**Faculty:** Ms. Mader, Chairperson; Mr. Abrahantes, Mr. DeYoung*, Mr. Gonthier, Mr. Krupczak**, Mr. Little, Mr. Misovich, Ms. Pawloski, Mr. Veldman.

The engineering program at Hope College offers a B.S. degree with a major in engineering that is ABET accredited. Our program emphasizes small class sizes, the opportunity to carry out research with faculty, and state-of-the-art laboratories. Hope engineering students are often double majors or participants in athletics. At Hope we offer the kind of one-on-one attention that insures that each student reaches his or her potential. Faculty are focused on the success of undergraduate students as our most important goal.

Our engineering curriculum is designed to help students identify and define their interests, and provide the technical background needed to begin work as an engineer or continue on to advanced graduate study. Our approach to engineering education includes challenging coursework in engineering fundamentals in the classroom and laboratory. Other aspects include rigorous study of science and mathematics, and a broad education in the humanities and social sciences. Our innovative engineering design class has appeared in USA Today. The Hope College engineering program has an excellent record of placing students after graduation either in graduate schools or industry. Our recent graduates have taken jobs with such industry leaders as: Ford, General Motors, Pfizer, Lockheed-Martin, and Hewlett Packard. About 50% of our students go directly on to engineering graduate schools. Since 1996 half of the Hope engineering students going to graduate school have gone to one of the top graduate engineering schools in the country. These graduate schools include: the Massachusetts Institute of Technology, the University of Michigan, and the University of California at Berkeley.

## MAJOR PROGRAMS

The department offers several different majors designed to meet a variety of students' needs. Students with a possible interest in physics should also see that section.

## ENGINEERING

*The mission of the Hope College Engineering Program is to provide engineering students with a solid foundation in engineering and the underlying mathematics and sciences within the framework of a liberal arts education, and to contribute to the education of other Hope College students.*

The professional practice of engineering requires an understanding of analytical methods, design techniques, social and economic influences, and an appreciation for cultural and humanistic traditions. Our program supports these needs by offering each engineering student the opportunity to acquire a broad yet individualized technical and liberal education. At the core of the curriculum is a sequence of mathematics, physics and engineering courses that foster analytical and design skills applicable to a range of engineering disciplines. Elective courses, design projects and undergraduate research opportunities allow students to pursue specific areas of interest. Hope's strong liberal arts core curriculum provides engineering students with critical thinking skills, proficiency in a foreign language, and exposure to a diversity of views and cultures. Graduates of the program are prepared to begin a professional career or continue study in graduate school.

*Sabbatical Leave, Academic Year 2004-05
**Meiji Gakuin Exchange Professor, Fall Semester 2004

# ENGINEERING

To educate engineers within the context of a liberal arts college that emphasizes small classes and attention to individual needs, the engineering program has established the following educational objectives:

1. To prepare graduates with the education and background necessary to begin a successful career in engineering practice and/or gain entry in engineering graduate school.
2. To train students in methods of analysis, including an understanding of mathematics, science and engineering principles appropriate for engineers to use in practice.
3. To develop the ability of students to select and use current engineering techniques to solve problems. This includes designing and conducting experiments, using computer software tools and interpreting data.
4. To equip students with the skills needed to design a process, component or system that meets desired needs. This includes the ability to handle ambiguous constraints, generate alternative ideas and deal with economic, social and ethical criteria.
5. To foster the ability of students to be effective working in multidisciplinary teams and communicating ideas to others.
6. To provide students with an awareness of the societal context of engineering. This includes recognizing the social, political, economic and environmental impacts of engineering decisions and technology.
7. To develop an appreciation of cultural diversity, an awareness of the international nature of engineering practice, and to prepare students to work in a global environment.
8. To provide students with the opportunity for specialization or study in a secondary area of interest. Examples are having a dual major, fulfilling a departmental minor or preparing for advanced study in the student's particular area of interest.
9. To provide applied educational opportunities for students via interactions with business and industry.
10. To offer undergraduate students the opportunity to become involved in research.

## BACHELOR OF SCIENCE IN ENGINEERING

The Bachelor of Science in Engineering is a rigorous major accredited by the Accreditation Board for Engineering and Technology (ABET). The major provides an excellent preparation for graduate school in engineering or for engineering positions in a wide variety of industries.

### Electrical Engineering Emphasis

For the Bachelor of Science degree with a major in engineering with an electrical engineering emphasis, the major consists of 48 credits including the following courses: ENGS 170, 221, 222, 224, 241, 331, 333, 345, 351, 451, 452, and 342. An additional 15 credits are required, including a minimum of 9 credits selected from ENGS 242, 332, 352 or other approved electrical engineering topics courses (ENGS 495). The remaining courses must be selected from other engineering courses, or CSCI 160 or 225.

### Mechanical Engineering Emphasis

For the Bachelor of Science degree with a major in engineering with a mechanical engineering emphasis, the major consists of 48 credits including the following courses: ENGS 170, 221, 222, 224, 241, 331, 333, 345, 346, 451, 452, and 361. An additional 15 credits are required, including a minimum of 9 credits selected from

ENGS 332, 344, 348, 355 or other approved mechanical engineering topics courses (ENGS 495). The remaining courses must be selected from other engineering courses, or CSCI 160 or 225.

**Chemical Engineering Emphasis**

For the Bachelor of Science degree with a major in engineering with a chemical engineering emphasis, the major consists of 48 credits of engineering and must include ENGS 170, 221, 222, 224, 241, 331, 333, 345, 346, 348, 451, 452, 14 credits of approved chemical engineering topical courses (ENGS 295 or 495), and two additional credits selected from engineering offerings, CSCI 160 or 225. In addition to the cognate requirements listed above for the major, CHEM 114, 121, 221, 255, 322, 343, and two additional credits in chemistry at the 200 level or above (lecture and laboratory) are required. This course sequence also satisfies the requirements for a chemistry minor.

**Computer Engineering Emphasis**

Students interested in computer engineering should contact the engineering program director or the department chairperson.

**Biochemical Engineering Emphasis**

Students interested in biochemical engineering should contact Professor Misovich or the department chairperson.

**No Emphasis Option**

For the Bachelor of Science degree with a major in engineering with no specified emphasis, the major consists of 48 credits including the following courses: ENGS 170, 221, 222, 224, 241, 331, 333, 345, 346 or 351, 451, 452, and 342 or 361. An additional 15 credits are required from other engineering courses, or CSCI 160 or 225.

**For all emphasis options,** two semesters of ENGS 080 are required. A maximum of only three credits of internship (ENGS 499) and research (ENGS 490) may be counted toward the major.

In addition, 31 credits in science and mathematics courses are required, including PHYS 121, 141, 122, 142, 280, MATH 131, 132, 231, 232, CHEM 111 and 113. Computer programming competence is required. Engineering students are expected to have programming experience by the beginning of the senior year. This requirement may be satisfied by CSCI 160 or 225, or by demonstrating competence on a problem chosen by the department. Twenty-four hours of work at the level of 300 or above must be completed at Hope College.

Students interested in Civil Engineering should consult with the engineering program director as early as possible.

## BACHELOR OF SCIENCE IN ENGINEERING SCIENCE

The Bachelor of Science in Engineering Science major conforms to the minimum requirements for a Bachelor of Science degree at Hope College. It provides an adequate preparation for graduate school in engineering or entry level positions in industry. The major consists of a total of 36 credits which must include the following courses: ENGS 170, 221, 222, 224, 241, 280, 331, 333, 342 or 361, 345, 346 or 351, 451. An additional 3 credits must be chosen from ENGS 100, 242, 332, 342, 344, 348, 351, 355, 361, 452, 490, 495, 499, or CSCI 160, 225. Two semesters of ENGS 080 are required. Other courses may be substituted for the optional or required courses with prior approval of the department. A maximum of only three credits of internship and research may be counted toward the major.

In addition, 24 credits in science and mathematics courses are required, including PHYS 121, 141, 122, 142, MATH 131, 132, 231 and 232, CHEM 111 and 113. Two semesters of PHYS 080 also are required. Computer programming competence is required. Engineering students are expected to have had programming experience by the beginning of the senior year. This requirement may be satisfied by CSCI 160 or 225, or by demonstrating competence on a problem chosen by the department.

## ENGINEERING PHYSICS

Students wishing to combine elements of physics and engineering in their major should consider the Bachelor of Science in Engineering Physics. This major (minimum of 36 credits) combines elements from both areas and is designed in consultation with the chairperson and requires prior approval from the department.

## DUAL MAJORS

In case of a dual major the physics and engineering courses required are those described above. The additional mathematics and science requirements shall be established by agreement between the student and the department. Recent dual majors have included engineering-dance, engineering-chemistry, physics-mathematics, physics-computer science, physics-geology, physics-chemistry, and physics-philosophy.

## ENGINEERING MINOR

A minor in engineering consists of 20 credits of engineering courses. It must include ENGS 221, 241, and at least one 300 level course. The remaining courses are to be chosen by the student in consultation with the department chairperson and the student's advisor. The exact courses will depend upon the intended major program of the student. Prior approval of the courses by the department is required.

## DUAL BACCALAUREATE IN ENGINEERING

In general, students planning to transfer under a dual baccalaureate program enroll in the same courses that students would who are expecting to earn a degree in engineering from Hope College. If a student enrolls in the usual engineering course pattern, the decision about transferring can be made in the junior year. It is the responsibility of the student to confirm the transferability of credits and the exact nature of the course work required by the engineering school. Early discussions with the engineering advisor in the Department of Physics and Engineering are strongly suggested.

## PHYSICS

The fields of engineering and physics are closely related. Similar principles and science concepts are found in both. One is more focused on application and one tends more to the abstract. Students unsure of their specific career goals are encouraged to read about the physics program elsewhere in this catalog.

## PREREQUISITE POLICY

Many courses in the department have prerequisites listed. A grade of C- or better is required in these prerequisite courses. If this is not the case, then it is the view of the department that the prerequisite has not been fulfilled and the course may not be taken without written permission of the instructor and the department chairperson.

## ENGINEERING COURSES

**080. Seminar —** This is cross listed as Physics 080 and a full description may be found there.

**100. Introduction to Engineering —** This course is designed to introduce students to the intellectual endeavors of engineers and the various disciplines which constitute the field. Major engineering accomplishments are studied from historical, political, artistic and economic viewpoints. Students work in teams to solve engineering problems and undertake laboratory investigations. Visits to local companies and industrial installations are included. Open only to first year students. No prerequisites.

*Two Credits Krupczak Spring Semester*

**170. Computer Aided Design —** An introduction to computer aided design. Students will learn to use a solid modeling design system for the purpose of creating their own designs. Design methods and techniques will be studied through development of increasingly complex devices. Each student is expected to design a device of his/her own choosing, investigate its properties, write a report on it and make a presentation of the design to the class. Corequisite: Physics 122 or prior permission of the instructor.

*One Credit Veldman Fall Semester*

**221. Introduction to Solid Mechanics I —** Fundamental concepts of statics and the mechanics of deformable bodies: forces and couples, free body diagrams, equilibrium, mass properties, stress and strain, Hooke's Law and material behavior. Application to the equilibrium analysis of trusses, structures and machines in two and three dimensions. Engineering analysis of the stresses and deformations in structures which involve the axial loading of bars, torsion of circular rods and bending of beams. Corequisite: Mathematics 132. Prerequisite: Engineering 100 or Physics 121.

*Four Credits Pawloski Fall Semester*

**222. Principles of Engineering Materials —** The properties of engineering materials depend on their internal structures. The role of these structures in metals, plastics, ceramics, and other materials is presented and applied to engineering problems. Failure theories for various structures are also discussed. Prerequisites: Mathematics 132, Chemistry 111, and Engineering 221.

*Three Credits Pawloski Spring Semester*

**224. Mechanics of Materials Laboratory —** A laboratory to accompany Engineering 222, Principles of Engineering Materials. The laboratory investigates the properties of engineering materials by use of standard testing means. Students are expected to analyze the results of tests using packaged software programs and programs that they develop themselves. Student teams will undertake a design project in which they must analyze the mechanical properties of the materials they will use and predict the mechanical behavior of the object they design and build. Corequisite: Engineering 222. Prerequisites: Chemistry 111 and Mathematics 132.

*One Credit Pawloski Spring Semester*

**241. Electronics I —** The course provides an introduction to analysis and design of DC, AC circuits, phasors, and LaPlace transforms. Diodes are introduced and utilized in nonlinear circuit applications. Transistors are studied for applications as amplifiers and switches. Operational amplifiers and circuit applications are introduced and analyzed. Prerequisite: Engineering 100 or Physics 122 and 142, or Physics 106 and 108, or permission of instructor. Same as Physics 241.

*Four Credits Kaloust Fall Semester*

**242. Electronics II —** The course examines in detail the design and analysis of analog and digital circuits. Analog integrated circuits include bipolar junction transis-

tor amplifiers, operational amplifiers, and active filters. Generalized Ohm's law is employed to analyze and design active filters. Logic circuit design is presented and digital circuits are analyzed and designed. Prerequisite: Engineering 241 or permission of instructor. Same as Physics 242.

*Four Credits Kaloust Spring Semester Even Years*

**280. Introduction to Mathematical Physics and Engineering —** A course in mathematical methods. It is cross listed as Physics 280. A full description may be found there.

**290. Independent Studies —** With departmental approval, freshmen or sophomores may engage in independent studies at a level appropriate to their ability and class standing, in order to enhance their understanding of engineering. Students may enroll each semester. Permission of the instructor is required.

*One or Three Credits Staff Both Semesters*

**295. Studies in Engineering —** A lecture and/or laboratory course in an engineering area of interest. Two to Four Credits Staff Both Semesters

**331. Dynamic Systems and Controls I —** Introduction to the mathematical modeling, analysis, and control of mechanical, electrical, hydraulic and thermal systems. Derivation of governing state (differential) equations. Analysis of the free and forced response of systems by direct analysis and computer simulation. Introduction to the design of feedback control systems including analyzing stability and characterizing system behavior. Includes laboratory component. Corequisite: Engineering 241. Prerequisites: Physics 122 and Mathematics 232.

*Three Credits Kaloust Fall Semester*

**332. Dynamic Systems and Controls II —** Design of linear feedback control for dynamic systems. Topics include stability analysis, root locus compensation and design, frequency response techniques, state space and digital controls. The mathematical software MATLAB is used extensively to analyze and simulate control systems. Prerequisite: Engineering 331. *Three Credits Kaloust Spring Semester*

**333. Dynamic Systems and Controls Laboratory —** A laboratory to accompany Engineering 331, Dynamic Systems and Controls I. The laboratory investigates the dynamic properties of systems of first and second order mechanical systems. Both linear and rotary systems are investigated. Systems with multiple masses and springs are studied. Controllers are developed and applied to some of the systems. Corequisite: Engineering 331. Prerequisites: Physics 122 and Mathematics 232.

*One Credit Veldman Fall Semester*

**342. Electricity and Magnetism —** A course in classical electromagnetism. It is cross listed as Physics 342. A full description may be found there.

**344. Mechanical Vibrations —** Free and forced response of single and multiple degree of freedom lumped mass systems, and of continuous bodies. Analytical and numerical methods for solving vibration problems. Applications to the vibrations of mechanical systems and structures, earthquake response of structures. Prerequisites: Engineering 221 and Mathematics 232.

*Three Credits Veldman Fall Semester Even Years*

**345. Thermodynamics —** Thermodynamics is the study of heat and work. The concepts of the zeroth, first and second laws of thermodynamics, and equations of mass and energy conservation are presented. These concepts are then applied to power generation systems, refrigeration cycles, internal combustion, and jet engines. Prerequisites: Mathematics 231 and Physics 122.

*Three Credits Misovich Fall Semester*

**346. Fluid Mechanics —** The study of fluid mechanics is essential in analyzing any physical system involving liquids and gases. The properties of a fluid and the concepts of fluid statics, the integral and differential analyses of fluid motion, and incompressible flow are presented. Applications of these concepts to various engineering situations, such as propulsion systems, aerodynamics, and piping systems, are examined. Corequisite: Physics 280. Prerequisites: Mathematics 232 and Engineering 221, 345. *Three Credits Misovich Spring Semester*

**348. Heat Transfer —** This course introduces the fundamental concepts of heat transfer. The three modes of heat transfer are addressed: conduction, convection, radiation. Both steady state and time varying situations are considered. The energy balance is applied extensively, and physical and mathematical principles underlying the concepts of heat transfer are presented. Rectangular, cylindrical and spherical coordinate systems are used in the analysis. Various aspects of heat transfer phenomena are studied in the laboratory. Corequisites: Engineering 346 and Physics 280. Prerequisite: Engineering 345. *Three Credits Pawloski Spring Semester Odd Years*

**351. Signal Analysis and Communications —** This course will introduce students to the basics of signal modulation and radio frequency analysis and design. The approach is tailored to a careful development of the mathematical principles upon which such systems are based. A wide variety of current communication systems will be presented. The emphasis in this course is the design and analysis of Amplitude Modulation (AM), Frequency (angle) Modulation (FM), and Pulse Width Modulation (PWM), and understanding the differences between these types of modulations. The students will also be introduced to band-pass filters that are extensively used in signal demodulation. Prerequisite: Engineering 241. *Three Credits Staff Fall Semester*

**352. Optics —** A course in geometrical and physical optics. It is cross listed as Physics 352. A full description may be found there.

**355. Structural Analysis —** This course covers the analysis of determinate and indeterminate structures; moment-area and conjugate beam methods; deflection of beams, trusses, and frames; consistent deformations method; influence lines; moment distribution method; and introduction to matrix methods in structures. Prerequisites: Engineering 222 and Engineering 224.
*Three Credits Pawloski Fall Semester Odd Years*

**361. Analytical Mechanics —** This course covers classical mechanics. It is cross listed as PHYS 361. A full description may be found there.

**451. Introduction to Engineering Design —** Engineers create products, systems, and processes to solve problems and meet social needs. This course introduces students to the art and science of engineering design. Engineering design methods and the characteristics of the engineering design process are studied including: problem definition, conceptual design, preliminary design and detail design. Exercises are carried out focusing on the development of creativity, independent thinking, and the ability to overcome unexpected problems, as well as ethics in the workplace. Students learn oral and written communication skills needed in engineering design and carry out individual hands-on design projects. Prerequisites: Engineering 170, 221, 222 and 241, and junior standing. *Three Credits Krupczak/Veldman Fall Semester*

**452. Engineering Design —** Engineering design problems are usually solved by teams working in an industrial environment. In this course students work in teams to solve an engineering design problem. The scope of activity extends from problem definition and development of requirements, through construction of a working prototype. Other course work includes: basic techniques of engineering project

management, a study of how the engineering design process is conducted within a typical industrial company or technical organization, building and working in an engineering design team, and development and refinement of communication skills needed in engineering design. Additionally, basic materials manufacturing processes for polymers, metals, and composite materials will be discussed. Prerequisites: Engineering 451 and senior standing. *Three Credits Krupczak/Veldman Spring Semester*

**490. Research —** With departmental approval, juniors or seniors may engage in independent studies at a level appropriate to their ability and class standing, in order to enhance their understanding of engineering. Students may enroll in each semester.
*One or Three Credits Staff Both Semesters*

**495. Topics in Engineering —** An advanced topic of engineering will be investigated in detail. The choice of the topic will vary from year to year to provide junior and senior students with the opportunity to study a field outside of the normally prescribed curriculum. Examples of such topics are: Finite Element Analysis Methods, Digital Signal Processing, Logic Circuits, Non-Linear Mechanical Systems, Phase Equilibrium and Separations, and Kinetic and Reaction Engineering. As the topic will be different each year, students will have the opportunity to study a different topic in their junior and in their senior year. Prerequisite: junior standing in engineering or permission of the instructor. *Two to Four Credits Staff Spring Semester*

**499. Internship in Engineering —** This program provides engineering experience for students and is usually done off-campus under the supervision of a qualified engineer. A written report and oral department seminar presentation appropriate to the internship experience are required. Approval of the chairperson is required.
*One Credit Staff Both Semesters*