of projects, learn how to apply this understanding to the creation of an interactive data-driven site via the use of an integrated web site development tool such as ColdFusion. Also considered are techniques to enhance security, privacy, and reliability and ways of incorporating other programs. Toward the end of the course, students are shown how these development tools are working. Design issues are emphasized. A major component of the course is the creation of a substantial web site.

INFO 3300 Data-Driven Web Applications

3 credits. Introduces students to modern database systems and three-tier application development with a focus on building web-based applications using database systems. Concepts covered include the relational model, relational query languages, data modeling, normalization, database tuning, three-tier architectures, Internet data formats and query languages, server- and client-side technologies, and an introduction to web services. Students build a database-backed web site.

Liberal Studies Courses

Courses in humanities, arts and social sciences. Six liberal studies classes/18 credit minimum (not including writing seminars) are required for graduation.

MATH 1910 Calculus for Engineers

4 credits. Essentially a second course in calculus. Topics include techniques of integration, finding areas and volumes by integration, exponential growth, partial fractions, infinite sequences and series, and power series.

MATH 1920 Multivariable Calculus for Engineers

4 credits. Introduction to multivariable calculus. Topics include partial derivatives, double and triple integrals, line integrals, vector fields, Green's theorem, Stokes' theorem, and the divergence theorem.

MATH 2930 Differential Equations for Engineers

4 credits. Introduction to ordinary and partial differential equations. Topics include: first-order equations (separable, linear, homogeneous, exact); mathematical modeling (e.g., population growth, terminal velocity); qualitative methods (slope fields, phase plots, equilibria, and stability); numerical methods; second-order equations (method of undetermined coefficients, application to oscillations and resonance, boundary-value problems and eigenvalues); Fourier series; linear partial differential equations (heat flow, waves, the Laplace equation); and linear systems of ordinary differential equations.

MATH 2940 Linear Algebra for Engineers

4 credits. Linear algebra and its applications. Topics include matrices, determinants, vector spaces, eigenvalues and eigenvectors, orthogonality and inner product spaces; applications include brief introductions to difference equations, Markov chains, and systems of linear ordinary differential equations. May include computer use in solving problems.

MATH 3040 Prove It!

4 credits. In this course, students learn various methods of mathematical proof, starting with basic techniques in propositional and predicate calculus and in set theory and combinatorics, and then moving to applications and illustrations of these via topics in one or more of the three main pillars of mathematics: algebra, analysis, and geometry. Since cogent communication of mathematical ideas is important in the presentation of proofs, the course emphasizes clear, concise exposition. This course is useful for all students who wish to improve their skills in mathematical proof and exposition, or who intend to study more advanced topics in mathematics.

M&AE 2120 Mechanical Properties & Selection of Engineering Materials

3 credits. Mechanics of deformable bodies and a reinforcement of the concept of "simple engineering elements" for mechanical analysis associated with design. Introduction to the broad range of properties and behaviors of engineering materials as they relate to mechanical performance. Emphasis is placed on general states of stress and strain, on elasticity and combined loading effects. Failure criteria including yielding, buckling, fracture, fatigue and environmental effects are developed. A general introduction to the function/constraints/objectives approach to material selection associated with mechanical design is provided with candidate material systems coming from metals, polymers, ceramics and/or composites. A general overview of material processing is presented within this context of material selection.

M&AE 2250 Mechanical Synthesis

4 credits. Hands-on introduction to the product design process, from conceptualization through prototype construction and testing. Design projects provide experience in basic prototyping skills using machine tools. Mechanical dissection used to demonstrate successful product design and function. Basic instruction on CAD and technical sketching.

MS&E 2060 Atomic and Molecular Structure of Matter

4 credits. Discusses the basic elements of structure; order and disorder; ideal gas; crystals; liquids; amorphous materials; polymers; liquid crystals; composites; crystal structure; x-ray diffraction

PHYS 1112 Physics I: Mechanics

4 credits. Covers the mechanics of particles with focus on kinematics, dynamics, conservation laws, central force fields, periodic motion. Mechanics of many-particle systems: center of mass, rotational mechanics of a rigid body, and static equilibrium. At the level of University Physics, Vol. 1, by Young and Freedman, 12th ed. (Course is calculus-based, and includes a laboratory component.)

PHYS 2213 Physics II: Heat/Electromagnetism

4 credits. Topics include temperature, heat, the laws of thermodynamics, electrostatics, behavior of matter in electric fields, DC circuits, magnetic fields, Faraday's law, AC circuits, and electromagnetic waves. At the level of University Physics, Vols. 1 and 2, by Young and Freedman, 12th ed. (Course is calculus-based, and includes a laboratory component.)

PHYS 2214 Physics III: Optics, Waves, & Particles

4 credits. Physics of oscillations and wave phenomena. Driven oscillations and resonance, mechanical waves, sound waves, electromagnetic waves, reflection and transmission of waves, standing waves, beats, Doppler effect, polarization, interference, diffraction, transport of momentum and energy, wave properties of particles, and introduction to quantum physics with applications to phenomena in physics, engineering, and biology. (Course is calculus-based, and includes a laboratory component.)