

DEPARTMENT OF ENGINEERING

Information for all Engineering Major and Minors

- 1) **General Guidelines:** A statement of principles underlying the program of study in the Engineering Section of the Swarthmore College Bulletin. You may use this document as a guide, but please refer to the Bulletin for your official planning.
- 2) **Course Major:** The program leading to a B.S. in Engineering via the Course Program is described in detail in the Engineering Section of the Bulletin, an abridged version follows. Eight mathematics and science courses are required, usually four of each. The Math requirement includes MATH 015, 025(S)/026, 033/034/035 and 043/044. However, if a student has credit for Math 027/028, 033/034/035 and 043/044 and fewer than four math credits, s/he may take a fifth science course. The Science requirement includes PHYS 003 & 004 (or PHYS 007 & 008), a course in biology or chemistry, and another science course. All science courses must be acceptable for credit toward a minimal major in the offering department. The Engineering requirement includes six core courses (ENGR 006, 011, 041, 090 and *at least* two from ENGR 012, 014, and 015) and five or six upper level electives, for a total of 12 credits. You will submit your elective program for departmental review and approval this spring; it may or may not conform to a traditional program in electrical, computer, mechanical or civil/environmental engineering. For non-traditional programs, a coherent explanation is required of how your choice of electives meets your stated educational objectives. This list of requirements is not exhaustive, please see catalog (or your advisor) for full details.
- 3) **Course Minor:** The requirements for a Course Minor in Engineering are in the Engineering Section of the Bulletin, and summarized on the following pages.
- 4) **Honors:** Requirements for participation in the Honors Program with a major or minor in Engineering are in the Engineering Section of the Bulletin, and summarized on the following pages. Every Honors major in Engineering must complete all the courses in engineering, mathematics and science listed in 2 (above). Every Honors major in Engineering must also include the ENGR 090 Senior Design Project as part of one of the examined Engineering preparations. Minors must be constructed from among the same upper level engineering elective courses as support preparations in the Major (but not ENGR 090).
- 4) **Double Major:** A "C" average among science, math, and engineering courses is required for admission to the engineering major; for approval of any double major including engineering, a "B" average among the same courses is strongly recommended.
- 5) **Course Selection:** A form to aid in planning your proposed program will be available on the department web site. This form must be completed and submitted as part of your sophomore paper. All engineering courses are to be listed on this form in the appropriate semesters. Check prerequisites carefully when completing the program planning form. Courses, prerequisites and their availability are listed in the College Catalog. Note that many courses are offered yearly, others in alternate years, and some only when demand and staffing permit. An updated prospective two-year schedule is also available on the web site.
- 6) **Study Elsewhere:** You should indicate in your Sophomore Paper and on the planning form whether you are contemplating taking a leave, studying abroad, participating in an exchange program or gaining work experience elsewhere for one or two semesters. Each of these activities is possible within an eight-semester program if carefully planned. Foreign coursework during the third year, in accordance with your plan of study as approved in advance by the department chair, normally results in two or three elective credits in Engineering awarded "en bloc" for a combination of three or four Engineering courses.

The Course Minor Program in Engineering

Students interested in pursuing a minor are responsible for finding a faculty member within the Engineering Department to advise them. They should consult their Engineering advisers regularly, and the sophomore papers of Engineering minors should indicate the plan to minor and the courses chosen to fulfill the minor.

A minimum of 5 credits in engineering is required, of which at least two must be core courses (ENGR 006, 011, 012, 014, 015, or 041, but not ENGR 090). At least two credits must be selected from elective course offerings within the department. Only those electives that count toward an engineering major can be counted toward a minor.

Supporting work in mathematics, physics, chemistry, when designated as a prerequisite to an individual engineering course, must be completed prior to enrollment. No directed readings may be used as one of the 5 credits for the minor. At most, 1 transfer credit, which must be pre-approved by the Engineering Department, will be accepted in partial fulfillment of the requirements for the minor. The transfer credit may not replace either of the two courses used to fulfill the core course requirement of the minor. No culminating experience is required and ENGR 090 is not open to students pursuing the course minor.

The Honors Program in Engineering

Eligibility

- 1) To participate in the honors program as an engineering major, a student must normally have a B+ average among courses in engineering, science, and mathematics at the time of application.
- 2) Applicants for engineering minors must show a similar level of achievement among courses in math, science and their major. Prerequisites for the upper level engineering courses proposed as minor preparation must be satisfied unless a written waiver by the engineering department accompanies the application.

Program of Study for the Honors Major in Engineering

- 1) This is a four-examination program, including three preparations in engineering (the major) and one minor preparation. Each area comprises two credits of work.
- 2) The minor preparation must comprise at least two credits of work in any department or program outside engineering, and be among those approved by that department or program.
- 3) Each major candidate must accumulate 12 credits in engineering, including ENGR 090, and the same number of science and math credits as required of course majors.
- 4) Each major preparation comprises of two related upper level engineering electives except that Engineering 90 may be substituted for an elective. A listing of preparations supported by existing engineering courses is appended. Credits from approved attachments or special topics courses may substitute for not more than one credit within any preparation. The major preparation including Engineering 90 may also be paired with a one-credit Honors Thesis to be completed in the Fall semester of senior year. Honors Thesis credit **may not** substitute for any of the twelve engineering credits required for the B.S.; candidates electing an Honors Thesis will therefore complete at least 13 credits in Engineering and 33 college wide.
- 5) For the major preparation that includes ENGR 090, a precis of not more than 12 pages (including tables and figures) of each candidate's ENGR 090 project must be submitted by the end of the tenth week of the Spring semester for mailing to the relevant honors examiner. The final ENGR 090 report will not be mailed to any examiner, but may be brought to the oral examinations.
- 6) Senior Honors Study is not taken by engineering majors.

Formats of Examination

Honors examination of engineering majors will include separate three-hour written exams on each of the three major preparations, plus subsequent oral examination of each candidate by at least the three examiners who prepared the written exams - the duration of each oral exam will not normally exceed 30 minutes. If the examiners' schedules and interests permit, a single oral exam not longer than 60 minutes before a panel of examiners may substitute for

the individual exams. The ENGR 090 project report may be brought to oral examination sessions.

Double Majors with Honors including Engineering

- 1) Regardless of whether a double major candidate chooses to be examined in three or one preparation in engineering, an engineering preparation including ENGR 090 may be among those examined for any double major that includes engineering.
- 2) No Swarthmore College diploma testifying to the award of the degree of Bachelor of Science shall be issued with honorifics unless three preparations in engineering were among those examined. Regardless of performance, double majors examined on only one engineering preparation will receive their B.S. diplomas without honorifics.

Program of Study for an Honors Minor in Engineering

- 1) Every engineering minor preparation is to comprise two related upper level engineering electives, for which all prerequisites must be satisfied. Credits from official Attachments or Special Topics courses in Engineering may substitute for not more than one course credit within an engineering minor preparation. A list of preparations supported by existing courses is appended.
- 2) Prerequisites to upper level engineering electives may be waived by the Department, depending upon the student's documentation of equivalent work in another department at the time of application.
- 3) Senior Honors Study is required for engineering minors, except those students who are pursuing a course major in engineering additionally, and must include at least 1/2 credit as an attachment to one of the courses in the engineering preparation. The remainder of Senior Honors Study credit will be based upon the candidate's non-engineering major preparation, and the total will conform to requirements set by the major department.
- 4) Formats of examination will follow those appropriate for the engineering major. Honors examination of engineering minors will consist of a three-hour written exam covering the engineering preparation, plus a subsequent oral examination of each candidate by the author of the written exam - either alone if need be to assure adequate evaluation of the engineering preparation, or as an invited member of an examining panel convened by the major department.

Senior Honors Study in Engineering

The SHS attachment to the engineering preparation for an Honors minor must:

- 1) Be proposed to the department before the Thanksgiving break and approved before the end of the Fall semester of senior year.
- 2) Be documented by a technical report or paper (for majors, separate from the ENGR 090 report) that will become part of the student's portfolio. Scope and length of this report will be appropriate to the amount of credit sought; the equivalent of a 3000 word text (10-12 pages including tables and figures) is typical of a half-credit effort. For a one-credit effort in engineering only, the limit of 4000 words (about 20 pages) will apply. The final version must be prepared and submitted (Deadline: Monday of Week 13 of Spring Classes) in time for mailing to the relevant honors examiner. It will not be reviewed by department faculty after final submittal.
- 3) Senior Honors Study is not required of students pursuing an engineering major in addition to the Honors minor in engineering because ENGR 090 serves as the culminating experience.

Honors Preparations in Engineering

Inclusion of a course in this list does not imply its availability in any particular academic year, but only during the two-year interval. Prerequisites, shown each year in the College Catalog, are not listed here, but must be fulfilled unless waived by the Department in writing. Engineering 90 may be substituted as appropriate for one credit within any of the listed areas. Other combinations of upper level engineering electives are possible, but must be proposed for departmental approval at the time of application to the honors program.

Preparations for Honors Exams

Communications and Electromagnetic Fields

- *Communication Systems**
- *Electromagnetic Theory I**

Communications and Signal Processing

- *Communication Systems**
- *Digital Signal Processing*

Computer Architecture

- *Fundamentals of Digital Systems*
- *Principles of Computer Architecture*

Electromagnetic Theory

- *Electromagnetic Theory I* and II**

Electronics

- *Electronic Circuit Applications*
- *Physical Electronics**

Environmental Systems

- *Operations Research*
- *Environmental Systems*

Heat Transfer and Fluid Mechanics

- *Heat Transfer*
- *Fluid Mechanics*

Integrated Electronics

- *Electronic Circuit Applications*
- *VLSI Design*

Materials Engineering

- *Mechanics of Solids*
- *Engineering Materials*

Robotics and Machine Vision

- *Computer Vision*
- *Robotics*

Signals and Systems

- *Control Theory and Design*
- *Digital Signal Processing*

Solar Thermal Systems

- *Solar Energy Systems*
- *Thermal Energy Conversion or Heat Transfer*

Structural Analysis and Design

- *Structural Theory and Design I and II**

Structures and Soils

- *Structural Theory and Design I*
- *Geotechnical Engineering: Theory and Design**

Thermal Energy Conversion and Heat Transfer

- *Thermal Energy Conversion*
- *Heat Transfer*

Visual Information Systems

- *Computer Graphics*
- *Computer Vision*

Water Quality and Fluid Mechanics

- *Water Quality and Pollution Control*
- *Fluid Mechanics*

Water Quality and Supply Systems

- *Water Quality and Pollution Control*
- *Environmental Systems*

*Offered only if demand and staffing permit.