CLASS OF 2019
WELCOME TO SWARTHMORE FROM THE ENGINEERING DEPARTMENT!
OUTLINE

- General Description of Program and Statistics
- Faculty-Student Research and Senior Design
- Life after Swarthmore: Recent Alumni/ae
- Faculty and Staff
- Requirements and Sample Schedules
- Academic Support
Why Engineering at SWAT?

- Solve multi-dimensional problems
- Help others
- Use your creativity. Make things!
- Combine Engineering with other interests
- Enjoy atmosphere of cooperation and collaboration
- Have fun!
Features of Swarthmore’s Engineering Program

- Accredited General Engineering B.S. degree with specializations
  - Civil/Environmental Engineering
  - Computer Engineering
  - Electrical Engineering
  - Mechanical Engineering

- Flexibility: 20 courses outside of Engineering
  - Double majors and minors
  - Study abroad
Features of Engineering Courses

- All Engineering courses have labs which are small (typically 8 or fewer students)
- All labs are taught by professors
- Required courses have two professors (often one for lecture, one for lab)
- Elective courses are small (typically 5-15 students)
- You get to use the machine shop/wood shop
Double Majors with Engineering over the last 10 years

Total Graduates: 200

Double Majors: 76 (38%)

- Economics: 31 (40%)
- Computer Science: 28 (37%)
- Physics: 7 (.092%)
- Mathematics: 6 (.079%)
- History: 4 (.05%)
- Art (History)/Music/Political Science/Sociology & Anthropology, Special Majors: 2 (<%)
- English Literature, Biology, Linguistics, Psychology, Philosophy, and Religion: 1 (< %) each
Minors Earned by Engineering Majors over the last 10 years

Total Graduates: 200
Minors: 73 (37%)

- Mathematics: 11 (15%)
- Computer Science: 11 (15%)
- Environmental Studies: 8 (11%)
- Chemistry, Engineering, Music: 4 (5%)
- Biology, English Literature, Philosophy, Physics, Religion: 3 (4%)
- Astronomy, Cognitive Science, Economics, Educational Studies, Greek, History, Spanish, Statistics: 2 (3%)
- Asian Studies, Chinese, French, Linguistics, Political Science, Psychology, Public Policy: 1 (1%)
Domestic and Study Abroad within Engineering

- **Domestic**
  - Harvey Mudd College
  - Pitzer
  - Rice University
  - UPenn

- **Study Abroad (21%)**
  - Argentina
  - Australia
  - Denmark
  - England
  - Ireland
  - London
  - New Zealand
  - Middle East
  - Poland/Czech Republic
  - South Africa (Cape Town)
  - Spain
  - Tasmania
Research Opportunities for Students

- Halpern Fund for student–initiated projects
- Research opportunities in faculty laboratories
- REU experiences at other universities
- Projects in courses
- Patents possible with faculty
Engineering Research Laboratories in Hicks and Papazian Halls

- Computer Architecture Laboratory
- Computer Laboratory
- Environmental Laboratory
- Hybrid Electric Vehicle (HEV) Laboratory
- Nonlinear Dynamics Laboratory
- Optics and Quantum Electronics Laboratory
- Robotics Laboratory
- Solar Laboratory
- Soils and Construction Laboratory
- Sound Booth/Audio Acoustics Laboratory
Engineering 90
Recent Senior Design Projects

- Walking pattern generation for humanoid robots
- Designing a solar electric carport for Swarthmore College
- Design/construction/testing of a shake table for simple structural elements
- Create an app to display personal data on carbon footprint metrics
- Simulation based design project to examine behavior of an electric grid system under different renewable energy conditions
- Research in the domain of audio signal processing, either music related (i.e. with live instruments) or speech related (involving vocal laryngeal sources)
Engineering 90
Recent Senior Design Projects

- Whistle recognition LED lamp
- Experiment with vehicle dynamics, path optimization, and autonomous vehicle control
- Institutional organization and problem solving platform
- Studying simultaneous localization and mapping (SLAM) algorithms and techniques
- Low cost e-reader
- Acoustic analysis and development of virtual surround sound
- Two-stage reusable rocket
Sample Student Publications


Sample Student Publications


Alums: What Do They Do?

- Jobs
  - Large Engineering Companies
  - Small Start-up Companies
  - Consulting Companies
  - Financial Firms

- Graduate or Professional School
  - Engineering
  - Other Related Disciplines (e.g. Mathematics, Physics, Computer Science)
  - Other Unrelated Disciplines (e.g. History, Economics)
  - Medical, Veterinary, Law, Architecture, Music, etc. Schools

- Service
  - Peace Corps
  - AmeriCorps/Teaching

- Fellowships (e.g. Watson, Fulbright, Churchill, Rhodes)

- Other (e.g. Travel, Time Off)
# Recent Alumni/ae Positions in Companies (A-C)

<table>
<thead>
<tr>
<th>Company Name</th>
<th>Position</th>
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<tbody>
<tr>
<td>Abt Associates Inc.</td>
<td>Analyst</td>
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<tr>
<td>Accenture Foundation, Inc.</td>
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<tr>
<td>Agilent Technologies</td>
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<td>Alphatech, Inc.</td>
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<td>American Museum of Natural History</td>
<td>Chief Engineer</td>
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<tr>
<td>Andersen Worldwide</td>
<td>Senior Consultant</td>
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<tr>
<td>Answerthink Consulting Group</td>
<td>IT Consultant</td>
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<tr>
<td>AT &amp; T</td>
<td>Senior Database Administrator</td>
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<tr>
<td>Barnett International/Parexel</td>
<td>Consultant</td>
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<tr>
<td>Bluefin Robotics Corp.</td>
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<td>Bridge Strategy Group</td>
<td>Management Consultant</td>
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<td>Bridgewater Associates</td>
<td>Senior Technology Associate</td>
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<tr>
<td>Brown and Caldwell</td>
<td>Engineer</td>
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<tr>
<td>Cedric D. Chong and Associates</td>
<td>Mechanical Engineer</td>
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<tr>
<td>Child and Family Service Agency of DC</td>
<td>Trainer/Analyst</td>
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<td>Churchill Consulting Engineers</td>
<td>Engineer</td>
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## More Recent Alumni/ae Positions in Companies (C-G)

<table>
<thead>
<tr>
<th>Company Name</th>
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<tr>
<td>City of Anaheim</td>
<td>Project Manager</td>
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<tr>
<td>Commonwealth Risk Services</td>
<td>Risk Management Associate</td>
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<tr>
<td>Composite Engineering Inc.</td>
<td>Engineer</td>
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<tr>
<td>Cornell University</td>
<td>Assistant Professor</td>
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<tr>
<td>Credence Systems Corporation</td>
<td>Staff Marketing Applications Engineer</td>
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<tr>
<td>Cybercivic</td>
<td>Electrical &amp; Computer Engineer</td>
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<tr>
<td>Deloitte &amp; Touche LLP</td>
<td>Consultant</td>
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<tr>
<td>Demand Management Institute</td>
<td>Project Manager</td>
</tr>
<tr>
<td>Deutsche Bank North America</td>
<td>Vice President, OTC Derivatives</td>
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<td>Dewberry-Goodkind, Inc.</td>
<td>Structural Engineer</td>
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<td>Du Pont Company</td>
<td>Bio-Engineer</td>
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<td>DupontResearch</td>
<td>Engineer</td>
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<td>Eclectic Electric, LLC</td>
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<td>Ecotope Inc.</td>
<td>Engineer</td>
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<tr>
<td>Epic Software</td>
<td>Server Systems Engineer</td>
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<tr>
<td>Erler &amp; Kalinowski</td>
<td>Associate Engineer</td>
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<tr>
<td>Ernst and Young LLP</td>
<td>Quantitative Economics Consultant</td>
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<tr>
<td>Experio Solutions Inc.</td>
<td>Consultant</td>
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<tr>
<td>F.X. Browne, Inc.</td>
<td>Environmental Consultant</td>
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<tr>
<td>Google</td>
<td>Software Engineer/Site Reliability Engineer</td>
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Sampling of Graduate Schools Attended by Recent Alumni/ae

Carnegie Mellon University
Case Western Reserve University
Colorado State University
Cornell University
Duke University
Harvard University
Johns Hopkins School of Public Health
Johns Hopkins University
Massachusetts Institute of Technology
Purdue University
Seton Hall University

Stanford University
University of California – Berkeley
University of Florida
University of Illinois
University of Massachusetts
University of Michigan
University of Pennsylvania
University of Wisconsin
Yale University
Erik A. Cheever: B.S., Swarthmore College; M.S. and Ph.D. University of Pennsylvania

E. Carr Everbach: A.B., Harvard University; M.S. and Ph.D., Yale University

Nelson A. Macken: B.S., Case Institute of Technology; M.S. and Ph.D., University of Delaware

Arthur E. McGarity: B.S., Trinity University; M.S.E. and Ph.D., Johns Hopkins University
Lynne A. Molter: B.A. and B.S., Swarthmore College; S.M. and Sc.D., MIT

Allan R. Moser: B.S. and B.A., University of Texas; M.S. and Ph.D., Purdue University

Michael Piovoso: B.S., University of Delaware; M.S., University of Michigan; Ph.D., University of Delaware

Faruq M. A. Siddiqui: B.S., Bangladesh University of Engineering and Technology; M.S. and Ph.D., University of Pittsburgh

Matthew Zucker: B.A., Vassar College; Ph.D., Carnegie Mellon University
Engineering Staff

- Ann Ruether: Academic Support Counselor; B.S., Engineering Swarthmore College
- Cassy Burnett: Academic Coordinator
- Edmond Jaoudi: Electronics, Instrumentation, and Computer Specialist; B.S., Fairleigh Dickinson University; M. Arch., Virginia Polytechnic Institute and State University
- J. Johnson and Grant Smith: Mechanician
Erik Cheever, Professor

Professor Cheever teaches electrical engineering courses, and courses at the intersection of mechanical and electrical engineering. His interests are in analog electronics, signal processing and embedded computers (microcontrollers). He teaches ENGR 002 (How computers interface with reality), ENGR 5 (Engineering Methodology), ENGR 011 (Electrical Circuits), ENGR 012 (how to model the behavior of electrical and mechanical linear systems), ENGR 058 (How do you get an electromechanical system to behave as you want it to?), ENGR 071 (How can you use a computer to process signals (e.g., music)?), and ENGR 072 (how can you build a circuit to perform a particular function?).

His PhD is in bioengineering and most of his research has been in that area - mostly combined with the interests listed above: interactions of microwaves with living tissue, using skeletal muscle wrapped around the heart to increase cardiac output (as an alternative to transplants), using digital signal processing techniques to analyze DNA...

Professor Cheever enjoys biking and can help you find good local roads for riding.
Carr Everbach, Professor

My main research interest is *acoustics*, and in particular the interaction of sound waves with biological systems. My research involves how ultrasound drives microscopic bubbles to grow and collapse violently, a process called *acoustic cavitation*. Biomedical applications of ultrasound fall into two categories: therapeutic and diagnostic. In *therapeutic* ultrasound, the engineering objective is for the acoustic waves to cause beneficial changes in human tissue: removing cholesterol plaque from arteries, healing wounds, breaking up kidney stones, or killing bacteria. In *diagnostic* ultrasound applications, conversely, the engineering objective is to use ultrasound as sonar to produce high-quality images of human tissues without altering them: acoustical mammography, fetal ultrasound, echo-cardiography. As with many technologies, the same basic tools can be used in different ways to accomplish different tasks, and my students learn about wave propagation, transducers, amplifiers, signal processing techniques, and a bit of biology to carry the research forward. I have published fifteen research papers with students in the past 10 years, and my students routinely attend Acoustical Society of America meetings to present their results.

My strong secondary interest is in environmental technologies that help solve problems for the “bottom billion” of humanity. Active in the Environmental Studies program at Swarthmore and a founding member of the Sustainability Committee, I believe that engineers have a moral duty to use their talents and opportunities to make the world a better place. Global climate change, pollution reduction, poverty alleviation, and science education are all areas to which engineers should contribute, and in which I have active research projects. I am also the director of the Macalester-Pomona-Swarthmore study-abroad program at the University of Cape Town (South Africa) that takes place January-to-June for third-year students.
Nelson Macken, Professor

Professor Macken is a mechanical engineer and teaches in the area of thermal energy conversion.

Thermal energy is involved in the design of engines that are the prime movers of vehicles, the production of electricity, heating and cooling of buildings and all other processes that add and remove heat from human-made and natural systems. His work includes the design of energy conversion systems as well as the development of energy sources and their sustainability.

Prof. Macken’s current research interests include biomass conversion to biofuels, microfluids with biological applications, alternative energy, including fuel cell applications, and multiphase flow with applications to nuclear power generation. He has co-authored eight papers with Swarthmore students in the past five years. Recently, he advised our participation in the Shell Eco-Marathon, an international contest for highly efficient vehicles. Our fuel cell powered vehicle achieved over 1200 miles /gallon (gasoline equivalent)! Prof. Macken also conducts an outreach program involving college students and middle school students.

Prof. Macken enjoys working with students of all levels in his research and outreach projects. Please contact him for more information.
Arthur E. McGarity has taught Engineering at Swarthmore since 1978. He is co-founder of Swarthmore's interdisciplinary Program in Environmental Studies, and he also directs Swarthmore’s foreign study program in Central Europe (Poland and Czech Republic). He has developed and taught courses on environmental technology and modeling including: Introduction to Environmental Protection, Environmental Systems Engineering, Water Quality and Pollution Control, and Solar Energy Systems.

Professor McGarity has contributed to research in three fields including Environmental Engineering, Solar Energy, and Operations Research. He has co-edited a textbook in the field of environmental systems entitled Design and Operation of Civil and Environmental Engineering Systems (Wiley, 1997) and he has published numerous research papers. He has directed several recent projects to restore water quality and natural habitat in the local Crum Creek watershed. He is currently Principal Investigator on a four-year, EPA funded research project on Green Infrastructure technology implementation in Philadelphia. His research interests involve applications of operations research in the analysis of environmental problems, particularly in the areas of water quality management, nonpoint pollution, and urban stormwater management. His hobby is amateur radio, and he is advisor to the College’s Ham Radio Club.
Lynne Molter, Professor

Professor Molter is interested in optics and photonics in general, and in particular, she studies optical fibers and waveguiding devices for signal processing applications. These devices perform simple switching, splitting, and (de)multiplexing operations. She and her student research assistants model the waveguide devices, collaborators fabricate them, and students characterize their behavior. Devices fabricated using nonlinear materials are especially interesting for such applications. The Ti:Sapphire laser in her lab produces red and infrared light to characterize the waveguide devices.

She is also interested in student learning in Engineering, and in the Sciences and Mathematics as well. She is the PI of a Sloan Foundation grant in which 30 colleges and universities are studying retention of students in Science, Engineering, and Mathematics.

On Saturday morning, Professor Molter is not on campus. Instead, she volunteers as a patient escort one of the women’s clinics in center city Philadelphia. She also spends time away from campus with her family (including 3 exotic pet birds) and likes doing math puzzles.

Professor Molter is on leave 2015-2016
Allan Moser, Visiting Associate Professor

Allan Moser has experience teaching electrical and systems engineering courses at Swarthmore, Penn State, and the University of Delaware. His work experience in industry includes research in computational biology, data mining, machine learning, medical imaging, and signal processing. He also cofounded a start-up biotechnology company specializing in the development of novel computational algorithms for the analysis of biological data.

His current research interests include computational methods for biological & medical signals and algorithms for image & signal processing. Specific research projects on which he has worked recently include: pattern discovery in biological sequence data; image processing using the wavelet transform (it’s like the Fourier transform but even cooler!); high performance computing for drug discovery; and empirical modeling, classification, and discovery of causal relationships from large datasets.
Michael Piovoso, Visiting Professor

Michael J. Piovoso is a Professor of Electrical Engineering at Penn State University and a Visiting Professor at Swarthmore. Dr. Piovoso has been teaching at the University level for over 45 years. He has taught a number of courses offered at Swarthmore including ENGR 011, Electrical Circuit Analysis, ENGR015 Fundamentals of Digital Systems, ENGR 058 Control Theory and Design and ENGR 071 Digital Signal Processing.

Dr. Piovoso has 33 years of industrial experience with The DuPont Company. His work at DuPont was in the areas of the application of multivariate statistics to the improved understanding and control of complex systems, neural networks, expert systems, and process control. In 1999, Dr. Piovoso won the IEEE Control Systems Technology Award for his contributions in the application of multivariate statistics to process control.

His research interest has been in control of dynamic systems particularly the role of neural networks and multivariate methods. More recently, his work is in system biology. In particular, Dr. Piovoso has modeled the interaction of the HIV virus and antiviral drugs in the human body. This work has led to new approaches to the method used to change therapy for individuals who develop a resistant HIV virus. Also, more recent work provides new evidence as to the mechanism by which the HIV persists despite drug therapy. Over the years, Dr. Piovoso has published over 100 research papers.

Dr. Piovoso is active in the IEEE and the AIChE. He is a subject editor for the Chemical Engineering Research and Design, Official Journal of the European Federation of Chemical Engineering: Part A. Dr. Piovoso has also served on numerous committees including the National Science Foundation Review Committees.
Faruq Siddiqui, Professor

Professor Siddiqui's current research interests are in high performance concrete, smart materials and structures and dynamic behavior of structures. High performance concrete is concrete that is of high strength as well as versatile so that it can meet today’s demanding specifications. For example, in earthquake-prone areas, reinforced concrete structures need to behave in a ductile manner so as not to cause sudden brittle fractures; in bridge applications, it must be resistant to harsh environments as well as having a long service life and be relatively maintenance-free. Smart materials or structures are materials or structures which provide sufficient advance warning of distress, for example, crack propagation, excessive elongations, or materials that are easily recyclable and whose carbon footprint is small. Prof. Siddiqui is also interested in finite element applications and structural design problems.
Matthew Zucker, Assistant Professor

Professor Zucker is interested in robotics and other areas where computers interact with the real world. His PhD research was on planning and control for robotic locomotion, writing programs to make a quadruped robot walk over rough terrain. In the past, he worked with autonomous submarines. In his current research, he investigates enabling computers to learn to solve complex problems in robotics and control, either through their own experimentation, or with the help of a human expert. He teaches ENGR 15 (How do the fundamental building blocks of computers work), ENGR 028 (Mobile Robotics), ENGR 019 (Numerical Methods for Engineering Applications), ENGR 027 (Computer Vision) and ENGR 091 (Special Topics: Humanoid Robotics).
Ann Ruether
Academic Support Coordinator

Ann graduated from Swarthmore College in 1994 with a B.S. in Engineering. She worked in the engineering field for over 10 years, in optoelectronics, infrared technologies, and sensing and control applications. Her focus and interests were mainly in new product development and test automation.

Outside of work she enjoys reading, running, knitting, and spending time with her family. She is very much looking forward to working with the newest entering class of students!

You can find Ann in Hicks 307.
Need a key to a lab for the semester? Not sure how to fill out a timesheet for your work, or when to submit it? Having trouble sending that FAX or with a paper jam in the copier? Need to purchase some supplies or equipment? Find a flood in the basement? Cassy is your go-to-person! If she can’t help you herself, she will find out who can help.

You can find Cassy in the Department Office, Hicks 203.
Don’t know which end of the soldering iron to hold? Can’t figure out which of the hundreds of available transistors will work best in your application? Not sure what the difference is between a BNC and banana connector, or how to tell its gender? Not sure whether your instrument is working correctly, or whether operator error is the problem? Ed Jaoudi is the person who can help you!

You can find Ed in Hicks 313.
J. Johnson, Grant Smith
Mechanicians

Trying to design a mount to hold your sample? Want to learn what a lathe and milling machine do, and how to use them? Need to borrow some hand tools for a project? Need advice about the best material to use for your application? Want to borrow 500 cinder blocks for 2 weeks? Need to machine a high-precision part and want to learn how to do it yourself? They are eager to help.

You can find J. in the basement of Papazian.

Grant Smith is currently on leave
Engineering 5: Engineering Methodology

- Instructor: Professor Erik Cheever, lcheeve1@swarthmore.edu
  Hicks 305; x 8076; (610) 328-8076
- Lecture: Tuesday only @ 8:30 am –9:45 am, Sci Ctr 101
- Labs
  - Group A: Thursday @ 8:30 am, Hicks 212
  - Group B: Thursday @ 9:55 am, Hicks 212
  - Group C: Thursday @ 11:20 am, Hicks 212
- Engineering 5 is a half-credit course for those interested in engineering, presenting techniques, and tools that engineers use to define, analyze, solve, and report on technical problems and an introduction to department facilities. It is designed for students who are potential majors, as well as those interested only in an introduction to engineering. Although Engineering 5 is not required of prospective engineering majors, it is strongly recommended.
Requirements for an Engineering Major

12 Engineering Courses

- 7 Core Courses
  - ENGR 006: Mechanics
  - ENGR 011: Electrical Circuit Analysis
  - ENGR 012: Linear Physical Systems
  - ENGR 014: Experimentation for Engineering Design
  - ENGR 041: Thermofluid Mechanics
  - ENGR 090: Senior Design Project

- 5 Electives from Areas of Civil/Environmental, Computer, Electrical, Mechanical, and Cross-Disciplinary

  (ENGR 005 and 010 are not included in the 12 ENGR courses required for graduation.)
Mathematics and Science Requirements

- **4 Mathematics Credits (or 5)**
  - Typically MATH 15, 25/26, 33/34/35, 43/44
  - Often MATH 27/28 (highly recommended)
  - Can count Stat 11 but not Stat 1
- **4 Science Credits; 4 NSEPS (or 3)**
  - 2 Physics; typically PHYS 3 & 4 or Phys 5 (not NSEP), 7 & 8
  - 1 Biology or Chemistry; typically BIOL 1 or 2, or CHEM 10
  - 1 unspecified science NSEP from Astronomy, Biology, Biochemistry, Chemistry, or Physics (note PHYS/ASTR 5 must be taken before PHYS 7, 8 to count as science credit)
- Credit for AP, IB, etc. counts if approved by math or science department; **DO THIS ASAP!**
- Note: If in doubt, be sure to visit the Mathematics and Physics Departments about **Placement Exams**!
# Sample Freshman Schedules

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<thead>
<tr>
<th>FALL</th>
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<tr>
<td>ENGR 005 (0.5 credits)</td>
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<td>MATH 015</td>
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More Sample Freshman Schedules

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<tr>
<td>ENGR 005 (0.5 credits)</td>
<td>ENGR 006</td>
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<tr>
<td>MATH 025</td>
<td>MATH 027</td>
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<td>CHEM 010</td>
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<td>ENGR 011</td>
<td>ENGR 006 or 012</td>
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<td>PHYS 003</td>
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## Sample Four Year Schedule

(need College Distribution and Writing Courses, and perhaps Language Requirement)

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<td><strong>YEAR 1</strong></td>
<td>ENGR 005 (0.5 credits)</td>
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<td><strong>YEAR 2</strong></td>
<td>ENGR 011</td>
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<td><strong>YEAR 3</strong></td>
<td>ENGR 041 or Elective</td>
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<td>CHEM 010 or BIO 001</td>
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<td><strong>YEAR 4</strong></td>
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Academic Support

- Study sessions Sun-Thurs in Hicks and Sci Ctr
- Help with engineering and physics
- Supportive and friendly learning environment
- Staffed by Wizards--knowledgeable, experienced engineering students
- Food provided!

Academic Support Coordinator: Ann Ruether
Engineering Wizards

Fall ’15 Wizards’ Study Sessions
7:00-9:00 pm in Hicks 211
Sunday-Wednesday
Help with Engr 5, Engr 11, Engr 15
Additional help sessions Sunday-Thursday for Physics 3, 5, 7 in the Science Center
Grab a snack and get some work done with your classmates!

http://www.swarthmore.edu/wizards
Engineering Wizard Session
Thank You!

Thanks very much for coming to learn more about us. You can visit our web page at www.swarthmore.edu/engineering. Please ask any questions that occur to you. All of us in the Engineering Department look forward to seeing you soon in classes, labs, and study sessions in Hicks.