

CATALOGUE 2009-10



**HARVEY MUDD**  
COLLEGE

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HARVEY MUDD COLLEGE seeks the nation's brightest men and women to prepare them for leadership roles in an increasingly complex world. The college graduates engineers well-trained in the sciences, scientists with a knowledge of engineering, and mathematicians familiar with both science and engineering. The college emphasizes the humanities and social sciences so that its graduates will understand the impact of their work on society.

“Technology divorced from humanity is worse than no technology at all.”  
—HMC Founding Trustees

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The Harvey Mudd College Engineering Program is accredited by the Accreditation Board for Engineering and Technology, 111 Market Place, Suite 1050, Baltimore, MD 21202, 410.347.7700.

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# TABLE OF CONTENTS

<b>4</b>	<b>INTRODUCTION</b> The Claremont Colleges
<b>12</b>	<b>STUDENT LIFE</b>
<b>16</b>	<b>ADMISSION AND FINANCIAL AID</b> Application Policies and Procedures College Expenses Financial Aid
<b>24</b>	<b>ACADEMIC PROGRAM</b> Overview Common Core Humanities, Social Sciences, and the Arts Integrative Experience Majors (in general) Study Abroad and Domestic Exchanges
<b>33</b>	<b>DEPARTMENTS AND PROGRAMS</b> Biology Chemistry Computer Science Engineering Humanities, Social Sciences, and the Arts Mathematics Physical Education Physics
<b>92</b>	<b>INTERDISCIPLINARY PROGRAMS</b> Joint Major in Chemistry and Biology Joint Major in Computer Science and Mathematics Mathematical Biology
<b>96</b>	<b>OTHER PROGRAMS</b> Individual Program of Studies Off-Campus Major Minors Dual Degree Programs Graduate Courses for Undergraduates USAF ROTC
<b>100</b>	<b>REGULATIONS</b> Academic Regulations General Regulations
<b>113</b>	<b>FACULTY</b>
<b>124</b>	<b>SENIOR ADMINISTRATION</b>
<b>125</b>	<b>COLLEGE CALENDAR</b>
<b>127</b>	<b>INDEX</b> <b>THE CLAREMONT COLLEGES MAP, INSIDE BACK COVER</b>

## INTRODUCTION

Engineering, science and mathematics continue to be exciting, satisfying and lucrative for those prepared to work in these fields. Since 1957, Harvey Mudd College has sought high-ability students with the potential to develop thoughtful and creative solutions to the world's challenging problems. Those who attend HMC learn that technology divorced from humanity is worse than no technology at all. They commit to intellectual honesty. They learn humility. And they leave with a broad scientific and technological perspective that is applicable to many vocations.

### UNDERGRADUATE FOCUS

The opportunities offered by HMC's exclusive undergraduate focus give the college's students access to some of the top undergraduate engineering, science and mathematics faculty in the country. More than 95 percent of all faculty (full-time, part-time and instructors) hold a Ph.D., and courses taught by graduate students are extremely rare. Students enjoy a faculty dedicated to their education. They study and work in facilities that are comparable to what graduate students enjoy at research universities. Students at Harvey Mudd College learn both theory and practice. All students conduct research or do engineering design; all have the opportunity to work on the real-world problems of corporate and not-for-profit clients through the college's Clinic Program. These opportunities for hands-on learning give Harvey Mudd College graduates an advantage that has resulted in a high placement rate of its job-seeking graduates. HMC is also an outstanding setting in which to prepare for an advanced degree.

Additionally, Harvey Mudd College recognizes the importance of preparing its graduates to live and work in a multicultural world. Students have the opportunity to participate in a community that values diversity and promotes cultural competence. The social environment is also shaped by an Honor Code that sets a tone of trust and collaboration and minimizes the intense competition that is often the by-product of bringing together exceptionally accomplished individuals.

### HISTORICAL OVERVIEW

Harvey Mudd College was founded in 1955 and began operations in the fall of 1957, less than one month before Sputnik I launched the Space Age, making technical education a priority in the United States. Forty-eight students and seven faculty were the pioneers who shaped this unique, highly selective institution born of the generosity of businessman and philanthropist Harvey S. Mudd and the vision of Joseph B. Platt, the nuclear physicist who served as the college's first president. Harvey Mudd College became the fifth autonomous member of a much larger center of learning, The Claremont Colleges, an affiliation that broadens both academic and social opportunities for its students.

### COLLEGE MISSION

HMC's founders had a good basic idea, one that had gone untried. This "good basic idea" has been expressed a dozen different ways, but the simplest is the college's mission statement:

**Harvey Mudd College seeks to educate engineers, scientists and mathematicians well versed in all of these areas and in the humanities and social sciences so that they may assume leadership in their fields with a clear understanding of the impact of their work on society.**

Harvey Mudd College pioneered—and put into practice—the idea of relating human needs to engineering and science education. It was able to do so because, as a new institution, it had no particular tradition to uphold or other barriers to innovation. And the school's innovation

and spirit of educational adventure—qualities that attract superior people—appealed to new faculty, staff and students. Ever since its founding, the college's faculty has been made up of top-flight professionals—humanists who are not dissuaded by technology, and engineers and scientists who have an abiding faith in liberal learning.

### **DEDICATED FACULTY**

All of Harvey Mudd College's full-time faculty (about 80) have Ph.D.s or a terminal degree in their field of study, and all are engaged in research. Each faculty member's focus, however, is teaching the approximately 750 students at the college. For the college as a whole, upper-division classes and laboratory sections average between 10 and 15 students. Faculty-student interaction is particularly good as students take advantage of the extensive research and design opportunities.

### **A PROVEN CURRICULUM**

In the beginning, the courses and curriculum of Harvey Mudd College were formulated under a grant from the Carnegie Corporation, and featured a rigorous Core designed to graduate engineers, scientists and mathematicians with grounding in all of these fields as well as an understanding of their social context. This Core is still at the heart of the modern curriculum that fully integrates the humanities and social sciences. Now, as at the institution's inception, all Harvey Mudd College students receive general education in the humanities and social sciences (nearly one-third of all course work, more courses, in fact, than at any engineering college in the country) and basic work in biology, computer science, chemistry, engineering, mathematics and physics—the departmental major programs that the college offers. Students may also design individual programs of study outside of these majors, or major in an area of study offered at one of the other Claremont Colleges.

### **GRADUATE SUCCESS**

The curriculum developed by Harvey Mudd College is effective—the proof is in the college's graduates. About three out of four eventually enter graduate schools, most in the top graduate programs in their fields, be it at Harvard, Johns Hopkins, MIT, Caltech, Yale, Stanford, Berkeley or other prestigious graduate schools. Eventually, most graduates go to work in industry, typically for firms such as Boeing, ESRI, Fair Isaac, Microsoft, Northrop-Grumman, and Raytheon. HMC graduates far more than its share of leaders in the pure and applied sciences. Within five years of graduation, alumni have usually reached such jobs as project engineer, research scientist and systems engineer. Those out more than five years are more likely to be chief engineers, division managers, senior scientists or even vice-presidents or general managers. An increasing number are entrepreneurs and are founding their own companies—some while still in school.

Many Harvey Mudd College alumni with advanced degrees work for “think tanks” or industrial research centers like RAND, the Aerospace Corporation, Bell Laboratories, IBM's Watson Research Center, the Jet Propulsion Laboratory, Lawrence Berkeley National Laboratory and NASA. Others are on the faculties of Yale, MIT, the University of California (Berkeley, Davis, Los Angeles, San Diego, Santa Cruz), Columbia University, the University of Washington, Dartmouth, Purdue, Claremont McKenna College and Harvey Mudd College—not all teach engineering, mathematics and science. Included among our graduates are doctors in small towns and at research hospitals like the Mayo Clinic, artists, vintners, entrepreneurs, economists, historians, philosophers, oceanographers, actuaries, and even a few astronauts. The bottom line is that Harvey Mudd College graduates are able to seek out satisfying places for themselves in a wide variety of fields.

**HOME TO TOP STUDENTS**

The Harvey Mudd College student body of approximately 750 students come from many different places and backgrounds, but they are alike in one way: They have a deep dedication to engineering, science and mathematics and are also interested in the role of these fields in society. More than that, they are good in these fields, and they like to be around others who share their interests. They spend a great deal of time in classrooms and laboratories, in conference with faculty members, and in study—and like most of their work. They make time to participate in college and community life through volunteer service work, student government, or student publications. They compete on athletic teams or participate in club sports. They enjoy going to concerts, art exhibits and parties. Many play musical instruments and participate in Claremont Colleges performance groups. They are involved and engaged students who are intellectually gifted with a strong ability in engineering, science and mathematics.

**CAMPUS FACILITIES**

The Harvey Mudd College campus is a pleasant combination of beauty and efficiency. The buildings—residence halls, dining hall, classrooms, office buildings, laboratories, library and athletic center—are of a single, carefully planned architectural design, and the grounds have many tree-shaded paths, grassy slopes, flower beds, patios and plazas. Of course, the vast central facilities of The Claremont Colleges are open to everyone at Harvey Mudd College.

The Harvey Mudd College campus includes:

**Residence Halls**—Living accommodations for students are provided in eight residence halls: Mildred Mudd, West, North, Marks, Atwood, Case, Linde and Sontag. North Hall and Mildred Mudd Hall constitute the Seeley W. Mudd Memorial Quadrangle. Marks, Atwood, Case, Linde, and Sontag Halls are named in honor of David X. Marks, J.L. Atwood, Florence H. and Gerald R. Case, Ronald and Maxine Linde, and Frederick ('64) and Susan Sontag, respectively.

**Joseph B. Platt Campus Center**—This two-story building was named for the founding president. The Campus Center houses many student services, including the Dean of Students, Residential Life, Student Emotional Health, Student Activities, the Registrar, Academic Affairs, Career Services, Study Abroad, Institutional Diversity, and Facilities and Maintenance. The facility also includes a mailroom, lounges, music practice rooms, Jay's Place (a late-night dining and gathering place in memory of Jay Wolkin '99), a game room, offices for student organizations and the Green Room, a large meeting area.

**Hoch-Shanahan Dining Commons**—Completed in 2005, this dining facility, certified under LEED (Leadership in Energy and Environmental Design) guidelines, can hold 466 diners. It is home to the Aviation Room, which celebrates the college's former Bates Aeronautics Program and its graduates, and has a number of meeting rooms and patio areas. The building was named for trustees Richmond J. Hoch '63 and his wife, Diane, and R. Michael Shanahan and his wife, Mary.

**The Norman F. Sprague Memorial Building**—The building houses new Digital Learning Studios on the first floor. The offices of the Dean of Faculty are on the fourth floor, and work spaces for the Computer Science and Mathematics Departments are located on the second and third floors, respectively. The building was a gift of Dr. and Mrs. Norman F. Sprague Jr. in memory of Dr. Sprague's father.

**The Parsons Engineering Building**—Named in honor of Ralph M. Parsons, this three-story building houses the Department of Engineering, the Engineering Clinic, the Department of Humanities, Social Sciences and the Arts, and the Office of Computing and Information Services.

**The F.W. Olin Science Center**—A gift of the F.W. Olin Foundation, this three-story building, completed in 1992, houses the Departments of Biology, Computer Science, and Mathematics, instructional facilities, and research and teaching labs.

**The Jacobs Science Center**—A gift of Dr. and Mrs. Joseph J. Jacobs, this three-story building houses offices and laboratories for the Departments of Chemistry and Physics.

**W.M. Keck Laboratories**—A four-story building developed with a gift from the W.M. Keck Foundation, this facility houses a portion of the Departments of Chemistry and Physics, classrooms, laboratories, and a computer terminal room.

**Beckman Hall**—Built with a gift from the Arnold and Mabel Beckman Foundation, this facility houses classrooms, laboratories, computer facilities for the computer science, mathematics, biology and other departments, and a 75-seat auditorium.

**Galileo Hall**—This facility is a combination of a lecture/demonstration hall and workshops. It contains a concourse of workshops for the fabrication of instructional and research apparatus. The facility was named for the Galileo Society, an organization of area residents who support the college.

**Hixon Court**—In front of Galileo Hall is a stunning European fountain and koi pond, a gift from the Alexander Hixon family.

**Linde Activities Center**—The Linde Activities Center provides a central recreation area for the Harvey Mudd College community. It houses a full-length basketball court with six retractable hoops and is also suitable for volleyball, badminton and special events. The center also has a computing lab, an aerobics workout area, a fitness area with a full range of conditioning equipment, shower and locker facilities, a lounge area equipped with a big-screen television, and two large multipurpose rooms.

## INFORMATION TECHNOLOGY

Harvey Mudd College provides extensive computing resources to the campus community; the Computing and Information Services Department (CIS) is responsible for many of them. The department provides many services as well as opportunities for students to get involved in developing the college's computing infrastructure.

Students at The Claremont Colleges abide by the Claremont-wide acceptable use policy, available at: [www.cuc.claremont.edu/infotech/appuse0802.asp](http://www.cuc.claremont.edu/infotech/appuse0802.asp). Use of HMC information technology resources constitutes acceptance of this policy.

CIS manages the computing labs on campus—one in the Sprague Building, first floor, and one in the Linde Activities Center (LAC). All students have access to the labs 24 hours a day. In Fall 2009, new Digital Learning Studios opened on the first floor of the Sprague Building. The Learning Studios are comfortable, flexible spaces for instruction, drop-in computing, group work and high performance computing. News about the labs and studios can be found at the CIS news site: <http://www5.hmc.edu/ITNews/>.

CIS operates an equipment loan program which allows students to borrow laptops or projectors for short periods. The department also manages printers for student use in the Linde Activities Center, Platt Living Room and the Digital Learning Studios.

Sakai is The Claremont Colleges online learning environment. It is in use at all the colleges and many professors use it regularly to post quizzes, readings, class schedules and discussions. Information about Sakai can be found at <http://sakai.claremont.edu>.

E-mail accounts are offered to all students. The e-mail service is currently built on a system called Zimbra, a web-based collaboration suite.

CIS operates a Help Desk located in Parsons B142 Monday through Friday, 7:30 a.m. to 5 p.m. The Help Desk is students' first point of contact for all CIS services; and the staff can assist with hardware and software installation, configuration, troubleshooting, repair or advice. Students may drop by or contact the Help Desk via e-mail [helpdesk@hmc.edu](mailto:helpdesk@hmc.edu) or via phone at 909.607.7777.

The department operates the campus wireless network which was extensively upgraded in summer 2007. HMC resources can be accessed via the wireless network at any of The Claremont Colleges.

CIS offers a program that allows students to explore new technology, such as Tablet PCs or the Apple iPod Touch. Students can borrow hardware for up to a semester and are asked to report on their experiences using the technology.

Visit the CIS website ([www.hmc.edu/about/administrativeoffices/cis.html](http://www.hmc.edu/about/administrativeoffices/cis.html)) for more information about services.

### **CENTRAL TO MOUNTAINS, OCEANS, DESERTS**

The college is in Claremont, about 35 miles east of Los Angeles, in a suburban area that was once broad stretches of citrus groves. It is at the foot of Mount San Antonio (Mount Baldy), the highest peak in the San Gabriel Range—10,064 feet.

Claremont's population of about 34,000 live in well-tended homes on tree-covered streets. Freeways provide easy access to desert wilderness areas, Pacific Ocean beaches, the local mountains (snow-covered in the wintertime), Colorado River country, Pasadena (home of the Rose Parade), Disneyland, Knott's Berry Farm, San Diego and its wilderness and marine parks, Los Angeles and the many attractions of Hollywood—all within a few hours' drive.

### **THE CLAREMONT COLLEGES**

From the beginning, Harvey Mudd College drew great strength from its membership in The Claremont Colleges, currently five small, independent colleges and two graduate institutions. They are—in order of founding—Pomona College (1887), The Claremont Graduate University (1925), Scripps College (1926), Claremont McKenna College (1946), Harvey Mudd College (1955), Pitzer College (1963) and the Keck Graduate Institute of Applied Life Sciences (1997).

Each of the five undergraduate colleges has a four-year academic program leading to its own bachelor's degree. Each has its own campus, its own students and faculty, and its own distinctive style. Yet the campuses adjoin, and the colleges open their courses to one another's students and cooperate in sponsoring joint academic and extracurricular programs. Together, they provide students with facilities and services comparable only to a top-flight university.

With a combination of over 6,500 students and about 600 faculty members, the colleges generate an endless variety of intellectual, cultural, and social activities. Guest speakers, symposia and conferences are frequent, and there are numerous concerts, art exhibits, film series and theater productions.

The assets of The Claremont Colleges total more than \$4.8 billion, including substantial endowments in all of the colleges, over 175 buildings, and 550 acres of land—320 now occupied and 230 reserved for colleges and professional schools that may be founded in the future.

Founded in 1887, **Pomona College** is an independent, coeducational liberal arts college with approximately 1,550 students. It offers 45 majors in the humanities, natural sciences, social sciences and fine arts, leading to the bachelor of arts degree. The founding member of The Claremont Colleges, Pomona makes a number of its programs and facilities available to all Claremont students. The Pomona College Theatre and Dance Department offers instruction and performance opportunities to interested students from all the campuses. The Pomona College Symphony Orchestra and other instrumental and choral ensembles also invite other Claremont Colleges students to audition. Oldenborg Center for Modern Languages and International Relations, in addition to sponsoring a wide array of intercultural events, provides a setting for daily foreign language practice at language lunch tables. The Pomona College Museum of Art mounts temporary and student exhibitions that open with public receptions and may include lectures and related programs for The Claremont Colleges community.

**Claremont Graduate University (CGU)** (1925) awards master's and doctoral degrees in 25 academic and professional fields. It has about 2,050 students and a core faculty of approximately 88, supplemented by more than 200 faculty from the undergraduate Claremont



Colleges and affiliated institutions. Superior undergraduate students at The Claremont Colleges may work simultaneously toward the satisfaction of the undergraduate degree requirements and a master's degree. Applicants must be recommended by their respective colleges and usually enter the program at the beginning of their junior year or later. Interested students should consult their advisers as early as possible, preferably during their sophomore or junior years, to plan their academic programs. Claremont Graduate University is authorized to recommend candidates to the California Commission on Teacher Credentialing for public school teaching multiple or single-subject clear credentials with cross-cultural, language, and academic development (CLAD) emphasis in most recognized teaching areas. Interested students should contact the director of teacher education at the graduate university for specific information early in their undergraduate careers.

**Scripps College** was founded in 1926 by newspaper publisher, educator and philanthropist Ellen Browning Scripps as one of the few institutions in the West dedicated to educating women for professional careers, as well as personal intellectual growth. While many colleges are now coeducational, Scripps continues as a women's college because it believes that having women at the core of its concerns provides the very best environment for intellectually ambitious women to learn from a distinguished teaching faculty and from each other. Scripps' four-year liberal arts curriculum emphasizes interdisciplinary studies in the humanities, combined with rigorous training in the disciplines as the foundation for careers in the professions, the arts, business, science, government, and the academia, as well as for fulfilling private lives. The Scripps mission is to "develop in its students the ability to think clearly and independently and the ability to live confidently, courageously, and hopefully."

**Claremont McKenna College (CMC)**, founded in 1946, is a coeducational residential liberal arts college with an enrollment of about 1,200. The college educates students for responsible leadership in business, government and the professions within the context of a liberal arts curriculum that emphasizes economics and government. With 11 on-campus research institutes, CMC provides faculty and students the opportunity to study issues ranging from leadership to international relations to environmental management.

Founded in 1963, **Pitzer College** is a coeducational, undergraduate, liberal arts college that blends classroom instruction with fieldwork and engages a student's mind, heart and spirit by integrating educational resources on campus, abroad, and in the local community. Pitzer offers a curriculum that spans more than 40 majors and focuses on interdisciplinary, intercultural education with an emphasis on social responsibility and community service.

Established in 1997, **Keck Graduate Institute of Applied Life Sciences (KGI)** provides a professional degree program for scientists and engineers and recent college graduates with science and engineering degrees wishing to pursue business leadership roles in the bioscience industry. This two-year program includes rigorous interdisciplinary coursework, a capstone team project and an industrial internship. The curriculum interweaves the study of systems biology, computer science and bioengineering with instruction in organizational structure, finance, management and business ethics. Upon successful completion of the program, KGI confers the master of bioscience degree. KGI is an independent, coeducational institution, and was the first American graduate school dedicated exclusively to the applied life sciences.

## RESOURCES OF THE CLAREMONT COLLEGES

As one of The Claremont Colleges, Harvey Mudd College shares the use of many facilities and services, of which the library system is perhaps the most notable.

**The Libraries of The Claremont Colleges** provide vast resources that include well over two million volumes. Honnold/Mudd Library, the central library, holds collections in the humanities, sciences and social sciences. Honnold/Mudd has been a selective depository for United States Government publications since 1913. Its holdings include publications issued by the State of California, the United Nations, other international agencies, and Great Britain.

Also in Honnold/Mudd, the Asian Studies Collection includes over 80,000 items, most in Chinese, Japanese and Korean languages. Collections at Denison Library, on the Scripps College campus, focus on the arts and women's studies.

The Libraries are partners with The Claremont Colleges in learning, teaching and research. Librarians and staff in the two libraries provide assistance with locating and using both traditional and electronic information sources. The Libraries also offer research assistance via e-mail and instant messaging. One of the major activities of the Libraries is teaching students how to find, evaluate and effectively use information. Research instruction for classes and other groups, as well as individual appointments for instruction and research assistance, may be scheduled in each of the libraries. Classes in Honnold/Mudd Library are held in either the Keck Learning Room or Keck 2, the Libraries' hands-on classrooms.

The Libraries' large collection of electronic resources provides ready access to a wide variety of bibliographic, full-text and multimedia information. Through the World Wide Web, it is possible to search Blais, the online catalog, or any of hundreds of databases including services such as Lexis-Nexis Academic and ISI Web of Science. Full-text resources include electronic books and journals, as well as specialized resources such as the ACM Digital Library, Congressional Quarterly Library and Grove's Dictionary of Art Online. The Claremont Colleges Digital Library (CCDL) provides access to a growing number of digital collections from The Colleges as well as from the Libraries' Special Collections. Digital collections such as Early English Books Online and North American Women's Letters & Diaries make available thousands of additional primary source materials. Most of these resources are accessible via the Internet to students, faculty and staff of The Claremont Colleges in their dorms, labs, offices and homes, as well as in the Libraries.

The Libraries have many special collections. Some of the most distinctive are the Oxford Collection, the Bodman Collection (history and literature of the Italian Renaissance), the Philbrick Library (drama and theater history), the Westergaard and Bjork Collections (Scandinavia and the Baltic area), and the McCutchan Collection (American hymnology). Students in history may do research in the Macpherson Collection (by and about women), the William Smith Mason Collection (Western Americana), the Wagner Collection of History and Cartography of the North Pacific, the William McPherson Collection of Western Americana, and the Hanna Collection (Western Americana). Literary scholars will find much of interest in the special book collections: the Browning Collection, the Gertrude Stein Collection, and the Irving Wallace Collection. Local history collections include materials on water resources in Southern California and The Claremont Colleges Archives. For students in the sciences, the Hoover Collection contains rare volumes on the history of science and the metallic arts assembled by President Herbert Hoover and his wife, Lou Henry, and the Woodford Collection includes rare and historical geology books.

Students also have access to several nearby affiliated libraries, including the George C. Stone Center for Children's Books, a division of Claremont Graduate University's Center for Developmental Studies in Education; the botanical and horticultural library of the Rancho Santa Ana Botanic Garden; and the library at the Claremont School of Theology.

In addition, The Claremont Colleges support:

**Bridges Auditorium**, a central meeting place with 2,500 seats for cultural and academic gatherings.

**Tranquada Student Services Center**, headquarters for the student health services of the colleges. The building also includes Health Education Outreach and the Monsour Counseling and Psychological Services, with a staff of full-time psychologists trained to facilitate the development of human skills and competencies.

**The Robert J. Bernard Biological Field Station**, encompassing 86 acres of land near the campuses. It contains parcels in various stages of ecological succession and serves as a natural outdoor laboratory for many disciplines.

**McAlister Center for Religious Activities**, a nonsectarian meeting place for students and faculty as well as a place of worship.

**Huntley Bookstore** is the source for all course-required textbooks and support materials used at The Claremont Colleges. The bookstore carries many academic trade and reference titles, new releases, bestsellers, academic study aids, school and office supplies, emblematic clothing and gift items as well as magazines, snacks and soft drinks. Huntley Computer Sales provides both Apple and PC hardware and software at academic pricing as well as a selection of computer supplies, peripherals and repair services.

**Table Mountain Observatory**, is located one hour from campus, at an altitude of 7,200 feet and is owned by Pomona College. The site is on the opposite side of the San Gabriel Mountains from Claremont, shielded from the lights of Los Angeles. At the site, The Claremont Colleges jointly operate a 1.0-meter Cassegrain telescope, the largest undergraduate telescope in the country, which is available for use by qualified Harvey Mudd College students. The equipment available to students for classes and astronomical research includes two optical CCD imaging cameras, a near-infrared array camera, and a stellar spectrograph, all of which are interfaced to modern computers. Data analysis is done on campus in the Astronomical Imaging Laboratory.

Other educational resources of the colleges include the Intercollegiate Women's Studies Program, the Intercollegiate Departments of Africana and Chicano Studies, the Offices of Black and Chicano/Latino Student Affairs, the Claremont School of Theology, the Rancho Santa Ana Botanic Garden, the Blaisdell Institute for Advanced Study in World Cultures and Religion, the Institute for Antiquity and Christianity, and the California Institute of Public Affairs.

### **HARVEY S. MUDD, 1888–1955**

A mining engineer, Harvey S. Mudd (1888-1955) was a graduate of Stanford and Columbia Universities. He served with distinction as president of the American Institute of Mining and Metallurgical Engineers. With his father, he founded and later became president of Cyprus Mines Corp., whose Los Angeles-based international enterprises started with the development of the copper mines on the island of Cyprus.

Harvey Mudd was a director of the Southern Pacific Company, of the Texas Gulf Sulphur Company, and of the Founders Fire and Marine Insurance Company. He was a founding director of the RAND Corporation. He was a trustee of the California Institute of Technology, a director of the Hospital of the Good Samaritan, and a trustee of the Southwest Museum. He was president of the Southern California Symphony Association for 12 years and chairman of its board for nine years.

He had a particular interest in The Claremont Colleges and served as chairman of the Board of Fellows of Claremont College—now the Claremont Graduate University and the Claremont University Consortium—for a quarter of a century. While serving in that position, he helped plan for the undergraduate liberal arts college of engineering, science and mathematics that was chartered in 1955, shortly after his death.



## STUDENT LIFE

### HONOR SYSTEM

The Honor System, established and operated by the students, sets the fundamental principles of conduct for members of the college. It applies to all academic matters such as examinations, written material and laboratory reports—both at Harvey Mudd College and at the other Claremont Colleges—and to the safety of individuals, and private and college property.

### STANDARDS OF CONDUCT

When students enter Harvey Mudd College, it is assumed that they have an earnest purpose. Students are expected to act as responsible individuals, to conduct themselves with honesty and integrity both personally and academically, and to respect the rights of others. The college considers these standards to be essential to its academic mission and its community life.

In this context, the college is an inclusive community of faculty, students and staff. Those who make up the community have participated in developing the standards and the policies that they believe will support the primary purpose of the educational community and the personal development of the individual students.

Unbecoming behavior or violations of college policies or procedures are referred to the student Judiciary Board or the Disciplinary Board for action. These authorities may impose penalties of varying degrees of severity, including expulsion from the college. Students should be aware of federal regulations that require all colleges to implement programs to prevent illicit drug and alcohol use and alcohol abuse by students and employees. It is the policy of HMC to abide by these regulations. Violations may incur legal and college sanctions.

Students are expected to know and abide by all college policies, regulations and procedures, and to report any violations of these.

### NEW STUDENT ORIENTATION

The program of orientation, which begins prior to the opening of classes each fall, includes transition-to-college-life programming, social events, placement examinations and academic orientation. All new students are expected to attend.

### SCHEDULE

Since most courses meet three times a week and the normal academic program is five courses, most students spend three to five hours in class each day except Saturday and Sunday. In addition, most laboratory periods are scheduled in the afternoons. Most students do approximately three hours of academic work outside of class for every hour they spend in class (not including laboratories). Students should consult with their academic advisors to devise a realistic schedule that provides adequate time for study, extracurricular and social activity.

### HOUSING FACILITIES

There are eight residence halls. All first-year students are required to live on campus. Single rooms, doubles and suites for three or more are available. Lounges in each building afford additional space for meetings and social activities.

### DINING FACILITIES

Students may eat at HMC's Hoch-Shanahan Dining Commons or at any of the other dining halls of the undergraduate Claremont Colleges. In addition to standard cafeteria meals, each meal plan provides a weekly allocation of "Board Plus" dollars for food purchases at campus retail sites.

**SOCIAL LIFE**

The social life of a student at Harvey Mudd College may be as active as the student wants. The Claremont Colleges' Calendar includes at least one concert every month, outside speakers almost daily, a dozen art exhibits a year, frequent theater presentations, two distinct athletic programs (CMC-HMC-Scripps and Pomona-Pitzer), cinema series, intramurals and many other events. Student-led committees sponsor a myriad of activities for the student body, including trips to Los Angeles for sporting and theater events, movies, amusement parks and museums; beach trips; camping and hiking trips; campus parties; dances; and more.

**THE DEAN OF STUDENTS OFFICE**

The Dean of Students staff assists students in all aspects of their college lives. Off-campus recreational and cultural activities are planned in conjunction with student organizations. The campus life program, led by the Dean of Residential Life, operates cooperatively with residence hall presidents. Emotional health support is offered by a licensed clinical social worker, who serves as Associate Dean. These, and many other services, are designed to support students as they mature personally and academically.

**STUDENT COUNSELING**

All members of the Dean of Students Office staff, the Associate Dean for Academic Affairs, and members of the faculty and staff are readily available to help individual students with academic, career and personal questions. The Associate Dean for Student Emotional Health provides crisis intervention and brief counseling for students needing support while enrolled. The Associate Dean works closely with The Claremont Colleges' Monsour Counseling and Psychological Services that provide, without charge, the services of full-time psychologists. The service offers personal counseling, and all matters are confidential. Members of the staff also lead personal growth groups on topics such as psychological fitness, human sexuality, and relaxation and stress management.

**STUDENT HEALTH**

The Claremont Colleges maintain a fully-equipped health center with physicians and nurse practitioners in attendance. Medical advice and care are available to students in the colleges, with certain reasonable limitations. (See General Regulations, page 109, for details.)

**OFFICE OF THE REGISTRAR**

The Office of the Registrar provides information about the academic schedules and records of students, present and past. The office also processes classroom scheduling, class enrollment, major changes, adviser changes, degree audits, grades, Dean's List notation, enrollment verifications, transcript requests and degree verifications. In cooperation with the other four undergraduate colleges in The Claremont Colleges Consortium, the office produces the Undergraduate Schedule of Courses each semester.

**CAREER SERVICES**

The Office of Career Services provides resources to assist students in making informed career decisions. Throughout the academic year, workshops are conducted on resume writing, interviewing, networking, negotiating and researching. On-campus recruiting occurs bi-annually during Career Fairs that typically attract over 60 companies to campus. Various specialized nights are held during the academic year, including National Labs Night. All events are advertised to students on the Web and via e-mail. The Career Resource Library includes periodicals, how-to books, directories and industry-specific books; a database of companies provides additional resources for students. Individual career counseling is also available.

**WRITING CENTER**

The Harvey Mudd College Writing Center offers an arena where students can work through the writing process and improve the expression of their ideas by participating in workshops and individual conferences with trained peer consultants. Student writers of all skill levels and disciplines are able to work with student consultants, who offer feedback and encouragement during any stage of the writing process, from developing an idea to polishing a final draft. Peer consultants are also trained to help students with graduate school and fellowship essays, resumes and cover letters. The Writing Center is open five evenings a week throughout the academic year. In addition to individual conferences and topical group workshops, the center offers a variety of print and electronic resources for writers.

**OFFICE OF INSTITUTIONAL DIVERSITY**

The Office of Institutional Diversity serves as the hub of HMC diversity activities and as a supplementary adviser for students of color. This office coordinates programming with the ASHMC student Diversity Committee and provides funding for cultural programs sponsored by student clubs. The office also hosts the Summer Institute, an intensive two-and-a-half-week summer residential experience that offers new students an early introduction to HMC.

**ROTC**

Students interested in pursuing a commission in the United States Air Force concurrently with obtaining a degree may do so by enrolling in Air Force Reserve Officer Training Corps (AFROTC). Through a joint agreement with the University of Southern California, Harvey Mudd College offers AFROTC to the students of The Claremont Colleges and other four-year institutions in the local area. Additional information about Air Force ROTC, including course descriptions, scholarship opportunities and faculty contact information, can be found at the AFROTC website.

**ATHLETICS AND RECREATION**

Harvey Mudd College, Claremont McKenna College and Scripps College are associated in a joint program of intercollegiate athletics, intramural and recreational activities, physical education and club sports known as Claremont-Mudd-Scripps (CMS). CMS facilities include a football field, gymnasium (an aerobic fitness room, a weight room with both free weights and a Nautilus system), a soccer field, a lacrosse field, a nine-lane 400-meter track, a baseball field, a softball field, an aquatics center with a competition pool for swimming, diving and water polo, nine tennis courts, volleyball courts, and numerous intramural and recreational fields.

The intercollegiate athletic program is one of the most successful athletic programs in the country. A member of the NCAA Division III and the Southern California Intercollegiate Athletic Conference (SCIAC), which has eight members, CMS sponsors 21 intercollegiate sports for men (the “Stags”) and women (the “Athenas”).

Students who do not participate in intercollegiate competition may join intramural teams like inner-tube water polo, flag football, volleyball, soccer, basketball, softball, golf, swimming, paintball, tennis, ultimate Frisbee and floor hockey.

Club sports of ballroom dancing, fencing, men’s lacrosse, men’s and women’s rugby, women’s field hockey, ultimate Frisbee and rowing play are additional pastimes.

An extensive list of offerings is available for physical education credit, which may be pursued even beyond the three-semester requirement.

HMC’s Linde Activities Center (LAC) is the hub of students’ recreational and fitness activities. The LAC has aerobics and weight rooms, meeting rooms, a computing lab, and basketball, badminton and volleyball courts. It is open to all HMC students and their guests.

## STUDENT GOVERNMENT

The college encourages students to participate in the governing of student life through the Associated Students of Harvey Mudd College (ASHMC). Student body and class and dorm officers manage committees that plan and coordinate many extracurricular and social activities. ASHMC's Committee for Activities Planning, composed of students, plans and promotes off-campus activities for students, ranging from concerts to rock-climbing. All students are encouraged to participate and contribute ideas for upcoming events.

## OTHER ACTIVITIES

Many other activities of interest to students may be found on the Student Activities web page, [www.hmc.edu/studentlife1/activities.html](http://www.hmc.edu/studentlife1/activities.html).



# ADMISSION

## APPLICANT INFORMATION

Each year, Harvey Mudd College enrolls approximately 185 new students. Admission to HMC is highly selective, and the Admission Committee has the difficult task of selecting the students who will most benefit from and contribute to the intellectual, social and residential life of the college. While admission is competitive, the committee bases its decision on a holistic review of each application; therefore, no able student who has strong interest in mathematics and science, should be discouraged from applying.

When reviewing each candidate, the committee seeks to determine how the student has taken advantage of resources available. Of particular concern are the rigor of the student's academic course load, the grades earned, and the recommendations received in support of the applicant. Taking a full program of demanding academic work every semester, especially in mathematics, English, and laboratory science, is very important. The Admission Committee also notes trends in grades, relative strengths and weaknesses, and overall academic preparation.

Past academic performance is one of the strongest predictors of academic success in college and thus most of the college's entrants have stood in the top 10 percent of their high school classes. The Admission Committee is especially impressed by students who have earned top grades in mathematics and science, but who also excel in the humanities, social sciences and the arts. Harvey Mudd College students also tend to have high scores on the SAT or ACT tests.

It is individual students who enter Harvey Mudd College, not grades or class ranks or test scores. Looking beyond the objective criteria, the committee assesses the student's application in a holistic manner to identify qualities that show potential, motivation, perspective, creativity, energy, originality, character, and ability to work in teams. Extensive participation or leadership within one's school or community activities; an unusual accomplishment in a scientific area; a special talent; a notable amount of resilience; any of these qualities may influence a decision favorably. The college also seeks a diverse student population and encourages applications from candidates from groups traditionally underrepresented in engineering, science and mathematics.

Because of the focus on individual strengths, there is no disadvantage for multiple candidates from the same high school. Those who have an unusual academic background (alternative programs, home-schooling, graduating early, etc.) are given equal consideration, and should consult the Office of Admission counselors to learn how to present their experiences completely and clearly.

## FIRST-YEAR ADMISSION

There are three application deadlines for admission to the first-year class. The Early Decision I deadline is November 15 with notification sent by December 15. The second round of Early Decision applications has a deadline of January 2 with notifications sent by February 15. Regular Decision candidates apply by January 2, are notified by April 1 and must respond to the offer of admission by May 1. All acceptances are contingent upon satisfactory completion of the final term in good standing in all matters related to course work and character.

First-year students can apply for entrance only in the fall semester. Every candidate is responsible for ensuring that all credentials are received by the application deadline. If any questions arise about the application, the staff in the Office of Admission is available for advice and counsel to all students and their parents.

**Common Application**— All candidates for admission should apply using the Common Application as well as the HMC Supplement to the Common Application. Forms can be found by visiting [www.commonapp.org](http://www.commonapp.org) or by using the links provided on the HMC Admission website. Common Applications are also available from most high school guidance offices.



**Application Fee**— The admission application should be accompanied by a \$60 application fee, which covers part of the cost of processing the application. It is not refundable. Students who have unusual financial need should not be discouraged from applying, but should file their admission applications accompanied by an ATP Fee Waiver form or a letter from the high school counselor requesting that the fee be waived.

**Counselor and Teacher Recommendations**— These are confidential reports by the school counselor and by classroom teachers. The secondary school report is completed by a high school counselor. A mathematics, physics, chemistry or biology teacher should complete a second recommendation. A third recommendation must be completed by an English, history or foreign language instructor. These recommendation forms are found on the common application web site: [www.commonapp.org](http://www.commonapp.org). Applicants may submit more than the required number of recommendations, if they wish, but should not make substitutions. Students should be judicious in the number of additional recommendations submitted.

**Official Transcripts**— Applicants must submit transcripts from high school work through the junior year. A transcript showing work completed in the first semester or first trimester of the senior year should also be sent as soon as those marks are available. Students must also file transcripts for any college courses completed. A final official transcript confirming graduation and good standing at the conclusion of the school year is also required of any enrolling student.

**Standardized Tests**— Every first-year applicant is required to take the College Board SAT or the ACT exam (including the writing component). All applicants are also required to take two SAT Subject Tests: Math Level 2 and a second exam of the candidate's choice. Early Decision I applicants may take the SAT or ACT Reasoning Test and/or Subject Tests as late as the November test date. Applicants for the second round of Early Decision may submit scores from tests taken as late as December. Regular Decision applicants may take the SAT tests as late as the January test date or the ACT exam as late as the December test date.

Candidates must register with the College Board or ACT, Inc. to take the tests, which are offered several times a year all over the world. The Admission Committee will only accept and review official score reports submitted by the College Board or ACT, Inc.

Starting in Spring 2009, students taking the SAT may consider the option of sending only selected score reports to colleges. HMC's policy requires students to send all SAT and/or ACT scores.

In evaluating the application, the Admission Committee places more weight on the student's curriculum and grades than on test scores. We will only use the highest score from any one test to put the application in the best possible light.

**Personal Interview**— Interviews are not required but are strongly recommended. They provide an excellent opportunity for applicants to learn more about Harvey Mudd College. They also allow a member of the admission staff to get to know applicants better. Typically, interviews occur during the fall of, or in the summer just before, a student's senior year.

It should be noted that there is no need to postpone an interview until all credentials are on file. Simply call the Office of Admission at 909.621.8011, at least one week in advance for an appointment. The office is open weekdays throughout the year and on most Saturdays from September through November. Anyone is welcome to tour the campus.

## CURRICULAR EXPECTATIONS

Applicants are expected to complete a strong program of studies in the course of their secondary school preparations. Each enrolling student is required to complete one year of high school or one semester of college course work in calculus, chemistry and physics. Students who are unable to complete any of these courses may be admitted contingent upon successful completion of a summer college course in that discipline. Applicants who will have not completed the requirements should make this fact known at the time of their applications.

The Admission Committee encourages students to pursue advanced course work, especially in science and mathematics, if their preparation allows.

**English**– Four years. It is assumed that the student will have a thorough grounding in grammar and competence in writing and speaking.

**Mathematics**– Calculus is required before entering in the fall.

**Laboratory Science**– At least one year of chemistry and one year of physics are required before entering in the fall. One year of biology is recommended.

**Foreign Language**– Two years recommended.

**Social Science**– Applicants are encouraged to elect at least two years of social science courses, including at least one year of history.

### **FIRST-YEAR EARLY DECISION**

First-time college candidates who decide that Harvey Mudd College is clearly their first choice are encouraged to use one of the Early Decision options. This will allow them to resolve their college choice earlier in their senior year. Early Decision candidates should submit all their credentials by November 15. Students who apply under an Early Decision plan may only have one Early Decision application currently active at any one time. This means that a student may only use the Early Decision option at HMC if other Early Decision applications to other colleges have been closed. Early Decision is a binding decision. Applicants admitted through Early Decision are expected to withdraw all other college applications, to not initiate new ones and to enroll at Harvey Mudd College. Students sign a statement along with the high school counselor verifying that all other college applications have been withdrawn. Students who are unsure about their choice for college should not use an Early Decision option, but should instead apply by the Regular Decision deadline of January 2. Early Decision candidates should submit all of their credentials by November 15 for Early Decision I or by January 2 for Early Decision II.

In considering Early Decision applicants, the Admission Committee may vote in one of three ways: it may accept the Early Decision candidate, it may postpone action, or it may deny admission. An early application is denied if the committee feels that no other decision would be possible in the spring. If a decision is postponed, applicants' chances for acceptance are not prejudiced in any way, and the application is considered along with all Regular Decision candidates. Students whose decisions are postponed are released from the agreement (obligation to enroll) that was signed in the Early Decision Statement.

Early Decision I candidates who wish to apply for financial aid must file their online College Scholarship Service (CSS)/ Financial Aid PROFILE application by November 15. The CSS/ Financial Aid PROFILE is available via the College Board's website. Also, by November 15, students must submit a signed copy of their parents' federal income tax return from the previous year. These tax forms should be sent directly to the Office of Financial Aid. Please refer to the Financial Aid section on page 22 for more information. For information about applying for financial aid as an Early Decision candidate, please see the financial aid website at [www.hmc.edu](http://www.hmc.edu).

### **DEFERRED ENTRANCE**

Candidates who are accepted for admission may petition to delay (or defer) their entrance for a year. They should write to the Office of Admission describing their plans and must submit their commitment deposits by May 1. Once a request is approved, space is reserved for the next fall semester. Students may not enroll in a degree program at another college during this interval and they may not initiate any new applications.

## INTERNATIONAL STUDENTS

The procedure for the admission of students from foreign countries is essentially the same as the procedure for domestic students. International applicants must submit all official credentials in English or with translations. In addition, international students must show that they are sufficiently fluent in English to enable them to handle the work of all courses. Harvey Mudd College does not offer English as a Second Language or other special programs for non-English speaking foreign students.

Scores from the TOEFL (Test of English as a Foreign Language) are required. The minimum score for the TOEFL examination is 600 (paper test) or 100 iBT (internet Based Test). While Harvey Mudd College offers funding for some international students, financial aid for foreign students is extremely limited.

## TRANSFER ADMISSION

Students are considered for transfer standing if they will have completed the equivalent of one year of full-time academic course work by the time they enter Harvey Mudd College. Candidates must submit their applications by April 1 prior to the September of desired enrollment. Notices of the committee's decisions are mailed by May 15 and response regarding the offer of admission is required by June 10. Candidates who have applied previously to HMC should make that known when contacting the Office of Admission about transferring.

In addition to high school transcripts, two personal essays and the application fee, transfer candidates must submit transcripts from secondary school and of all previous college work, along with course descriptions of all college courses completed or in progress. At least one of the three required references must come from a mathematics, science or engineering instructor at the candidate's college. Students must present an official statement indicating that they left their previous college in good standing academically and socially. Transfer candidates are strongly encouraged to submit two SAT Subject Tests (Math Level 2 and another of the student's choice).

In assessing transfer applications, the Admission Committee places considerable weight on the nature and quality of the previous college record. Where college transcripts do not clearly indicate the quality of work (e.g., many pass/no credit courses), it is the applicant's responsibility to provide supplemental information to assist the committee's evaluation.

All transfer students must spend the equivalent of four full-time semesters at HMC and must complete all HMC degree requirements.

The college policy on awarding credit for work completed elsewhere is described under "Academic Regulations." Offers of admission are conditional, pending review of final transcripts showing satisfactory completion of courses in progress.

## 3-2 PROGRAMS

HMC offers a 3-2 Program in Economics and Engineering in cooperation with Claremont McKenna College. The program is designed for students who want a liberal arts background, with emphasis on economics and management, and an engineering major. The students spend their first three years at Claremont McKenna College studying mathematics, science, economics, management and general education courses. At the end of the junior year, they may apply as transfer students to HMC.

HMC also has a 3-2 program in Engineering with Scripps College. It is similar to the 3-2 program with Claremont McKenna College, but the 3-2 Program with Scripps College does not include the emphasis on economics. The students reside at Scripps College for their first three years and cover a broad range of courses with emphasis in mathematics and science.

Students accepted into either 3-2 program must complete HMC's requirements for general education and for the engineering major. Because curricular expectations for the 3-2

transfer program are specific, potential applicants are strongly encouraged to consult with the Harvey Mudd College Office of Admission as well as the chairperson of the Department of Engineering.

**VETERANS**

Candidates who are veterans of the armed services should submit a copy of their honorable discharge papers along with the other required credentials.

**ADVANCED PLACEMENT**

The Admission Committee recognizes that advanced placement (AP), International Baccalaureate (IB) and honors courses are often more demanding than conventional courses and gives appropriate weight to them in the selection process. Please refer to the Academic Regulations section for details about HMC's policy for awarding credit or placement out of HMC courses.

**COURSES FOR HIGH SCHOOL STUDENTS**

Local high school students may be permitted to take a small selection of HMC mathematics and science courses if such courses are not offered in their high schools. These students must have excellent academic credentials and submit a "special student application" no later than two weeks prior to the start of classes. Selection is made by the Office of Admission after reviewing the application and following consultation with the appropriate academic department(s). These students are not considered to be in residence. Charges for special course work are nominal, reflecting only the administrative processing costs, not the cost of instruction. The Office of Admission can provide details on fees for the coming year.

**CAMPUS VISITS**

Students and their parents are encouraged to visit Harvey Mudd College, especially when classes are in session. Tours, class visits, interviews and overnight stays are available. Please contact the Office of Admission at 909.621.8011 or visit the HMC website to arrange a visit and get directions.

**RETENTION**

Of the 196 students who enrolled as HMC first-year students in September 2007, 187 returned to register in September 2008 for a first-year retention rate of 95 percent. Of the 192 students who enrolled as first-year students in 2003, 174 have graduated as of May 17, 2009 for a six-year graduation rate of 91 percent.

**COLLEGE EXPENSES****TUITION**

The tuition charge for the 2009–2010 academic year at Harvey Mudd College is \$38,222. (Students enrolled in 10 or more units are charged full tuition. Those in less than 10 are charged pro rata.) The tuition charged is less than half the actual cost of the student's education. The college bears the additional expense through gifts from alumni and friends. In effect, every student receives a partial scholarship. On the basis of recent experience, tuition can be expected to increase each year due to increasing costs. However, the college has been very successful in assisting students who need financial aid through its extensive program of scholarships, loans and employment opportunities.

**ENROLLMENT DEPOSIT**

Every admitted student who plans to enter is required to remit a non-refundable enrollment deposit of \$300 by the date prescribed in the acceptance letter. It is imperative that students planning to attend the college submit the deposit to the Office of Admission by the deadline. Confirmation of final admission is contingent upon this deposit. Following acceptance of admission, first-year students are also required to submit a \$150 room reservation deposit. This deposit will assure students of a room assignment in a dormitory on campus. A room reservation deposit is required in the spring of each succeeding year the student plans to live on campus. (See "Housing Deposit" under General Regulations, page 109.)

**ROOM AND BOARD**

The 2009–2010 charge for a campus room is \$6,605. Board charges for the year are \$5,965 for 16 meals a week plus \$16 "Board Plus" per week (full board). Other board plans available are \$4,997 for 12 meals a week plus \$12 "Board Plus" per week, and \$3,579 for eight meals a week plus \$8 "Board Plus" per week. The cost of living off campus is generally similar to on-campus charges.

**DUES AND FEES**

Dues set by the Associated Students of Harvey Mudd College are \$245 per year. A fee of \$20 per semester is charged to every student who operates a motor vehicle of any sort on the campus.

**TOTAL EXPENSES**

Listed below are the total college expenses for the 2009–2010 academic year:

Tuition	\$38,222
Room Rent	\$ 6,605
Board (16 meals)	\$ 5,965
Student Body Fee	\$ 245
<b>Total</b>	<b>\$51,037</b>

It is projected that overall expenses will increase between 4 and 6 percent each academic year. The college reserves the right to change these, or any other fees, at any time. Entering first-year and transfer students will be charged an additional \$100 orientation fee.

**OTHER EXPENSES**

Additional expenses for a year at Harvey Mudd College also include the cost of books and supplies, clothing, transportation, recreation and incidentals. The cost of books and supplies averages \$800 per year. Personal expenses will vary but are approximately \$900 per year. An allowance toward transportation expenses should be added for students outside the Southern California region only.

**MONTHLY PAYMENT PLAN**

Payment of all regular charges is due prior to the beginning of each semester per the due date on the Harvey Mudd College billing statement. However, annual charges may be paid in ten monthly installments. The first installment is due in July and the final installment is due the following April. Applications for the monthly payment plan are mailed to all students in June and there is a service charge of \$10 per month (\$50 per semester). Use of the monthly payment plan is a privilege that may be revoked for cause.

**FINANCIAL AID**

Harvey Mudd College offers a comprehensive program of scholarships, grants, loans and work from the college, the federal and state governments, and from other sources to assist students and parents in paying the cost of attending Harvey Mudd College. The college is committed to its need blind admission policy and guarantees that it will meet the 100% of the demonstrated financial need of each applicant as determined by the FAFSA and the College Scholarship Service Profile Form.

Approximately 83 percent of the families with students attending Harvey Mudd College receive need-based or non-need based financial assistance in the form of scholarships, grants, work-study, and/or loan funds. Approximately 70 percent receive scholarship assistance directly from Harvey Mudd College.

One of the primary goals of the financial aid staff is to inform prospective students and parents, as well as current students and parents, of the various financial aid programs available to assist families with educational costs. For information, consult “Costs and Financial Aid” on the HMC website ([www.hmc.edu](http://www.hmc.edu)) or contact the financial aid staff with questions at 909.621.8055.



## ACADEMIC PROGRAM

### OVERVIEW

*Harvey Mudd College seeks to educate engineers, scientists and mathematicians well versed in all of these areas and in the humanities and social sciences so that they may assume leadership in their fields with a clear understanding of the impact of their work on society.*

The founders of Harvey Mudd College envisioned a distinctive educational experience for the college's students. The curriculum was designed to create scientists and engineers with unusual breadth in their technical education and a firm academic grounding in the humanities, social sciences and the arts.

The required curriculum is divided into four components: the Common Core, which provides the foundation for advanced study; the program in Humanities, Social Sciences, and the Arts, which completes the liberal arts nature of a Harvey Mudd College education by providing humanistic and social scientific perspectives; the Major, which builds depth and technical competence; and the Integrative Experience, which explicitly addresses the interface between society and science and technology. Unifying all of these is an emphasis on strong oral and written communications, the development of computational skills, and direct experience with a research or design project. The academic programs are demanding, but the college fosters cooperation rather than competition under a successful Honor Code.

In order to be recommended by the faculty for the Bachelor of Science degree, students are required to complete satisfactorily a minimum of 128 credit hours of courses (including approved transfer credits for courses taken at other colleges). Students must also complete all of the requirements of each of the four curricular components as well as a physical education requirement.

### COMMON CORE

The Common Core presents a coordinated, common foundation essential to the education of all students. It includes four semesters of mathematics, three semesters of physics and associated laboratories, two semesters of chemistry and associated laboratories, one writing-intensive course in humanities and social sciences, and one course each in biology, computer science and engineering.

Core courses address three objectives: (1) acquisition of disciplinary knowledge and experience with disciplinary-related techniques, (2) skill development in the areas of oral and written communication, critical thinking, teamwork and collaboration, project management and/or leadership, and (3) explorations of either the interrelationship of technical work and society or the understanding of one's own culture or other contemporary cultures.

All core courses must be attempted by the end of the fifth semester.

Harvey Mudd College is committed to continuous improvement informed by assessment of student learning outcomes and, as such, changes in the curriculum happen periodically after careful study and deliberation. The 2009–2010 academic year will be a bridge year during which new courses will be piloted and tested prior to the debut of a New Core in the fall of 2010. This means that the current requirements are in force for the 2009–2010 academic year. It is also the case that students have the option of graduating under any catalogue in effect during their continuous enrollment at the College. Thus anyone entering in the fall of 2009 will be able to graduate under the 2009–2010 catalogue.

Core courses are listed below. Course descriptions are given in the course listings for the departments.

### BIOLOGY

#### 52. INTRODUCTION TO BIOLOGY (3)

Topics in cell biology, molecular biology, genetics, and evolution. Prerequisites: one semester of general chemistry and one semester of calculus.



## CHEMISTRY

### 21-22. GENERAL CHEMISTRY (3)

Three credit hours per semester. Stoichiometry, kinetic theory, phase behavior, equilibrium, bonding, thermodynamics, kinetics and descriptive chemistry.

### 25-26. CHEMISTRY LABORATORY. (1)

One credit hour per semester. Laboratory taken concurrently with Chemistry 21-22.

## COMPUTER SCIENCE

### 5. INTRODUCTION TO COMPUTER SCIENCE (3)

Introduction to elements of computer science. Students learn general computational problem-solving techniques and gain experience with the design, implementation, testing and documentation of programs in a high-level language. In addition, students learn to design digital devices, understand how computers work, and learn to program a computer in its own machine language. Finally, students are exposed to ideas in computability theory. The course includes discussions of societal and ethical issues related to computer science.

## ENGINEERING

### 59. INTRODUCTION TO ENGINEERING SYSTEMS (3)

An introduction to the concepts of modern engineering emphasizing modeling, analysis, synthesis and design. Applications to chemical, mechanical and electrical systems. Prerequisites: sophomore standing and concurrent registration in Physics 51.

## HUMANITIES, SOCIAL SCIENCES, AND THE ARTS

### 1. INTRODUCTION TO THE HUMANITIES AND SOCIAL SCIENCES (4)

An introduction to college level studies in the humanities and social sciences focusing on the development of essential reading, critical thinking, research and especially writing skills.

## MATHEMATICS

### 11. CALCULUS (2)

Complex numbers, limits, formal epsilon-delta limit definition, derivatives and differentiation rules; proofs by contradiction and induction; infinite series; integration; applications of the calculus; introduction to calculus of complex-valued functions. Prerequisite: one year of calculus at the high school level.

### 12. INTRODUCTION TO LINEAR ALGEBRA (2)

Matrix representation of systems of equations, matrix operations, determinants; linear independence and dependence, bases; inner products, eigenvalues and eigenvectors; examples of discrete dynamical systems, fixed points, chaos, stability, bifurcations. Prerequisite: one year of calculus at the high school level.

### 13. DIFFERENTIAL EQUATIONS (1.5)

Modeling physical systems, first-order ordinary differential equations, existence; uniqueness and long-term behavior of solutions; bifurcations, approximate solutions; second-order ordinary differential equations and their properties, applications; first-order systems of ordinary differential equations. Prerequisite: Math 11 or the equivalent.

### 14. MULTIVARIABLE CALCULUS I. (1.5)

Vectors, dot and cross products; vector descriptions of lines and planes; partial derivatives and differentiability; gradients and directional derivatives; chain rule; higher order derivatives and Taylor approximations; double and triple integrals in rectangular and other coordinate systems; line integrals; vector fields, curl and divergence; introduction to Green's theorem, divergence theorem and Stoke's theorem. Prerequisite: Math 11.

**61. MULTIVARIABLE CALCULUS II (1.5)**

Review of basic multivariable calculus; optimization and the Second Derivative Test; constrained optimization using Lagrange multipliers; conservative and nonconservative vector fields; Green's theorem; parametrized surfaces and surface integrals; divergence theorem, outline of proof and applications; Stoke's theorem, outline of proof and applications; unification of major vector theorems. Prerequisite: Math 14.

**62. INTRODUCTION TO PROBABILITY AND STATISTICS (1.5)**

Sample spaces, events, axioms for probabilities; conditional probabilities and Bayes' theorem; random variables and their distributions, discrete and continuous; expected values, means and variances; covariance and correlation; law of large numbers and central limit theorem; point and interval estimation; hypothesis testing; chi-square goodness of fit; simple linear regression; introduction to analysis of variance; applications to analyzing real data sets. Prerequisite: Math 12.

**63. LINEAR ALGEBRA II (1.5)**

Review of basic linear algebra; vector spaces; row and column spaces of matrices, rank-nullity theorem; orthogonal bases and Gram-Schmidt procedure; orthogonal expansion and Fourier coefficients; linear transformations; change of basis and similarity; eigenvalues, eigenvectors and characteristic polynomials; diagonalization of symmetric matrices; applications of eigenvalues to systems of ordinary differential equations. Prerequisite: Math 12.

**64. DIFFERENTIAL EQUATIONS II (1.5)**

Review of basic ordinary differential equations, especially systems; undriven linear systems; orbital portraits; stability and conservative systems; Lyapunov functions; cycles and long-term behavior of solutions; Sturm-Liouville problems; series solutions near ordinary and regular singular points; Bessel functions; chaos. Prerequisite: Math 12 and Math 13.

**PHYSICS****23. SPECIAL RELATIVITY AND AN INTRODUCTION TO QUANTUM MECHANICS (2)**

Time dilation, length contraction, Lorentz transformations, spacetime, relativistic momentum and energy; the wave and particle nature of light, the principles of quantum mechanics as seen in the sum-over-paths approach to the subject.

**24. MECHANICS AND WAVE MOTION (3)**

Kinematics, dynamics, linear and angular momentum, work and energy, harmonic motion, waves and sound.

**28. PHYSICS LABORATORY (1)**

Experiments in mechanics using digital electronic measuring devices. Corequisite with Physics 24.

**51. ELECTROMAGNETIC THEORY AND OPTICS (3)**

An introduction to electricity and magnetism leading to Maxwell's electromagnetic equations in differential and integral form. Selected topics in physical optics. Prerequisites: Physics 23-24 and Mathematics 14.

**53. ELECTRICITY AND OPTICS LABORATORY (1)**

Electrical and magnetic techniques in such measurements as the Hall effect and the earth's magnetic field. Introduction to electronics, including use of the oscilloscope and measurements on RC and RCL circuits. Experiments in physical optics, including studies of diffraction patterns. Prerequisite: Physics 51 or concurrently.

**COMPLETING THE COMMON CORE**

For many students the academic program in the first two years consists of the Common Core, two additional humanities or social sciences courses, two courses in the major and two electives. Usually it is possible for students to delay their choice of a major until midway through

the sophomore year or even to the beginning of the junior year. Students should consult their academic advisers early in their program in order to ensure that their options will remain open. After the first year, students must register for all deficient first-year courses each time they are offered. All such courses must be passed before the beginning of the junior year. Sample programs for the first two years appear below.

**Sample First-Year Program**

	First Semester Credit Hours	Second Semester Credit Hours
Chemistry 21/22, 25/26		
General Chemistry with Lab	4	4
Computer Science	3	0
Introduction to Computer Science		
Humanities and Social Sciences 1,	4	3
Introduction to Humanities and Social Sciences/Fall		
Advisor-approved Spring-Semester HSA Elective		
Mathematics 11-12 & 13-14	4	3
Calculus		
Introduction to Linear Algebra		
Differential Equations		
Multivariable Calculus I		
Physics 23-24, 28	2	4
Special Relativity and an Introduction		
to Quantum Mechanics		
Mechanics and Wave Motion with Lab		
Biology 52/Elective	0	3
Introduction to Biology		
Physical Education	0	0
Approved PE course		
<b>TOTAL</b>	<b>17 hours</b>	<b>17 hours</b>

The instructors in the first-year program meet regularly with the Associate Dean for Academic Affairs to insure that course material, major assignments and examinations are coordinated throughout the year.

**Sample Sophomore Program**

	Credit Hours
Engineering 59	3
Introduction to Engineering Systems	
Mathematics 61, 62, 63, 64	6
Multivariable Calculus II	
Introduction to Probability & Statistics	
Linear Algebra II	
Differential Equations II	
Physics 51, 53	4
Electromagnetic Theory & Optics with Lab	
Biology 52/Elective(s)	6
Introduction to Biology or an elective	
Humanities, Social Sciences, and the Arts	6
Major Courses	6-9
Physical Education	0
<b>TOTAL</b>	<b>31-34 hours</b>

**HUMANITIES, SOCIAL SCIENCES, AND THE ARTS**

The program in Humanities, Social Sciences, and the Arts is one of the distinctive and defining aspects of Harvey Mudd College. From its inception, the college has regarded a strong grounding in these areas as an essential part of the education of engineers, scientists and mathematicians, who need to be mindful of the richness and complexities of the human experience as well as the social contexts and consequences of their own endeavors. In addition to the Common Core course, students must complete 11 full semester courses (one of them in the spring semester of the first year) in a coherent program planned with the approval of their humanities, social sciences and the arts adviser. This program must include two key elements: a concentration of courses in a single discipline or in an interdisciplinary field chosen from the distinct areas of liberal arts study offered at The Claremont Colleges; a distribution of courses in different disciplines that exposes students to the varieties of intellectual approaches that inform the humanities and social sciences. To foster the growth of an intellectual community, students must take at least six courses (including Humanities 1) from departmental faculty members. Students may select their remaining courses from a large number available at Harvey Mudd College and the other Claremont Colleges. For more specific information regarding these requirements, see the listing under Departmental Programs in this catalogue, as well as the Department of Humanities, Social Sciences, and the Arts Advising Handbook.

**INTEGRATIVE EXPERIENCE**

The founders of the college held that “technology divorced from humanity is worse than no technology at all.” To explore the meaning of the founders’ vision, students choose a one-semester integrative experience (IE) course that explores the interaction between science, technology and society. IE courses may be offered by any academic department, and they are frequently team-taught. The IE program is supervised by the Curriculum Committee.

An IE course may be (1) a faculty-initiated course/experience or (2) a student initiated experience. Included in category (1) are (a) courses that include consideration of one or more issues involving the relationship of science or technology with contemporary society; (b) courses offered in parallel with Clinic or research involving groups of students in critical reflection on the ethical and social issues involved in their projects and/or prior projects; and (c) project-based courses that specifically address a societal need, in the performance of which students substantively consider the wider set of societal issues that create the context and need for their actions. In category (2), a student-initiated experience is an independent project/experience designed by a student or a group of students that includes treatment of specific interactions between science/technology and society. Students proposing an experience must complete the online form prior to close of business on the first day of the semester. In all IE course/experiences, there should be a final paper or project with demonstrable evidence of significant self-reflection and critical analysis, and an oral presentation of the work in a forum that allows open discussion of the work in a community setting. The Curriculum Committee will be responsible for determining whether a course or experience meets the IE guidelines. With the exception of student initiated IEs, courses/experiences to be taken for IE credit must be approved by the Curriculum Committee prior to the pre-registration period for the semester in which the course is to be offered or the project/experience is to be undertaken. An IE course cannot be taken with a Pass/Fail grading type to satisfy the IE graduation requirement. A list of currently approved Integrative Experience courses and guidelines for creating individual Integrative Experiences is maintained by the Office of the Dean of Faculty.

**INTEGRATIVE EXPERIENCE (IE) COURSES****142. SEMINAR IN MATH AND SCIENCE EDUCATION (3)**

*Yong, Dodds.* Students will learn about and contribute to math and science education in our community. Over the course of the semester, students observe math and science classrooms

and reach out to integrate with our readings and discussions, which will be centered around questions such as What is effective math and science teaching?, What is effective math and science education?, and How does math and science education impact our society? (Fall)

**144. MATHEMATICS, MUSIC, ART: COSMIC HARMONY (3)**

*Alves, Orrison.* A seminar exploring some of the many intersections between mathematics and music within our own and non-Western cultures, including proportion in art, tuning systems, algorithmic composition, artificial intelligence and creativity, and music synthesis. The class will also examine the ethical, aesthetic, and cultural ramifications of compression technology, sampling, downloading, and the effects of technology on music and vice-versa. (Fall)

**150. PUBLIC SPEAKING FOR SCIENCE AND CITIZENSHIP (3)**

*Steinberg.* This course builds student speaking skills in three areas: communicating advanced topics in science and technology to non-specialists; speaking out on questions of politics and values; and engaging the intersection of the two through presentations on technically intensive social controversies. 3 credit hours. (Fall)

**162. BEYOND CALCULATION (3)**

*Erlinger.* Students will review the history of computing, the current state of computing, and various predictions of the future of computing through lecture, literature research, presentations and short papers. The reviews will encompass social and economic aspects of computing along with the technical aspects. Using the above three views of computing and their breadth in science and the humanities, students will produce their own prediction of everyday computing in ten or fifteen years. These predictions will be done by means of a research paper and class presentation. Student predictions will include all aspects of the computing equation: scientific, economic and social. (Fall)

**171. BUILDING LOS ANGELES (3)**

*Groves and Petersen.* This course explores the complex network of urban communities in which we live in order that we might think more deeply about the relationship of the built to the natural environment. To complicate our conceptions of Los Angeles, we will consider the city's history and the massive infrastructure that allows it to function. We will focus for a substantial part of the course on architecture, which can be a profound expression of the relationship between the built and the natural. And we will explore contemporary developments, including adaptive re-use, the new urbanism, and green design. (Offered alternate years in Fall semester)

**185. HUMAN PHYSIOLOGY AND DISEASE (3)**

*Staff.* This course will provide an overview of the organ systems in the human body and their corresponding diseases. Lectures will provide the general background in human anatomy and physiology, while student-driven presentations will examine diseases and disease-related issues that impact our society. Prerequisites: Bio 52 or approval from instructor. (Spring)

**198. SOCIAL CHOICE AND DECISION MAKING (3) (Also listed as MATHEMATICS 188)**

*Su.* Basic concepts of game theory and social choice theory, representations of games, Nash equilibria, utility theory, non-cooperative games, cooperative games, voting games, paradoxes, Arrow's impossibility theorem, Shapley value, power indices, "fair division" problems and applications. Prerequisite: Math 63 and (recommended) Math 55 or permission of instructor. (Offered alternate years in Spring)

Other courses can be designated as IE courses depending on the instructor and teaching methods of the course for the semester. Such courses have included the following:

**ANTH110. LIFE: KNOWLEDGE AND PRACTICES**  
**ANTH111. INTRODUCTION TO THE ANTHROPOLOGY OF SCIENCE AND TECHNOLOGY**  
**BIOL082. CURRENT ISSUES IN BIOLOGY**  
**ECON150. POLITICAL ECONOMY OF HIGHER EDUCATION**  
**ENGR138. INTRODUCTION TO ENVIRONMENTAL ENGINEERING**  
**ENGR174. PRACTICES IN CIVIL ENGINEERING**  
**ENGR201. ECONOMICS OF TECHNICAL ENTERPRISE**  
**HIST184. SCIENCE AND RELIGION**  
**MATH188. SOCIAL CHOICE AND DECISION MAKING**  
**PHIL125. ETHICAL ISSUES IN SCIENCE AND ENGINEERING**  
**PHYS080. ENERGY AND THE ENVIRONMENT**  
**RLST184. SCIENCE AND RELIGION**  
**SOSC180. TROPICAL FORESTS: POLICY AND PRACTICE**  
**STS 001. INTRODUCTION TO SCIENCE, TECHNOLOGY AND SOCIETY**  
**STS 114. SOCIAL AND POLITICAL ISSUES IN CLINIC**  
**STS 124. U.S. SCIENCE AND TECHNOLOGY POLICY**  
**STS 185. SCIENCE AND ENGINEERING FROM AN "OTHER" PERSPECTIVE**  
**STS 187. HIV/AIDS: SCIENCE, SOCIETY AND SERVICE**

See the corresponding departmental course listing for a description of these courses.

### **PHYSICAL EDUCATION**

The physical education requirement helps students develop skills for lifelong physical fitness. Students must register for a physical fitness course in their first year, and the typical student must complete three courses of physical education. For further details, and for information about the relationship of intercollegiate and approved club sports to the physical education requirement, see Physical Education in the Departmental Programs section, page 86.

### **MAJORS (IN GENERAL)**

A student must complete the requirements for one of the departmental majors, one of the interdisciplinary majors, an approved individual program of studies (IPS), or an off-campus major (OCM) and technical minor with approval from the Associate Dean for Academic Affairs. The departmental majors are: biology, chemistry, computer science, engineering, mathematics and physics. There are currently three interdisciplinary majors: chemistry and biology, computer science and mathematics, and mathematical biology. Requirements for each major are listed in that major's section of this catalogue.

Every student should seek early guidance from faculty advisers in order to clarify the preparation required for specific majors. Typically, students either select a major or file a tentative IPS plan by the end of the fourth semester.

In the junior and senior years, students take two or three courses each semester in their major and related fields. Some of these are requirements while others are electives. All majors culminate in original research and design opportunities.

## STUDY ABROAD AND DOMESTIC EXCHANGES

Harvey Mudd College students may spend a semester or a year studying at a university abroad, or they may choose to participate in the domestic exchange program with Swarthmore College or Rensselaer Polytechnic Institute in Troy, N.Y. This is most commonly done in the junior year.

### Study Abroad

The Harvey Mudd College Study abroad program provides students the opportunity to develop an international perspective and broaden their education in ways not possible in Claremont. For this reason, it is recommended that students select courses unique to their site.

Students normally take a course load equivalent five HMC semester courses (15–16 credit hours), whether or not they need the credits to graduate. Except under extraordinary circumstances, overloads will not be approved. Students should discuss course selection with both of their faculty advisers.

Departmental approval is required for all courses to be counted toward their major or humanities/social sciences requirements, and is also a requirement to go abroad. It is highly advised that you retain all syllabi, reading lists, copies of submitted work, including all papers and exams as a record of your academic performance abroad.

Because the college wants all student study abroad decisions to be driven by academic, rather than financial factors, students pay a comprehensive fee to HMC that is equal to charges for tuition, room, full board and fees for the same period of time at HMC. The fee covers the costs of the academic program, reasonable room and board (16 meal plan) in the host country, and an allowance for round-trip transportation to the program site.

Because students remain enrolled at HMC, those on financial aid normally receive their regular assistance while on a semester or year abroad. Students interested in taking a Leave of Absence (LOA) to study abroad for a semester should note that their courses will not transfer back as HMC credit.

Acceptance to most programs is a two-step process requiring both HMC and the program sponsor or host institution approval. Students should be able to follow university lectures in the language in which they are given, participate in seminar discussions, take notes and understand written material in their field. Generally, four or five semesters of a foreign language at the university level is required.

Students must participate fully in all orientation and evaluation processes offered by HMC and the host institution as well as observe HMC and host institution deadlines for the submission of all required materials.

Credit toward graduation from HMC is granted only to participants in programs of study officially approved by the HMC Study Abroad Committee.

All courses taken while studying abroad are to be taken for a grade unless the course is only offered on a Pass/Fail credit basis. Transfer credit will be awarded only on grades of C or better and some departments require grades of B or better for courses to fulfill major requirements. It is advised that students verify the departmental minimum grade requirements. All grades received will appear on the HMC transcript, but the grades will not be computed into the HMC GPA.

Grades for the semester prior to departure will be reviewed before final approval is granted for participation in study abroad. Should grades fall below qualifying standards, approval for participation will be withdrawn.

It is the student's responsibility to consult her/his academic advisers to affirm the applicability of her/his proposed coursework. Any changes from this plan should be communicated, in writing, to the adviser and the Study Abroad Office. HMC's acceptance of coursework taken abroad is contingent upon approval by the student's major department, the Humanities, Social

Sciences, and the Arts Department and the Registrar. For further information see the Study Abroad site, [www.hmc.edu/academicsclinicresearch/internationalopportunities/studyabroad-program.html](http://www.hmc.edu/academicsclinicresearch/internationalopportunities/studyabroad-program.html).

All students participating in study abroad are required to carry comprehensive health insurance. In addition, an International Student Identity Card (ISIC) is required as a supplement to their original insurance policy.

All students accepted for studying abroad affirm their understanding that they must conform to rules and regulations not only of HMC, but also of the program and the country in which they study. Failure to do so may result in the student being immediately discharged from the program and returned home, at their expense, without a refund of program fees.

Students accepted for studying abroad affirm the additional academic and personal risk involved and recognize as well the limited responsibility of the college for such programming. Before final approval for participation is given, each applicant must complete the Waiver, Release and Indemnification Agreement that outlines the limits of the college's liability.

A list of students approved by the HMC Study Abroad Committee will be forwarded to the HMC Dean of Students, the HMC Registrar, and to Monsour Counseling and Psychological Services of The Claremont Colleges.

### **Domestic Exchange Program**

Students may participate in the Domestic Exchange Program during their sophomore or junior year. The application is processed through HMC and students may choose to attend Swarthmore College or Rensselaer Polytechnic Institute for a semester. Cost for the program is the same as if the student were on-site at HMC; payment is made to HMC and payment plans may continue to be implemented.

Students are able to enroll in the same manner as students at the host college, and transfer credit is awarded on grades of C or better. Some departments require grades of B or better for courses to fulfill major requirements. Information on these programs is available in the Office of Academic Affairs, Joseph B. Platt Campus Center.





## DEPARTMENTS AND PROGRAMS

### BIOLOGY

(See also **Mathematical Biology and Joint Major in Chemistry and Biology**)

*Professors* Adolph (Interim Chair), Ahn, Bush, Drewell, Haushalter, McFadden and Williams; *Visiting Professor* Hamlett; *Teaching Postdoctoral Fellow* Poon

The biology program prepares graduates for further study and employment in biology and related fields. Our graduates work in biotechnology, mathematical ecology, medicine, vaccine research, molecular genetics, dentistry, bioinformatics, pharmacology, neurobiology, veterinary medicine, forensic science, conservation biology, science teaching, environmental activism, and other areas.

The HMC biology major, in conjunction with the common technical core, provides the topical breadth that is the foundation of modern biology, and the intellectual depth that enables students to understand how discoveries in the life sciences are made and communicated. A set of required Biology Core courses provides a broad foundation in biology. Building on this foundation, each student, in consultation with a biology faculty adviser, selects a group of advanced biology and related technical courses that introduce a life sciences subdiscipline in depth. In addition to Harvey Mudd courses, students may draw upon the extensive course offerings at Pomona College, the Joint Science Department of Claremont McKenna, Pitzer, and Scripps Colleges, the Keck Graduate Institute of Applied Life Sciences, and the Rancho Santa Ana Botanic Garden.

**BIOLOGY MAJOR REQUIREMENTS.** A biology major must successfully complete the following courses:

#### **BIOLOGY CORE**

**BIOLOGY 54. BIOLOGY LABORATORY**

**BIOLOGY 101. COMPARATIVE PHYSIOLOGY**

**BIOLOGY 108. ECOLOGY & ENVIRONMENTAL BIOLOGY**

**BIOLOGY 109. EVOLUTIONARY BIOLOGY**

**BIOLOGY 113. MOLECULAR BIOLOGY**

**CHEMISTRY 56. CARBON COMPOUNDS**

**CHEMISTRY 58. CARBON COMPOUNDS LABORATORY**

**CHEMISTRY 105. ORGANIC CHEMISTRY**

#### **Biology Electives**

13 units of advanced biology, selected by the student and adviser, to include at least two HMC laboratory courses (selected from Bio 103, 110, 111, 184) and one HMC seminar-style course (requiring student presentations and reading from the primary literature, selected from Bio 121, 122, 164, 185, 189). Related non-biology technical courses may be substituted for advanced biology courses with permission of the department. With prior departmental permission, up to two credits of Bio 197/198 (Directed Reading) may count as Biology Electives.

#### **Colloquium**

4 semesters of Biology 191–192: Biology Colloquium.

The Biology 191–192 Biology Colloquium requirement is waived for any semester during which a student is away on a study abroad program.

**Capstone Project**

2 semesters (at least 6 credits total) of Senior Thesis Research (Biology 193–194, or Biology 195–196) or an approved biology-related Clinic (CS 183–184, Engineering 111–114, Environmental Studies 190, Math 193 or Physics 193–194).

**MOLECULAR BIOLOGY OPTION**

Students may also select the molecular biology option within the biology major. A student seeking to complete the molecular biology option must satisfactorily complete the following courses:

**MOLECULAR BIOLOGY CORE**

*Biology Core from above, plus the following additional courses:*

**BIOLOGY 111. MOLECULAR BIOLOGY LABORATORY**

**BIOLOGY 182. CHEMISTRY IN LIVING SYSTEMS**

**CHEMISTRY 51. PHYSICAL CHEMISTRY**

**CHEMISTRY 111. ORGANIC CHEMISTRY LABORATORY**

**Electives**

8 units of approved biology electives, selected by the student and adviser, to include at least one HMC laboratory course (BIOL 103, 110, 184) and one HMC seminar-style course (requiring student presentations and reading from the primary literature selected from BIOL121, 122, 164, 185, 189). One chemistry course may be substituted for an advanced biology course with the prior approval of the department.

**Colloquium**

4 semesters of Biology 191–192: Biology Colloquium, or Chemistry 199: Chemistry Seminar. The colloquium requirement is waived for any semester during which a student is away on a study abroad program.

**Capstone Project**

2 semesters (at least 6 credits total) of Senior Thesis Research (Biology 193–194 or Biology 195–196 or Chemistry 151–152).

**CHEMICAL BIOLOGY**

Important opportunities are emerging at the interface of chemistry and biology. The Joint Major in Chemistry and Biology provides an organized framework in which students will be able to appreciate the biological context of their research questions and master the chemistry fundamentals that underlie the properties and reactions of biomolecules. Students interested in the Joint Major, which is administered by the Departments of Biology and Chemistry, should contact the Chairs of Biology and Chemistry.

**ENVIRONMENTAL BIOLOGY**

Harvey Mudd College is part of a consortium that enables HMC students to participate in the Semester in Environmental Science (SES) at the Ecosystems Center of the Marine Biological Laboratory, Woods Hole, Mass. This semester-long program emphasizes interdisciplinary, inquiry-based approaches to the in-depth study of both aquatic and terrestrial ecosystems. Biology 171 and 173 are only offered as part of this program. Students interested in this program should contact Professor Catherine McFadden for information and applications. The Department of Biology also participates in the HMC Center for Environmental Studies, which coordinates multi-disciplinary programs in environmental studies. For more information or to design an environmental studies concentration, contact Professor Stephen Adolph, the Environmental Studies adviser for the Department of Biology.

**MATHEMATICAL BIOLOGY**

Applications of mathematical and computational methods are vital to many areas of contemporary biological and medical research, such as genomics, molecular modeling, structural biology, ecology, evolutionary biology, neurobiology and cancer treatment. Students interested in the interface between biology and mathematics may pursue the Mathematical Biology Major, which is jointly administered by the Departments of Biology and Mathematics. For more information contact Professor Stephen Adolph (Biology), Professor Lisette de Pillis (Mathematics) or Professor Jon Jacobsen (Mathematics).

**HEALTH PROFESSIONS**

An excellent premedical preparation can be obtained at HMC. In fact, the college's emphasis on the humanities and the social sciences is a valuable asset for pre-medical studies. While there is no specific premedical curriculum, a premedical program can be arranged through any of the majors, if supplemented by appropriate biology and chemistry course work. Most medical schools require, as a minimum, one year of physics and biology and four semesters of chemistry, including organic chemistry. Students interested in medicine or related fields, such as dentistry or veterinary medicine, should contact the pre-professional coordinators, Professors Karl Haushalter and Robert Drewell, for advice.

**FACILITIES**

The biology department is housed in the F.W. Olin Science Center, which provides exceptionally well-equipped teaching and research laboratories to support our laboratory-centered curriculum. The Robert J. Bernard Biological Field Station, located directly across the street from Harvey Mudd College, is the natural laboratory for field biology courses and student-faculty research. Automated DNA sequencing is carried out at the adjacent Rancho Santa Ana Botanic Garden.

**RESEARCH**

Areas available for student-faculty research within the department include biochemistry, cellular and developmental biology, molecular genetics, population biology, physiological ecology, biomechanics, animal locomotion, tissue engineering, plant physiology, animal behavior, bioinformatics, mathematical ecology, computational genetics, and molecular evolution. Students wishing to pursue research prior to their senior year may enroll in Biology 161–162, Research Problems, or Biology 197–198, Directed Reading. Summer research positions are also available. Contact the Department of Biology Research Coordinator, Professor Catherine McFadden, for details and applications.

**BIOLOGY COURSES****7. INTRODUCTION TO BIOLOGY AND COMPUTER SCIENCE (3)**

*Bush, Dodds (Computer Science), Libeskind-Hadas (Computer Science).* Second course in a two-course series that combines Biology 52 and Computer Science 5. Successful completion of this course satisfies the Biology 52 core requirement. Restricted enrollment for first-year students. Prerequisites: Computer Science 6. (Spring)

**52. INTRODUCTION TO BIOLOGY (3)**

*Adolph, Bush, Drewell.* Topics in genetics, molecular biology, and evolution. Prerequisites: one semester of general chemistry and one semester of calculus. (Fall and Spring)

**54. BIOLOGY LABORATORY (1)**

*Ahn, Hamlett, McFadden.* Investigations in physiology, biochemistry, ecology, molecular biology and other areas of experimental biology. Prerequisite: Biology 52 (may be taken concurrently). (Spring)

**81, 82. CURRENT ISSUES IN BIOLOGY (3)**

*Staff.* Study of a biological topic of current importance to society. Active participation and discussion are stressed. It is expected that this course will usually count for Integrative Experience credit. (May not be counted for credit toward the biology major.) Prerequisite: Biology 52. (Fall or Spring)

**95. FOUNDATIONS OF NEUROSCIENCE (3)**

*Staff.* Introduction to the biological bases of human and animal behavior. Analysis of modern neurobiological approaches within a framework established by philosophical and historical traditions in the neurosciences. This course is jointly taught by Claremont Colleges Neuroscience faculty. (May not be counted for credit toward the biology major.) (Fall)

**101. COMPARATIVE PHYSIOLOGY (3)**

*Ahn.* Topics in the structural basis underlying general physiological mechanisms of plants and animals. Prerequisite: Biology 52. (Spring)

**103. COMPARATIVE PHYSIOLOGY LABORATORY (2)**

*Ahn.* Experimental techniques and concepts in plant and animal physiology, including the general areas of cellular biology, energetics, ionic regulation and signaling. The final third of the course will involve independent student research projects culminating with oral and written presentations of experimental investigations. Prerequisites: Biology 52, Biology 54, Bio 101. (Fall)

**108. ECOLOGY AND ENVIRONMENTAL BIOLOGY (3)**

*Adolph, McFadden.* Principles of organization of natural communities and ecosystems, including population dynamics, species interactions and island biogeography. Modern experimental and mathematical approaches to ecological problems. Application of ecological principles to conservation biology, human demography and harvesting of natural resources. Prerequisites: Biology 52 and Mathematics 11. (Spring)

**109. EVOLUTIONARY BIOLOGY (3)**

*McFadden.* Evolutionary mechanisms, including natural selection, population genetics, speciation and macroevolutionary processes. Modern methods of phylogenetic reconstruction. History of biological diversity and the fossil record. Prerequisite: Biology 52. (Fall)

**110. EXPERIMENTAL ECOLOGY LABORATORY (3)**

*McFadden.* Design and analysis of ecological experiments with an emphasis on hypothesis testing, sampling techniques and computer-based statistical analysis of data. Most projects are field-based, designed to address aspects of population, community, physiological and behavioral ecology in animals and plants; work in both terrestrial and aquatic habitats. Includes several all-day field trips to local coastal, desert and mountain sites. Prerequisites: Biology 54 and 108 (may be taken concurrently) or permission of instructor. (Spring)

**111. MOLECULAR AND CELLULAR BIOLOGY LABORATORY (2)**

*Bush, Hamlett.* Basic techniques of molecular biology, including restriction mapping, DNA cloning, protein expression, and fluorescence microscopy. Prerequisites: Biology 54 and 113 (may be taken concurrently) or permission of instructor. (Fall)

**113. MOLECULAR BIOLOGY (3)**

*Drewell.* Molecular description of gene function in both prokaryotic and eukaryotic cells, including DNA, RNA and protein structure; DNA replication; transcription and translation; and gene regulation. Prerequisites: Biology 52 and Chemistry 56. (Fall)

**118. MATHEMATICAL BIOLOGY I (2) (Also listed as MATHEMATICS 118)**

*Adolph, de Pillis (Mathematics), Jacobsen (Mathematics).* Mathematical models of biological processes emphasizing continuous models. May include models in epidemiology, population dynamics, cancer modeling and disease treatment modeling. Prerequisites: Math 64, Biology 52, or permission of instructor. (First half of Spring)

**119. MATHEMATICAL BIOLOGY II (2) (Also listed as MATHEMATICS 119)**

*Adolph, de Pillis (Mathematics), Jacobsen (Mathematics).* Mathematical models of biological processes emphasizing discrete and continuous models. May include one- and two-locus population genetics, metapopulations and matrix population models as well as models in physiology and neurobiology. Prerequisites: Math 64, Biology 52, or permission of instructor. (Second half of Spring)

**121. MARINE ECOLOGY (3)**

*McFadden.* Advanced ecology focusing on marine communities. Dispersal, recruitment, competition, disturbance, plant/animal interactions and other topics. Readings in the primary literature. Counts as a seminar course for Biology majors. Prerequisite: Biology 108 or permission of instructor. (Fall, alternate years—offered in Fall 2008)

**122. CELL AND DEVELOPMENTAL BIOLOGY (3)**

*Drewell, staff.* Cellular and molecular mechanisms of animal development, including cell fate determination, morphogenesis and pattern formation. Emphasis on modern experimental organisms and approaches. Readings in the primary literature. Counts as a seminar course for Biology majors. Prerequisite: Biology 113 or equivalent or permission of instructor. (Spring, alternate years—offered in Spring 2009.)

**126. BIOLOGY OF PROKARYOTES (3)**

*Staff.* Current topics in prokaryotic biology jointly selected by students and instructor. Emphasis on molecular mechanisms of adaptation to diverse environments. Primarily seminar format with readings from the primary literature. Prerequisite: Biology 113 or permission of instructor.

**128. PROKARYOTES LABORATORY (2)**

*Staff.* Techniques for isolating, identifying and characterizing bacteria from diverse environments. Prerequisites: Biology 54 and 126 (may be taken concurrently).

**153. BIostatISTICS (3)**

*Adolph.* Statistical techniques for analyzing biological data, including both parametric and non-parametric methods. Statistical aspects of experimental design. Additional topics may include spatial statistics, circular statistics, multivariate methods, randomization tests and bootstrapping. Prerequisites: Biology 52 and Math 62 or permission of the instructor. (Fall)

**161, 162. RESEARCH PROBLEMS (1–3)**

*Staff.* Original experimental investigations in biology undertaken in consultation with a faculty member. (May not be counted for credit toward the biology major.) Prerequisite: permission of instructor. 1 credit hour for each 3 hours of laboratory per week. (Fall and Spring)

**164. GENETICS (3)**

*Drewell, Staff* Current topics in genetics and developmental genetics. Emphasis on experimental techniques and design with model experimental organisms. Readings from the primary literature. Counts as a seminar course for Biology majors. Prerequisites: Biology 54 and Biology 113. (Spring, alternate years—offered in Spring 2010)

**166. CELL BIOLOGY AND GENETICS LABORATORY (2)**

*Staff.* Techniques for investigations of protein localization, organelle isolation, genetic mapping, and fluorescence microscopy. Laboratories consist of student projects. Prerequisites: Biology 54 and Biology 113; corequisite: Biology 164 or permission of instructor.

**167. PLANT DEVELOPMENT (3)**

*Williams.* Mechanisms of plant development including hormone action, gene regulation, embryogenesis and cellular differentiation. Emphasis on molecular and genetic approaches. Prerequisite: Biology 113 (may be taken concurrently) or permission of instructor. (Not offered in 2009-10)

**169. PLANT DEVELOPMENT LABORATORY (2)**

*Williams.* Tissue culture and molecular approaches to research in plant development. Prerequisite: Biology 54 and 167 (may be taken concurrently) or permission of instructor.

**171. ANALYSIS OF AQUATIC ECOSYSTEMS. MARINE BIOLOGICAL LABORATORY (MBL) (4)**

*Staff.* The nature and controls of ecosystem processes (production, decomposition, element cycling and biogeochemistry) in freshwater, estuarine and marine ecosystems. Application of basic principles of ecosystems ecology to contemporary environmental problems such as coastal eutrophication, fisheries exploitation, effects of introduced species, acid deposition and global change. Includes lecture, discussion, laboratory and field work. Prerequisites: Biology 52, 54, Chemistry 22, 26 and Mathematics 11. (Fall.) Offered only through the Semester in Environmental Science Program at the MBL Ecosystems Center, Woods Hole, Mass.

**173. ANALYSIS OF TERRESTRIAL ECOSYSTEMS (4)**

*MBL Staff.* Fundamental biogeochemical processes in fields, pastures, tundra and forested ecosystems. Physiological ecology of land- plants and soil organisms in an ecosystems context. Impacts of environmental change on the landscape at local, regional and global scales. Includes lecture, discussion, laboratory and field work. Prerequisites: Biology 52, 54, Chemistry 22, 26 and Mathematics 11. (Fall.) Offered only through the Semester in Environmental Science Program at the MBL Ecosystems Center, Woods Hole, Mass.

**174. BIOPHYSICS (2)**

*Haskell (Physics).* Selected topics in biophysics reflecting areas of active research in the field. Possible topics: imaging techniques, membrane biophysics, sensory transduction, motility. Seminar format. Prerequisites: Biology 52 and Physics 51. (First half of Spring)

**178, 179. BIOLOGY CLINIC (3)**

Contact Chair of Biology. Team projects in biology, with corporate affiliation. Prerequisite: Upper-division standing. (Fall and Spring)

**182. CHEMISTRY OF LIVING SYSTEMS (3)**

*Haushalter, Vosburg (Chemistry).* Relation of molecular structure and energy flow to reactions in living systems. Prerequisite: Chemistry 105. (Spring)

**184. METHODS IN BIOCHEMISTRY (1)**

*Haushalter, Vosburg (Chemistry).* Experiments in biochemistry. Prerequisite: Biology/Chemistry 182 (may be taken concurrently.) (Spring)

**185. TOPICS IN PHYSIOLOGY (3)**

*Ahn.* Readings from the primary literature in animal physiology. Specific topics may vary. Counts as a seminar course for Biology majors. Prerequisites: Biology 52, Biology 101 or consent of instructor. (Fall, alternate years—offered in Fall 2009)

**186. SPECIAL TOPICS IN BIOLOGY (3)**

*Staff.* Topics in a particular area of biology, depending on the instructor. Prerequisites: Biology 52, and possibly other courses. (Spring)

**187. HIV-AIDS: SCIENCE, SOCIETY AND SOCIETY (3)**

*Haushalter.* Molecular biology of HIV infection. Biochemical basis for antiretroviral therapy and HIV prevention strategies. The causes and impact of the global HIV-AIDS pandemic, including the interrelationships among HIV-AIDS, prejudice, race, and stigma. Students will complete a community service project in partnership with a local AIDS organization. Prerequisites: Biology 113, Biology 182/Chemistry 182 or permission of the instructor. (Fall; not offered in 2009)

**188. COMPUTATIONAL BIOLOGY (3)**

*Bush.* Computational algorithms and methods used in the study of genomes. Lectures, discussions and computer laboratory exercises. Prerequisites: Biology 52 and Computer Science 5 or permission of instructor. (Spring)

**189. TOPICS IN BIOCHEMISTRY AND MOLECULAR BIOLOGY (3)**

*Haushalter, staff.* Advanced topics at the interface between chemistry and biology. Counts as a seminar course for Biology majors. Prerequisites: Biology/Chemistry 182 or permission of the instructor. (Fall)

**190B. BIOMECHANICS (3)**

*Orwin (Engineering), Ahn.* Mechanical properties of biological tissues, including bone, connective tissue and muscles. Static analysis of joints. Analysis of how muscle generates motion, leading to dynamics, including kinematics, kinetics and locomotion, and how these principles scale for different sized animals. Focus on applications and primary literature. Prerequisites: Biology 52 and Engineering 83 or permission of instructor. (Fall, alternate years)

**191, 192. COLLOQUIUM (0)**

*Staff.* Oral presentations and discussions of selected topics including recent developments. Participants include biology majors, faculty members and visiting speakers. Required for junior and senior biology majors. (Fall and Spring)

**193, 194. SENIOR THESIS RESEARCH (3)**

*Staff.* A year-long experimental investigation in biology under the direction of a faculty adviser. Two oral presentations, a written proposal and a thesis are required. Required of all senior biology majors. Prerequisite: permission of instructor. (Fall and Spring)

**195, 196. INTENSIVE RESEARCH (6)**

*Staff.* Intensive experimental research in biology undertaken in consultation with a faculty member. Prerequisite: Biology 161, 162 or 193 and departmental approval of formal application. Replaces 3 units of 193–194 and 3 units of advanced biology courses for credit toward biology major. (Fall and Spring)

**197, 198. DIRECTED READING (1–3)**

*Staff.* Directed readings or independent laboratory research in selected topics in biology. With prior permission, up to 2 credits may count toward biology major. Prerequisite: permission of instructor. (Fall and Spring)

**CHEMISTRY****(See also Joint Major in Chemistry and Biology)**

*Professors* Van Ryswyk (Chair), Baker, Cave, Daub, Haushalter, Johnson, Karukstis, Kubota (emeritus), Maloney, Myhre (emeritus), Van Hecke and Vosburg.

The central program in chemistry provides instruction that prepares graduates for careers and advanced study in chemistry and related fields. Following the core courses in chemistry, the chemistry program consists of a set of intermediate lecture and laboratory courses that provide necessary breadth. The advanced courses and experimental research or project work in the senior year provide opportunities for in-depth study of selected areas.

A second program, administrated jointly by the departments of chemistry and biology, is the Joint Major in Chemistry and Biology. This joint major provides an opportunity for students interested in study at the interface between chemistry and biology. Students wishing to study such interdisciplinary areas as biochemistry, molecular biology, biological chemistry and chemical biology will find this program well tailored to their postgraduate plans. Details on this program are listed in the "Interdisciplinary Programs" section of the catalogue.

The chemistry faculty believe that research or project work on a significant chemical problem is an exceptionally valuable educational experience; all majors must participate in such a project. The department is exceptionally well equipped with the instrumentation necessary for this research work and has a strong record of research productivity.

Students completing the chemistry major have an exceptionally strong and broad background for immediate employment, professional school (business, law or medicine), or graduate work in chemistry or a wide range of allied fields. Our alumni work not only in chemistry, but in materials science, chemical engineering, biochemistry, pharmacology, molecular biology, genetics, oceanography, teaching, publishing and viticulture. All chemistry graduates are certified by the American Chemical Society (ACS).

Students completing the Joint Major in Chemistry and Biology graduate with a clear view of the science in both disciplines. Such a degree will prepare the graduate for advanced study in molecular biology, biological chemistry, biochemistry or chemical biology. This degree is not an ACS certified chemistry major; students wishing to obtain ACS certification can do so by taking Chem 104.

**CHEMISTRY MAJOR REQUIREMENTS.** A chemistry major must satisfactorily complete the following courses: Chemistry 51, 52, 53, 56, 58, 103, 104, 105, 109, 110, 111, 112, 114, four to six hours of Chemistry 151–152, Chemistry 182 and four semesters of Chemistry 199.

Students can, in consultation with their adviser, build upon the chemistry degree by taking additional courses tailored to their interests. Sample programs supporting a broad array of career paths are listed:

**Applied Chemistry or Graduate Study in Chemical Engineering:** Chemistry 166, Engineering 82 (Chemical and Thermal Processes), Engineering 131 (Fluid Mechanics) or 132 (Heat Transfer), Engineering 136 (Mass Transfer and Separation Processes) and Engineering 133 (Chemical Reaction Engineering). Engineering 112–113 (Clinic) may be substituted for Chemistry 151–152.

**Biological Chemistry:** Chemistry 184, Biology 54 (Biology Laboratory), Biology 111 (Molecular and Cellular Biology Laboratory), Biology 113 (Molecular Biology), one biology elective or two courses selected from Chemistry 168B, Chemistry 189, JS Chemistry 172 (NMR Spectroscopy), JS Chemistry 118 (Bioinorganic Chemistry), JS Chemistry 119 (Natural Products Chemistry), JS Chemistry 134 (Introduction to Molecular Modeling), PO



Chemistry 174 (Bio-Organic), PO Chemistry 175 (Introduction to Medicinal Chemistry with Computational Lab), or PO Chemistry 180 (Advanced Biochemistry).

**Chemical Education:** CGU Education 170G (Introduction to Public School Teaching) and Chemistry 197–198 as a 3-unit teaching internship under the supervision of a local K–12 teacher involving a minimum of 3 hours per week of classroom contact.

**Chemical Physics:** One additional physics course beyond the core, plus 6 credit hours of study selected from Chemistry 161 or Physics 117 (Statistical Mechanics and Thermodynamics), Chemistry 168, Physics 111 (Theoretical Mechanics), Physics 116 (Quantum Mechanics), Physics 151 (Electromagnetic Fields), Math 115 (Fourier Series and Boundary Value Problems), Math 136 (Complex Variables and Integral Transforms), or other advanced courses in chemistry, physical chemistry or mathematics.

**Computational Chemistry:** Three courses selected from Chemistry 161 or Physics 117 (Statistical Mechanics and Thermodynamics), JS Chemistry 134 (Introduction to Molecular Modeling), Computer Science 60 (Principles of Computer Science), Math 164, (Scientific Computing), Math 167 (Complexity Theory), Physics 111 (Theoretical Mechanics), Physics 116 (Quantum Mechanics), or another advanced course in computer science, physics or chemistry.

**Environmental Chemistry:** JS Chemistry 139 (Environmental Chemistry), Engineering 138 (Introduction to Environmental Engineering), and two courses in environmental policy.

**Graduate Study in Chemistry:** Chemistry 161, a half-course emphasizing synthetic chemistry (Chemistry 165, 171, or 173), and a technical elective.

**Geochemistry:** PO Geology 20 (Introduction to Geology), PO Geology 120 (Introduction to Geochemistry), and PO Geo 127 (Mineralogy with Laboratory).

**Materials Chemistry:** Engineering 106 (Materials Engineering), Chemistry 168C, and Physics 162 (Solid State Physics).

**Medical School:** There is no specific premedical track at HMC. However, an excellent premedical preparation can be obtained at HMC. In fact, the college's emphasis on the humanities and the social sciences is an asset for premedical studies. A premedical program can be arranged through any of the majors, if supplemented by appropriate biology and chemistry course work. Students should consult with the premedical advisers, Professors Rob Drewell or Karl Haushalter, for more information.

Students are encouraged to discuss professional options and opportunities with members of the chemistry department.

**CHEMISTRY COURSES****21-22. GENERAL CHEMISTRY (3)**

*Staff.* Stoichiometry, kinetic theory, phase behavior, equilibrium, bonding, thermodynamics, kinetics and descriptive chemistry.

**25-26. CHEMISTRY LABORATORY (1)**

*Staff.* Laboratory taken concurrently with Chemistry 21–22.

**51. PHYSICAL CHEMISTRY: THERMODYNAMICS AND KINETICS (3)**

*Karukstis.* Phase equilibria, thermodynamics and chemical kinetics. Prerequisites: Chemistry 21–22 and 25–26. (Fall)

**52. PHYSICAL CHEMISTRY: GROUP THEORY, QUANTUM CHEMISTRY AND SPECTROSCOPY (3)**

*Van Hecke.* Introduction to quantum mechanics with application to atoms and molecules. Group theory. Survey of spectroscopic techniques. Prerequisites: Chemistry 21–22 and 25–26. (Spring)

**53. PHYSICAL CHEMISTRY LABORATORY (2)**

*Karukstis, Van Hecke.* Physical chemical measurements of molecular properties. Prerequisite: Chemistry 51 or taken concurrently. (Fall)

**56. CARBON COMPOUNDS (3)**

*Maloney.* A systematic study of the chemistry of carbon-containing compounds, emphasizing synthesis, reaction mechanisms, and the relation of structure to observable physical and chemical properties. Prerequisites: Chemistry 21–22 and 25–26. (Spring)

**58. CARBON COMPOUNDS LABORATORY (1)**

*Maloney, Daub, Johnson, Vosburg.* Laboratory taken concurrently with Chemistry 56. Prerequisite: one year of college chemistry. (Spring)

**103. CHEMICAL ANALYSIS (3)**

*Van Ryswyk.* Applications of chemical equilibria in qualitative and quantitative analysis with emphasis on inorganic systems. Introduction to electrochemistry. Prerequisites: Chemistry 21–22 and 25–26. Chemistry 109 should be taken concurrently. (Fall)

**104. INORGANIC CHEMISTRY (3)**

*Johnson.* Systematic study of the preparation, properties, structures, analysis and reactions of inorganic compounds. Prerequisites: Chemistry 51, 52, 56 and 105, or equivalents or instructor approval. (Spring)

**105. ORGANIC CHEMISTRY (3)**

*Vosburg.* A continuation of the chemistry of carbon compounds. Prerequisite: Chemistry 56. Chemistry 111 should be taken concurrently. (Fall)

**109. CHEMICAL ANALYSIS LABORATORY (1)**

*Van Ryswyk.* Chemical analysis. Prerequisites: Chemistry 103 or taken concurrently. (Fall)

**110. INORGANIC CHEMISTRY LABORATORY (1)**

*Johnson.* Synthesis and characterization of inorganic compounds. Prerequisites: Chemistry 104 or taken concurrently. (Spring)

**111. ORGANIC CHEMISTRY LABORATORY (1)**

*Vosburg, Daub, Maloney.* Synthesis, characterization and analysis of organic compounds. Prerequisites: Chemistry 58, Chemistry 105 or taken concurrently. (Fall)

**112. INSTRUMENTAL ANALYSIS LABORATORY (1)**

*Van Ryswyk.* Instrumental methods of analysis. Prerequisites: Chemistry 114, or taken concurrently. (Spring)

**114. ADVANCED ANALYTICAL CHEMISTRY (3)**

*Van Ryswyk.* Special topics in analytical chemistry including instrumental analysis, electrochemistry, and chemometrics. Prerequisites: Chemistry 51 and 103. (Spring)

**151–152. RESEARCH PROBLEMS (2-3)**

*Staff.* Two oral reports and a written thesis are required. 2 or 3 credit hours per semester. (2 credit hours equals a minimum of 6 hours of laboratory per week, 3 credit hours equals a minimum of 10 hours of laboratory per week; additional library time is required.) Topics in chemical literature will be covered in the first three weeks of the fall semester.

**161. ADVANCED PHYSICAL CHEMISTRY (2)**

*Staff.* Classical and Statistical Thermodynamics. Equilibrium thermodynamics with applications to chemistry. Prerequisites: Chemistry 51 or equivalent. (Offered alternate years)

**165. ORGANOMETALLIC CHEMISTRY (2)**

*Johnson.* Study of the metal carbon bond: synthesis, structure, bonding, reactivity and catalysis. Prerequisite: Chemistry 105 or equivalent (may be taken concurrently). (Fall)

**166. INDUSTRIAL CHEMISTRY (2)**

*Van Hecke.* Elements of chemical engineering for chemists. Organization and goals of industrial research. Readings, case studies and seminar discussions. Prerequisite: junior or senior standing. (Offered alternate years)

**168A. ADVANCED PHYSICAL CHEMISTRY (2)**

*Van Hecke.* Lasers in Chemistry. Introduction to the principles of the operation of lasers. Prerequisite: Chemistry 52 or equivalent. (Offered alternate years)

**168B. ADVANCED PHYSICAL CHEMISTRY (2)**

*Karukstis.* Biophysical Chemistry. Physical chemistry applied to answer questions involving the conformation, shape, structure, dynamics and interactions of biological macromolecules and complexes. Prerequisite: Chemistry 51 or equivalent. (Offered alternate years)

**168C. ADVANCED PHYSICAL CHEMISTRY (2)**

*Staff.* Chemistry and Physics of Stuff. Prerequisite: Chemistry 52, or equivalent. (Offered alternate years)

**168D. ADVANCED PHYSICAL CHEMISTRY (3)**

*Van Ryswyk.* Materials Science of Energy Conversion and Storage. Prerequisite: Chemistry 52 and 104, or equivalent. (Offered alternate years)

**171. ADVANCED ORGANIC CHEMISTRY (2)**

*Vosburg.* Organic Synthesis. Prerequisite: one year of organic chemistry. (Offered alternate years)

**173. ADVANCED ORGANIC CHEMISTRY (2)**

*Daub.* Pericyclic reactions. Prerequisite: one year of organic chemistry. (Offered alternate years)

**182. CHEMISTRY IN LIVING SYSTEMS (3)**

*Haushalter, Vosburg.* Relation of molecular structure and energy flow to reactions in living systems. Prerequisite: Chemistry 105. (Spring)

**184. METHODS IN BIOCHEMISTRY (1)**

*Haushalter, Vosburg.* Experiments in biochemistry. Prerequisite: Chemistry 182 or concurrently. (Spring)

**187. HIV-AIDS: SCIENCE, SOCIETY AND SERVICE (3)**

*Haushalter.* Integrative experience course that studies the molecular biology of HIV infection, the biochemistry of antiviral interventions, and the causes and impact of the global HIV-AIDS pandemic, including the interrelationships among HIV-AIDS, prejudice, race, and stigma. Students will complete a community service project in partnership with a local AIDS organization. Prerequisite: Biology 52. (Offered alternate years)

**189. TOPICS IN BIOCHEMISTRY AND MOLECULAR BIOLOGY (3)**

*Staff.* Advanced topics at the interface between chemistry and biology. Prerequisite: Biology 113 or instructor approval. (Fall)

**197, 198. CHEMISTRY (1-3)**

*Staff.* Special readings in chemistry. Open to seniors only. 1–3 credit hours per semester. (Fall and Spring)

**199. SEMINAR (0)**

*Staff.* Discussions of contemporary research by students, faculty and visiting scientists. Attendance by majors is required. No credit. (Fall and Spring)

Available at the other Claremont Colleges:

**JS 118. BIOINORGANIC CHEMISTRY**

**JS 119. NATURAL PRODUCTS CHEMISTRY**

**JS 134. INTRODUCTION TO MOLECULAR MODELING**

**JS 136. MODERN MOLECULAR PHOTOCHEMISTRY**

**JS 139. ENVIRONMENTAL CHEMISTRY**

**JS 172. NMR SPECTROSCOPY**

**PO 174. BIO-ORGANIC CHEMISTRY**

**PO 175. INTRODUCTION TO MEDICINAL CHEMISTRY WITH COMPUTATIONAL LABORATORY**

**PO 180. ADVANCED BIOCHEMISTRY**

**PO 185. SOFT NANOMATERIALS**

**PO 187. PROTEINS AND ENZYMES**



## COMPUTER SCIENCE

(See also Joint Major in Computer Science and Mathematics)

*Professors Erlinger (Chair), Alvarado, Dodds, Keller, Kuenning, Libeskind-Hadas, O'Neill, Stone and Sweedyk.*

Computer science is an exciting and rapidly-evolving discipline with components of design, logic, mathematics, engineering and philosophy. The role of computer science can be characterized as providing the logical infrastructure for the modern, information-based society.

The Harvey Mudd College Computer Science major, established in 1992, provides a strong foundation in the fundamental principles and concepts of computer science through a blend of experimentation, theory and design. Our students are well-prepared to make contributions to the field of computing, to science within a computational framework, and to society in general through the development of tools and technologies that can have a significant, positive, societal impact.

Each computer science major participates in a year-long Computer Science Clinic project, addressing real-world problems provided by sponsors from industry and research laboratories. A Clinic project typically comprises three to five students, supervised by a faculty member and a liaison from the sponsor, working on a project from “concept to product.”

Our students may also engage in research with our faculty during both the academic year and the summer. Examples of recent student involvement in research include the design, analysis, and simulation of next generation optical networks; the design of a system that recognizes and correctly interprets human sketches of digital logic circuits on tablet computers; the design and implementation of new programming languages; research into issues of applying and deploying network security; and the design of vision algorithms for autonomous robots.

Graduates of the Computer Science Department have gone on to work for a diverse set of employers and, in some cases, have started their own companies. Some employers that have hired our graduates in recent years include Apple Computer, FICO, Google, Green Hills Software, Hewlett-Packard, IBM, JPL, Lawrence Livermore National Laboratory, Lockheed-Martin, Microsoft, Qualcomm, Rockwell, Stanford Linear Accelerator, Sun Microsystems and The Aerospace Corporation.

A significant fraction of our majors have gone on to graduate study. Some of the graduate programs where our students have enrolled include Caltech, Carnegie Mellon University, Cornell, Georgia Institute of Technology, Stanford, UC Berkeley, UC Davis, UCLA, UC San Diego, University of North Carolina, University of Illinois at Urbana-Champaign, University of Texas, University of Washington and University of Wisconsin. Our graduates have done advanced study in areas such as algorithm design and analysis, logical foundations of computer science, software engineering, computer graphics, networking, distributed systems, mobile computing, performance analysis, programming languages, computer architecture, computer operating systems, parallel computing, artificial intelligence, computer vision, robotics, speech understanding, virtual reality, artificial life, neural networks, human-computer interfaces and telecommunications. Most of these areas are introduced in courses at HMC.

All students at Harvey Mudd College are required to fulfill Computer Science 5 (Introduction to Computer Science) which provides an exposure to some major concepts in the discipline including functional programming, object-oriented programming, digital logic and computer organization, computability theory and societal issues. The computer science major continues with the foundation courses, starting with Computer Science 60 (Principles of Computer Science) which provide a broad exposure to many areas of computer science and further develop fundamental competence in programming, logic, algorithm analysis and computer structure. Mathematics 55 is taken to develop skills in discrete mathematics that are needed for advanced computer science areas. Computer Science 70 (Data Structures and Program Development) improves the students' depth of programming competence and

diversifies the set of data structures and corresponding analysis techniques to which the computer science student is exposed. Computer Science 81 (Computability and Logic) introduces the mathematical foundations of computer science, particularly logic, automata and computability theory, and demonstrates the applications of the aforementioned areas to problems of practical significance.

Building on the foundation courses are the kernel courses. Computer Science 105 (Computer Systems) develops a deep understanding of computer structure and its relationship to correct and efficient program implementation. Computer Science 121 (Software Development) focuses on requirements analysis and specification techniques for large software systems and the project management skills needed to develop such systems. Computer Science 131 (Programming Languages) investigates concepts underlying a wide variety of modern programming languages. Computer Science 140 (Algorithms) develops fundamental skills needed to perform comparative analysis of algorithms and to enable the synthesis of new algorithms. The broad array of computer science electives (over 20 elective and seminar courses) allows students to achieve more specialization in areas of personal interest.

The Computer Science Clinic provides a way of putting many of the acquired skills into practice. Examples of recent Computer Science Clinic projects are:

- A new system for the management of rocket launch countdown clocks;
- An extensible interface for current and future insulin pumps, glucose sensors and related diabetes technology;
- A computer security tool based on the biological immune system paradigm;
- An extensible software architecture that enables satellite anomalies to be detected and displayed in visual form;
- A simulation model of the GPS ground network and verification of that model through available data;

Sponsors of Computer Science Clinic projects have included Boeing, FICO (Fair Isaac), Google, GTE, IBM, Jet Propulsion Laboratory, Microsoft, Octel Communications, Optivus Technology, Q, Sandia National Laboratories, Teradyne, and The Aerospace Corporation.

The final element of the major is the Computer Science Colloquium, which features speakers drawn from both industry and academia who present results of their current research. Recent colloquium speakers have come from a variety of companies, research labs, and universities.

**DEGREE REQUIREMENTS.** A computer science major must complete the following courses:

**Computer Science Foundation**

COMPUTER SCIENCE 60. PRINCIPLES OF COMPUTER SCIENCE, OR  
COMPUTER SCIENCE 42. PRINCIPLES AND PRACTICE OF COMPUTER SCIENCE  
MATHEMATICS 55. DISCRETE MATHEMATICS  
COMPUTER SCIENCE 70. DATA STRUCTURES AND PROGRAM DEVELOPMENT  
COMPUTER SCIENCE 81. COMPUTABILITY AND LOGIC

**Computer Science Kernel**

COMPUTER SCIENCE 105. COMPUTER SYSTEMS  
COMPUTER SCIENCE 121. SOFTWARE DEVELOPMENT  
COMPUTER SCIENCE 131. PROGRAMMING LANGUAGES  
COMPUTER SCIENCE 140. ALGORITHMS

**Three Computer Science Electives**

COMPUTER SCIENCE 124. USER INTERFACE DESIGN  
COMPUTER SCIENCE 125. COMPUTER NETWORKS

COMPUTER SCIENCE 132. COMPILER DESIGN  
 COMPUTER SCIENCE 133. DATABASES  
 COMPUTER SCIENCE 134. OPERATING SYSTEMS: DESIGN AND IMPLEMENTATION  
 COMPUTER SCIENCE 135. FILE SYSTEMS  
 COMPUTER SCIENCE 136. ADVANCED COMPUTER ARCHITECTURE  
 COMPUTER SCIENCE 141. ADVANCED TOPICS IN ALGORITHMS  
 COMPUTER SCIENCE 142. COMPLEXITY THEORY  
 COMPUTER SCIENCE 144. SCIENTIFIC COMPUTING  
 COMPUTER SCIENCE 147. COMPUTER SYSTEMS PERFORMANCE ANALYSIS  
 COMPUTER SCIENCE 151. ARTIFICIAL INTELLIGENCE  
 COMPUTER SCIENCE 152. NEURAL NETWORKS  
 COMPUTER SCIENCE 153. COMPUTER VISION  
 COMPUTER SCIENCE 154. ROBOTICS  
 COMPUTER SCIENCE 155. COMPUTER GRAPHICS  
 COMPUTER SCIENCE 156. PARALLEL AND REAL-TIME COMPUTING  
 COMPUTER SCIENCE 157. COMPUTER ANIMATION

Students may substitute electives in one or more computer science-related areas, such as in engineering or mathematics, with the consent of their faculty adviser. Computer Science 186 (Computer Science Research II) can be counted as an elective for the major and requires Computer Science 185 (Computer Science Research I) as a prerequisite. Other research or project courses cannot normally be counted as electives for the major.

**Both of the following:** Two semesters of **COMPUTER SCIENCE 183, 184 (CLINIC)** and four semesters of **COMPUTER SCIENCE 193-196 (COLLOQUIUM)**.

**COMPUTER SCIENCE COLLOQUIUM** is only required when students are in residence at HMC. Study abroad students are excused from the colloquium requirement during their time away from the HMC campus.

### **CONCENTRATION IN COMPUTER ENGINEERING**

Students frequently ask about the possibility of pursuing a computer engineering major at HMC. As the Department of Engineering offers a non-specialized engineering degree, students interested in computer engineering may wish to major in computer science. While the courses offered in the Computer Science Department are focused primarily on systems and software, appropriate engineering courses may be counted toward the elective course requirements of the CS major. In addition, the computer science major allows flexibility for taking additional electives beyond the major requirements, and these may be taken in engineering as well. Thus an HMC computer science major may graduate with a hardware or engineering emphasis. Engineering courses that are generally accepted as CS technical electives include **E85: DIGITAL ELECTRONICS AND COMPUTER ENGINEERING; E115: PROJECT MANAGEMENT; E151: ENGINEERING ELECTRONICS; E155: MICROPROCESSOR-BASED SYSTEMS: DESIGN AND APPLICATIONS; E161: COMPUTER IMAGE PROCESSING AND ANALYSIS; and E158: INTRODUCTION TO CMOS VLSI DESIGN.**

### **COMPUTER SCIENCE MAJORS FROM THE OTHER CLAREMONT COLLEGES**

Pomona College offers an undergraduate major in computer science; there is close cooperation between the Pomona and HMC Computer Science Departments.

HMC welcomes Computer Science majors from the other Claremont Colleges. Students from the other colleges who desire to major in Computer Science at Harvey Mudd College should inform the Chair of the Computer Science Department of their plans so that they may be assigned an appropriate adviser.

The HMC Computer Science major assumes significant material included in the HMC

Technical Core. In particular, it is assumed that students have taken courses in calculus, linear algebra and differential equations. Part of the advising process for an off-campus student involves identifying the courses that the student should take before enrolling in HMC Computer Science courses.

## **COMPUTER SCIENCE COURSES**

### **5. INTRODUCTION TO COMPUTER SCIENCE (3)**

*Alvarado, Dodds, Kuenning, Libeskind-Hadas.* Introduction to elements of computer science. Students learn general computational problem-solving techniques and gain experience with the design, implementation, testing and documentation of programs in a high-level language. In addition, students learn to design digital devices, understand how computers work, and learn to program a computer in its own machine language. Finally, students are exposed to ideas in computability theory. The course includes discussions of societal and ethical issues related to computer science. (Fall)

### **6. INTRODUCTION TO BIOLOGY AND COMPUTER SCIENCE (3)**

*Bush (Biology), Dodds, Libeskind-Hadas.* First course in a two-course series that combines Biology 52 and Computer Science 5. Successful completion of this course satisfies the Computer Science 5 core requirement. Restricted enrollment for first-year students. (Fall)

### **42. PRINCIPLES AND PRACTICE OF COMPUTER SCIENCE (3)**

*Alvarado, Keller.* Accelerated breadth-first introduction to computer science as a discipline for students (usually first-year) who have some programming background. Computational models of functional, object-oriented and logic programming. Data structures and algorithm analysis. Computer logic and architecture. Grammars and parsing. Regular expressions. Computability. Extensive practice constructing applications from principles, using a variety of languages. Successful completion of this course satisfies the Computer Science 5 core requirement and Computer Science 60 coursework. Prerequisite: permission of instructor. (Fall)

### **60. PRINCIPLES OF COMPUTER SCIENCE (3)**

*Alvarado, Dodds, Keller, Libeskind-Hadas.* Introduction to principles of computer science. Information structures, functional programming, object-oriented programming, grammars, logic, logic programming, correctness, algorithms, complexity analysis, finite state machines, basic processor architecture and theoretical limitations. Those who have completed Computer Science 42 cannot take Computer Science 60. Prerequisites: Computer Science 5 and one semester of calculus. (Fall and Spring)

### **70. DATA STRUCTURES AND PROGRAM DEVELOPMENT (3)**

*Kuenning, O'Neill, Stone.* Abstract data types including priority queues, dynamic dictionaries and disjoint sets. Efficient data structures for these data types, including heaps, self-balancing trees and hash tables. Analysis of data structures including worst-case, average-case and amortized analysis. Storage allocation and reclamation. Secondary storage considerations. Extensive practice building programs for a variety of applications. Prerequisites: Computer Science 60 or 42. (Fall and Spring)

### **81. COMPUTABILITY AND LOGIC (3)**

*Keller, Bull (Pomona), Sweedyk.* An introduction to some of the mathematical foundations of computer science, particularly logic, automata and computability theory. Develops skill in constructing and writing proofs, and demonstrates the applications of the aforementioned areas to problems of practical significance. Prerequisites: Computer Science 60 or 42, Mathematics 55. (Fall and Spring)



**105. COMPUTER SYSTEMS (3)**

*Erlinger, Kuening, Bull (Pomona).* An introduction to computer systems. In particular the course investigates data representations, machine level representations of programs, processor architecture, program optimizations, the memory hierarchy, linking, exceptional control flow (exceptions, interrupts, processes and Unix signals), performance measurement, virtual memory, system-level I/O and basic concurrent programming. These concepts are supported by a series of hands-on lab assignments. Prerequisite: Computer Science 70. (Fall and Spring)

**121. SOFTWARE DEVELOPMENT (3)**

*Keller, Sweedyk.* Rigorous introduction to the technological and managerial discipline concerned with the design and implementation of large software systems. Techniques for software specification, design, verification and validation. Formal methods for proving the correctness of programs. Student teams design, implement and present a substantial software project. Prerequisite: Computer Science 70. (Fall and Spring)

**124. USER INTERFACE DESIGN (3)**

*Alvarado.* This course introduces students to issues in the design, implementation and evaluation of human-computer interfaces, with emphasis on user-centered design and graphical interfaces. Students will learn skills that aid them in choosing the right user interaction technique and developing an interface that is well-suited to the people for whom it is designed. Prerequisite: Computer Science 5 or 42. (Spring, alternate years)

**125. COMPUTER NETWORKS (3)**

*Erlinger.* Principles and analysis techniques for internetworking. Analysis of networking models and protocols. Presentation of computer communication with emphasis on protocol architecture. Prerequisite: Computer Science 105. (Fall)

**131. PROGRAMMING LANGUAGES (3)**

*Bruce (Pomona), O'Neill, Stone.* A thorough examination of issues and features in language design and implementation including language-provided data structuring and data-typing, modularity, scoping, inheritance and concurrency. Compilation and run-time issues. Introduction to formal semantics. Prerequisite: Computer Science 70 and 81. (Fall and Spring)

**132. COMPILER DESIGN (3)**

*Stone.* The theory, design, and implementation of compilers and interpreters. The interaction between compiler design and run-time organization. Logistics of porting to new hardware. Prerequisites: Computer Science 105 and 131. (Spring, alternate years)

**133. DATABASES (3)**

*Keller.* Fundamental models of databases: entity-relationship, relational, deductive, object-oriented. Relational algebra and calculus, query languages. Data storage, caching, indexing and sorting. Locking protocols and other issues in concurrent and distributed databases. Prerequisites: Computer Science 70 and 81 (131 recommended). (Fall, alternate years)

**134. OPERATING SYSTEMS: DESIGN AND IMPLEMENTATION (3)**

*O'Neill.* Design and implementation of operating systems, including processes, memory management, synchronization, scheduling, protection, file systems and I/O. These concepts are used to illustrate wider concepts in the design of other large software systems, including simplicity; efficiency; event-driven programming; abstraction design; client-server architecture; mechanism vs. policy; orthogonality; naming and binding; static vs. dynamic, space vs. time, and other trade-offs; optimization; caching; and managing large code bases. Group projects provide experience in working with and extending a real operating system. Prerequisite: Computer Science 105. (Spring, alternate years)

**135. FILE SYSTEMS (3)**

*Kuenning.* Computer storage and file systems. Characteristics of nonvolatile storage, including magnetic disks and solid-state memories. RAID storage. Data structures used in file systems. Performance, reliability, privacy, replication, and backup. A major portion of the course is devoted to readings selected from current research in the field. Prerequisites: Computer Science 105. (Fall, alternate years)

**136. ADVANCED COMPUTER ARCHITECTURE (3)**

*Kuenning.* Reduced vs. complex instruction-set architecture, pipelining, instruction-level parallelism, superscalar architectures, advanced memory-hierarchy design, advanced computer arithmetic, multiprocessor systems, cache coherence, interconnection networks, performance analysis and case studies. Prerequisite: Computer Science 105. (Spring, alternate years)

**140. ALGORITHMS (3) (Also listed as MATHEMATICS 168)**

*Libeskind-Hadas, Pippenger (Mathematics), Chen (Pomona).* Algorithm design, analysis, and correctness. Design techniques including divide-and-conquer and dynamic programming. Analysis techniques including solutions to recurrence relations and amortization. Correctness techniques including invariants and inductive proofs. Applications including sorting and searching, graph theoretic problems such as shortest path and network flow, and topics selected from arithmetic circuits, parallel algorithms, computational geometry, and others. An introduction to computational complexity, NP-completeness, and approximation algorithms. Proficiency with programming is expected as some assignments require algorithm implementation. Prerequisite: Computer Science 70 and Mathematics 55. (Both semesters. Students taking the course as Mathematics 168 have slightly different prerequisites.)

**141. ADVANCED TOPICS IN ALGORITHMS (3)**

*Libeskind-Hadas.* Advanced topics in the design and analysis of combinatorial algorithms. Example topics are amortized analysis of data structures, competitive analysis of on-line algorithms, matroid theory, and introduction to parallel and distributed algorithms. A significant component of the course is written and oral student presentations of material from the original literature. Prerequisite: Computer Science 140/Mathematics 168. (Fall, alternate years)

**142. COMPLEXITY THEORY (3) (Also listed as MATHEMATICS 167)**

*Libeskind-Hadas, Pippenger (Mathematics).* Brief review of computability theory through Rice's Theorem and the Recursion Theorem followed by a rigorous treatment of complexity theory. The complexity classes P, NP, and the Cook-Levin Theorem. Approximability of NP-complete problems. The polynomial hierarchy, PSPACE-completeness, L and NL-completeness, #P-completeness. IP and Zero-knowledge proofs. Randomized and parallel complexity classes. The speedup, hierarchy and gap theorems. Prerequisite: Computer Science 81. (Fall, alternate years)

**144. SCIENTIFIC COMPUTING (3) (Also listed as MATHEMATICS 164)**

*de Pillis (Mathematics), Yong (Mathematics).* Computational techniques applied to problems in the sciences and engineering. Modeling of physical problems, computer implementation, analysis of results; use of mathematical software; numerical methods chosen from: solutions of linear and nonlinear algebraic equations, solutions of ordinary and partial differential equations, finite elements, linear programming, optimization algorithms and fast Fourier transforms. Prerequisites: Mathematics 64 and Computer Science 60 or 42. (Spring)

**147. COMPUTER SYSTEMS PERFORMANCE ANALYSIS (3)**

*Kuenning.* Measurement and analysis of computer software and systems performance, with emphasis on methodological issues. Measurement planning and experimental design. Statistical methods for data analysis. Hypothesis testing. Effective graphical and tabular presentation of data. Common errors in performance measurement. Elementary queuing theory. Simulation methods. Project in performance measurement. Typical projects include measurement of

databases, theorem provers, file systems, networks, OS kernels and computer processors. Prerequisites: Mathematics 62 and Computer Science 70. (Spring, alternate years)

### 151. ARTIFICIAL INTELLIGENCE (3)

*Alvarado, Sood (Pomona)*. Knowledge representation, including rule-based systems and neural networks, learning paradigms, and philosophical challenges to artificial intelligence. Discussion of areas of current research: natural language processing, robotics, vision, cognitive modeling, case-based reasoning. Prerequisite: Computer Science 81 (Computer Science 131 recommended). (Fall and Spring)

### 152. NEURAL NETWORKS (3)

*Keller*. Modeling, simulation and analysis of artificial neural networks and their relation to biological networks. Design and optimization of discrete and continuous neural networks. Back propagation and other gradient descent methods. Hopfield and Boltzmann networks. Unsupervised learning. Self-organizing feature maps. Applications chosen from function approximation, signal processing, control, computer graphics, pattern recognition, time-series analysis. Relationship to fuzzy logic, genetic algorithms and artificial life. Prerequisites: Computer Science 60 or 42 and Mathematics 63. (Fall)

### 153. COMPUTER VISION (3)

*Alvarado, Dodds*. Computational algorithms for visual perception. Image acquisition, image processing, segmentation. Representation of color, shading, texture, shape. Stereo and motion analysis. Object recognition. Relations to robotics, human perception, image databases. Prerequisite: Computer Science 70. (Fall, alternate years)

### 154. ROBOTICS (3)

*Dodds*. Introduction to robotics from a behavioral perspective. Topics span from sensor operation and low-level actuator control to architectures and algorithms for accomplishing tasks. The basic framework and analysis of both industrial and biologically-motivated robots are addressed. The laboratory component of the class provides experience in developing algorithms, programming and testing a range of robot behaviors on our hardware platforms. Prerequisites: Computer Science 70 or permission of instructor. (Spring, alternate years)

### 155. COMPUTER GRAPHICS (3)

*Sweedyk*. Geometric models for visual output. Rastering. Three-dimensional volume and surface modeling. Reflectance and illumination models. Texturing and shading. Color and animation. Prerequisites: Mathematics 63, Computer Science 70 and 140. (Fall)

### 156. PARALLEL AND REAL-TIME COMPUTING (3)

*Keller, Chen (Pomona)*. Characteristics and applications for parallel and real-time systems. Specification techniques, algorithms, architectures, languages, design and implementation. Prerequisites: Computer Science 105 and 140 (Computer Science 131 recommended). (Spring, alternate years)

### 157. COMPUTER ANIMATION (3)

*Sweedyk*. This course introduces students to the theory and practice of computer animation. The course covers the algorithms and data structures for building and animating articulated figures and particle systems including interpolation techniques, deformations, forward and inverse kinematics, rigid body dynamics, and physically based modeling. In addition, the course surveys the art, history and production of animation. Prerequisite: Computer Science 155. (Spring, alternate years)

### 181, 182. COMPUTER SCIENCE SEMINAR (3)

*Staff*. Advanced topics of current interest in computer science. Prerequisite: Permission of instructor. (Fall and Spring)

**183, 184. COMPUTER SCIENCE CLINIC I, II (3)**

*Staff.* Team project in computer science, with corporate affiliation. Prerequisite: Computer Science 121.

**185. COMPUTER SCIENCE RESEARCH I (2-3)**

*Staff.* An independent research project under faculty supervision. The course also has regular class meetings that address research methods and presentation skills. Prerequisite: permission of instructor. (Fall)

**186. COMPUTER SCIENCE RESEARCH II (3)**

*Staff.* A continuation of independent research carried out in Computer Science 185 culminating in a research paper and oral presentation. Prerequisite: Computer Science 185. (Spring)

**189. PROGRAMMING PRACTICUM (1)**

*Dodds, Stone.* This course is a weekly programming seminar, emphasizing efficient recognition of computational problems and their difficulty, developing and implementing algorithms to solve them, and the testing of those implementations. Attention is given to the effective use of programming tools and available libraries, as well as to the dynamics of team problem-solving. Prerequisite: Computer Science 5 or 42 or permission of instructor. (May be repeated for elective credit up to three times.) (Fall and Spring)

**191, 192. COMPUTER SCIENCE PROJECT I, II (1-3)**

*Staff.* Participation in projects of substantial interest to computer scientists. Emphasis is on the design and implementation of computer systems for real problems. Students typically work in small teams with faculty supervision. Prerequisite: permission of instructor.

**193, 194, 195, 196. COMPUTER SCIENCE COLLOQUIUM (0)**

*Staff.* Oral presentations and discussions of selected topics, including recent developments in computer science. Participants include computer science majors, Clinic participants, faculty members and visiting speakers. Required for all junior and senior computer science majors, both semesters while in residence. All majors welcome. No credit.

**197, 198. ADVANCED PROBLEMS IN COMPUTER SCIENCE (1-3)**

*Staff.* Independent study in a field agreed upon by student and a faculty member. Prerequisite: permission of instructor.

## ENGINEERING

*Professors* Durón (Chair), Bassman, Baumgaertner, Bright, Cardenas, Cha, DiMaggio, Dym, D. Harris, S. Harris, King, Lape, Little, Molinder, Orwin, Ravi (2009–2010), Remer, Spjut, Wang and Yang.

### PROGRAM EDUCATIONAL OBJECTIVES:

- Produce graduates who are exceptionally competent engineers whose work is notable for its breadth and its technical excellence;
- Provide a “hands-on” approach to engineering so that graduates develop an understanding of engineering judgment and practice;
- Prepare and motivate students for a lifetime of independent, reflective learning;
- Produce graduates who are fully aware of the impact of their work on society, both nationally and globally;
- Offer a curriculum that is current, exciting and challenging for both students and faculty, but can be completed in four years by any motivated student who is admitted to HMC.

Based on the premise that design is the distinguishing feature of engineering, the HMC engineering program provides a broad-based, hands-on experience in engineering practice and synthesis, as well as in analysis. Thus, the engineering program is designed to prepare graduates for professional practice, for advanced study in a specific engineering discipline, and for a lifetime of independent learning. Culminating in an unspecialized bachelor’s degree, the program emphasizes an interdisciplinary approach to problem solving.

The engineering curriculum can be described as having three stems. The **engineering science stem** consists of five required courses (E82, E83, E84, E85 and E106) that collectively embody the fundamental “applied science” knowledge base needed by a broadly educated engineer practicing in the foreseeable future.

The **systems stem** is a sequence of three required courses (E59, E101, E102) that provides analysis and design tools to model and interpret the behavior of general engineering systems. The sequence is multidisciplinary in approach, enabling students to gain a unified view of the entire spectrum of engineering disciplines.

The **design and professional practice stem** includes five required courses that focus on working in teams on open-ended, externally-driven design projects that, over the course of the curriculum, encompass conceptual design, preliminary (or embodiment) design, and detailed design. Hands-on exposure to professional practice begins with students undertaking challenging design problems in the first year (E4), continues with a practicum (E8) on drawing and making objects a laboratory course in experimental engineering (E80), and culminates with three semesters of Engineering Clinic (E111–113).

Pioneered by the Department of Engineering at Harvey Mudd College in 1965, the **Engineering Clinic** brings together teams of students to work with faculty advisers and external liaison engineers on carefully selected, industry- and government-sponsored design and development projects. The students plan and execute their projects; the faculty advise, coach, monitor, evaluate and provide feedback; the sponsors’ liaisons ensure that the sponsors’ goals are achieved and that the design experience corresponds as closely as possible to what engineers encounter in actual practice. Thus, the questions and problems that student teams face are typical of those regularly confronted by practicing engineers, and the solutions they devise must work in practice, not just in theory.

We believe that our broad engineering program graduates engineers capable of adapting changing technologies to expanding human needs, while at the same time being sensitive to the impact of their work on society. In this context, an engineering major may choose to emphasize a particular engineering specialty by appropriate choice of elective courses and

Engineering Clinic projects. Specific programs tailored to individual needs are developed in consultation with an engineering faculty adviser.

An engineering major must satisfactorily complete the following required courses for the bachelor's degree: Engineering 4, 8, 59, 80, 82, 83, 84, 85, 101–102, 106, 111–113 and 121–124. In addition, three upper-division engineering technical electives are also required and seniors must submit a final Clinic report that is acceptable to the project's faculty adviser. Students should note that many electives are offered in alternate years.

To keep the option open for majoring in engineering, a student should have taken Engineering 4 and 59 before the fourth semester. Any proposed variation from this program must be discussed in advance with an engineering adviser.

## **ENGINEERING COURSES**

### **4. INTRODUCTION TO ENGINEERING DESIGN (3)**

*Staff.* Design problems are, typically, open-ended and ill-structured. Students work in small teams applying techniques for solving design problems that are, normally, posed by not-for-profit clients. The project work is enhanced with lectures and reading on design theory and methods, project management techniques and engineering ethics. Enrollment limited to first-year students and sophomores, or by permission of the instructor. (Fall and Spring)

### **8. DESIGN REPRESENTATION AND REALIZATION (1)**

*King, Orwin.* A practicum that provides hands-on, shop-based experience to give meaning to the concepts of design representation and design realization. Students are introduced to ASME drawing specifications and are required to generate drawings that meet the appropriate specifications. Students manufacture a tool tray, screwdriver and hammer, using equipment in the student shop. Students are exposed to limits in the design and manufacture of engineering components. Open to all students. (Fall and Spring)

### **8A. DESIGN REPRESENTATION AND REALIZATION (1)**

*Orwin.* See description for Engineering 8 above. This version of the class will be integrated into Engineering 4. The two courses must be taken together.

### **59. INTRODUCTION TO ENGINEERING SYSTEMS (3)**

*Staff.* An introduction to the concepts of modern engineering, emphasizing modeling, analysis, synthesis and design. Applications to chemical, mechanical and electrical systems. Prerequisite: sophomore standing. Corequisite: Physics 51. (Fall and Spring)

### **80. EXPERIMENTAL ENGINEERING (3)**

*Staff.* A laboratory course designed to acquaint the student with the basic techniques of instrumentation and measurement in both the laboratory and in engineering field measurements. Emphasis on experimental problem solving in real systems. Prerequisites: Engineering 8 (taken previously or concurrently), E59 or permission of instructor. (Spring)

### **82. CHEMICAL AND THERMAL PROCESSES (3)**

*Lape.* The basic elements of thermal and chemical processes, including: state variables, open and closed systems, and mass balance; energy balance, First Law of Thermodynamics for reactive and non-reactive systems; entropy balance, Second Law of Thermodynamics, thermodynamic cycles and efficiency. (Fall and Spring)

### **83. CONTINUUM MECHANICS (3)**

*Bassman.* The fundamentals of modeling continuous media, including: stress, strain and constitutive relations; elements of tensor analysis; basic applications of solid and fluid mechanics (including beam theory, torsion, statically indeterminate problems and Bernoulli's principle); application of conservation laws to control volumes. (Fall and Spring)

**84. ELECTRONIC AND MAGNETIC CIRCUITS AND DEVICES (2)**

*Wang, Yang.* Introduction to the fundamental principles underlying electronic devices and applications of these devices in circuits. Topics include electrical properties of materials; physical electronics (with emphasis on semiconductors and semiconductor devices); passive linear electrical and magnetic circuits; active linear circuits (including elementary transistor amplifiers and the impact of non-ideal characteristics of operational amplifiers on circuit behavior); operating point linearization and load-line analysis; electromagnetic devices such as transformers. (Fall and Spring)

**85. DIGITAL ELECTRONICS AND COMPUTER ENGINEERING (3)**

*D. Harris, S. Harris.* This course provides an introduction to elements of digital electronics, followed by an introduction to digital computers. Topics in digital electronics include: Boolean algebra; combinational logic; sequential logic; finite state machines; transistor-level implementations; computer arithmetic; and transmission lines. The computer engineering portion of the course includes computer architecture and micro-architecture: levels of abstraction; assembly-language programming; and memory systems. The digital electronics portion of E85 may be taken by non-engineering majors as a stand-alone half course under the number E85A. (Fall and Spring)

**85A. DIGITAL ELECTRONICS (1.5)**

*D. Harris, S. Harris.* This course provides an introduction to elements of digital electronics, intended for non-engineering majors who may be interested in pursuing other advanced engineering courses that require this background. Lectures for this course coincide with lectures for the first half of E85. (Fall and Spring)

**101–102. ADVANCED SYSTEMS ENGINEERING (3)**

*Molinder, Bright, DiMaggio.* Analysis and design of continuous-time and discrete-time systems using time domain and frequency domain techniques. The first semester focuses on the connections and distinctions between continuous-time and discrete-time signals and systems and their representation in the time and frequency domains. Topics include impulse response, convolution, continuous and discrete Fourier series and transforms, and frequency response. Current applications, including filtering, modulation and sampling, are presented and simulation techniques based on both time and frequency domain representations are introduced. In the second semester additional analysis and design tools based on the Laplace- and z-transforms are developed and the state space formulation of continuous and discrete-time systems is presented. Concepts covered during both semesters are applied in a comprehensive treatment of feedback control systems including performance criteria, stability, observability, controllability, compensation and pole placement. Prerequisite: E59 or permission of instructor. 3 credit hours per semester. (Year-long sequence)

**106. MATERIALS ENGINEERING (3)**

*King, staff.* Introduction to the structure, properties and processing of materials used in engineering applications. Topics include: material structure (bonding, crystalline and non-crystalline structures, imperfections); equilibrium microstructures; diffusion, nucleation, growth, kinetics, non-equilibrium processing; microstructure, properties and processing of: steel, ceramics, polymers and composites; creep and yield; fracture mechanics; and the selection of materials and appropriate performance indices. Prerequisites: Physics 51, E82 and E83 or permission of instructor. (Fall and Spring)

**111. ENGINEERING CLINIC I (3)**

*Little, staff.* Participation in engineering projects through the Engineering Clinic. Emphasis is on design of solutions for real problems, involving problem definition, synthesis of concepts, analysis and evaluation. Prerequisite: junior standing in engineering or permission of Clinic director. (Fall and Spring)

**112–113. ENGINEERING CLINIC II–III (3)**

*Little, staff.* Participation in engineering projects through the Engineering Clinic. Emphasis is on design of solutions for real problems, involving problem definition, synthesis of concepts, analysis and evaluation. Prerequisites: E4, E8, E80 and E111 or permission of Clinic director. 3 credit hours per semester.

**114. ENGINEERING CLINIC (1-3)**

*Little, staff.* A continuation of Engineering Clinic for juniors who elect a second semester. Prerequisite: permission of Clinic Director. (Spring)

**115. PROJECT MANAGEMENT (3)**

*Little.* This course teaches tools and techniques commonly used in managing engineering projects, including work breakdown structures, PERT/CPM analysis, and budgeting, forecasting and aspects of project control. It also introduces use of models and operations research techniques in selecting and assigning resources to projects. Students are required to develop and implement a work plan for a small-scale project, typically a Clinic project. (Fall)

**116. COST ESTIMATION AND MODELING (3)**

*Remer.* Principles of cost and schedule estimation and modeling for capital projects, and for estimation and budgeting of operations and maintenance of ongoing processes. Hardware and software and integrated design projects are included. Advantages and disadvantages of different estimation methods are explored. (Every other year; Spring)

**119. PRELIMINARY DESIGN (3)**

*Staff.* This course examines the general principles associated with functional analysis and preliminary design, and applies these principles to a particular design problem. Students in the course will be expected to demonstrate competency in the application of functional analysis techniques and setting of performance specifications, design of artifacts to meet the functional specifications, and documentation of successful designs. Students will be offered a choice of several design problems which may come from one of the traditional engineering disciplines (chemical, civil, electrical, mechanical, etc.) or may cut across several boundaries. (Every other year; Fall)

**121–122. ENGINEERING SEMINAR (0)**

*Staff.* Weekly meetings devoted to discussion of engineering practice. Required of junior engineering majors. No credit. (Year-long sequence)

**123–124. ENGINEERING SEMINAR (0)**

*Staff.* Weekly meetings devoted to the discussion of engineering practice. Required of senior engineering majors. No credit. (Year-long sequence)

**131. FLUID MECHANICS (3)**

*Cardenas.* The flow of incompressible fluids. Primarily a study of momentum transport in continuous media. Included are the treatment of viscosity, the equations of continuity and of motion, and turbulence. Applications to analysis and design. Prerequisite: E83. (Fall)

**132. HEAT TRANSFER (3)**

*Lape.* A study of conduction, convection and radiation phenomena with application to selected problems in several fields of engineering. Prerequisite: E82. (Spring)

**133. CHEMICAL REACTION ENGINEERING (3)**

*Remer, Spjut.* The fundamentals of chemical reactor engineering: chemical reaction kinetics, interpretation of experimental rate data, design of batch and continuous reactors for single and multiple reactions including temperature and pressure effects, and the importance of safety considerations in reactor design. (Every other year; Fall)

**134. ADVANCED ENGINEERING THERMODYNAMICS (3)**

*Lape, Spjut.* The application of classical thermodynamics to engineering systems. Topics



include power and refrigeration cycles, energy and process efficiency, real gases and non-ideal phase and chemical reaction equilibria. Prerequisite: E82. (Every other year; Spring)

### 136. MASS TRANSFER AND SEPARATION PROCESSES (3)

*Lape.* Principles of mass transfer, application to equilibrium-stage and finite-rate separation processes. Extension of design principles to multistage systems and to countercurrent differential contacting operations. Applications from the chemical processing industries and from such fields as desalination, pollution control and water reuse. Prerequisite: E82. (Every other year; Spring)

### 138. INTRODUCTION TO ENVIRONMENTAL ENGINEERING (3)

*Cardenas.* Introduction to the main concepts and applications in modern environmental engineering. Included are surface and groundwater pollution (both classical pollutants and toxic substances); risk assessment and analysis; air pollution; and global atmospheric change. (Every other year; Spring)

### 140. INTRODUCTION TO COMPRESSIBLE FLOW (3)

*Cardenas.* The effects of compressibility in the governing integral and differential equations for fluids. The effects of friction, heating and shock waves in steady one-dimensional flow. Unsteady wave motion and the method of characteristics. Two-dimensional flow over air foils, linearized potential flow and the method of characteristics for supersonic flow. Prerequisite: E131. (Every other year; Spring)

### 151. ENGINEERING ELECTRONICS (3)

*Yang.* Analysis and design of circuits using diodes, bipolar junction transistors and field-effect transistors, following a brief treatment of solid state electronics and the physics of solid state devices. Analysis and design of single and multi-transistor linear circuits including operational amplifiers. Corequisite: E153. Prerequisite: E59 and E84 or permission of instructor. (Fall)

### 153. ELECTRONICS LABORATORY (1)

*Baumgaertner.* Experimental evaluation of electronic devices and circuits. Prerequisite: E84 or permission of instructor; taken concurrently with E151. (Fall)

### 155. MICROPROCESSOR-BASED SYSTEMS: DESIGN AND APPLICATIONS (4)

*S. Harris, D. Harris.* Introduction to digital design using programmable logic and microprocessors. Combinational and sequential logic. Finite state machines. Hardware description languages. Field programmable gate arrays. Microcontrollers and embedded system design. Students gain experience with complex digital system design, embedded programming, and hardware/software trade-offs through significant laboratory and project work. Prerequisites: E85 or E85A and CS60 or permission of instructor. (Fall)

### 156. INTRODUCTION TO COMMUNICATION AND INFORMATION THEORY (3)

*Molinder.* Comprehensive treatment of explicit and random signal transmission through linear communication networks by generalized harmonic analysis including signal sampling and modulation theories. Treatment of noise in communication systems including design of optimum linear filters and systems for signal detection. Introduction to information theory including the treatment of discrete noiseless systems, capacity of communication channels and coding processes. Prerequisite: E101. (Spring)

### 158. INTRODUCTION TO CMOS VLSI DESIGN (3)

*D. Harris.* Introduction to digital integrated system design. Device and wire models, gate topologies, logical effort, latching, memories and timing. Structured physical design and CAD methodology. Final team project involves design and fabrication of custom chips. Prerequisites: E84 and E85A or permission of instructor. (Spring)

**159. ENGINEERING ELECTROMAGNETICS (3)**

*Staff.* Analysis of electrostatic systems, magnetostatic systems, Maxwell's equations, eddy current systems, transmission lines, radar, wave guides and antennae. Prerequisite: Physics 51. (Every other year; Fall)

**161. COMPUTER IMAGE PROCESSING AND ANALYSIS (3)**

*Wang.* An introduction to both image processing, including acquisition, enhancement and restoration; and image analysis, including representation, classification and recognition. Discussion on related subjects such as unitary transforms, and statistical and neural network pattern recognition methods. Project oriented. Prerequisites: E101–102 and programming proficiency, or permission of instructor. (Every other year; Fall)

**164. INTRODUCTION TO BIOMEDICAL ENGINEERING (3)**

*Orwin.* The application of engineering principles to help pose and solve problems in medicine and biology. Focus on different aspects, particularly biomedical measurements, bio systems analysis, biomechanics and biomaterials. (Every other year; Spring)

**166. HIGH-SPEED PC BOARD DESIGN (3)**

*S. Harris.* This course provides the student exposure to fundamental and practical issues in the design and fabrication of printed circuit boards (PCBs), with primary emphasis on boards for high-speed digital circuits. Students work in teams to design a high-speed PCB, which can then be fabricated and subsequently tested by the students. Upon completing this course, students should be able to use appropriate CAD tools to capture a circuit schematic, choose a board cross-section, place components on a board and route wiring. Further, the course should enable students to recognize when circuit speed/size combinations are likely to make "high-speed effects" such as reflections and cross talk important, know how to quantify these effects and their impact on performance, and to design their boards to reduce the deleterious effects to an acceptable level. Prerequisites: E84 and E85A. (Every other year; Spring)

**168A. INTRODUCTION TO FIBER OPTIC COMMUNICATION SYSTEMS (3)**

*Yang.* This course provides the fundamentals of optics and its applications in communication systems. The physical layer of optical communication systems will be emphasized. Topics include optical materials; dispersion and nonlinear effects; polarization and interference; and the basic elements of system implementation such as laser sources, optical amplifiers and optical detectors. The course will include a multiple channel system design. (Every other year, Spring)

**168B. ANALYSIS & TEST OF MECHANICAL SYSTEMS (3)**

*DiMaggio.* Response of single- and multi-degree of freedom lumped parameter mechanical systems and applications in the space and launch vehicle industry. Derivation of equations of motion and numerical approaches to their solution in the time and frequency domains. Discussion of hardware failure mechanisms with focus on strength and fatigue. Introduction to testing techniques including one or more of the following approaches: static, sine dwell, sine sweep, random, acoustic and/or shock. Establishing mechanical test requirements and validating analytical models using selected signal processing techniques. Probability and random vibration. Possible discussion of finite element methods and/or response of continuous systems. Prerequisites: E101, E171 or permission of the instructor.

**171. DYNAMICS OF ELASTIC SYSTEMS (3)**

*Cha.* Free and forced response of single- degree-of-freedom systems. Eigenvalue problem for multi-degree-of-freedom systems; natural modes of free vibration. Forced response of undamped and viscously damped, multi-degree-of-freedom systems by modal analysis. (Fall)

**172. STRUCTURAL MECHANICS (3)**

*Dym.* Introduction to elementary structural systems: trusses, beams. Force and deflection analysis. Energy methods. Stability. Introduction to finite element methods. Prerequisite: E83. (Spring)

**173. APPLIED ELASTICITY (3)**

*Dym.* Introduction to the concepts of stress and strain. Application to the theory of bending and torsion. Topics in elementary elasticity. Prerequisite: E83. (Every other year; Fall)

**174. PRACTICES IN CIVIL ENGINEERING (3)**

*Little, Cardenas, Dym.* The student is exposed to the practice of civil engineering through a series of case studies discussed within the context of a broad-based engineering curriculum. Engineering fundamentals related to the selection and use of construction materials, stress and strain, and to the analysis and design of structural and transportation systems may be discussed. Types and specifics of case studies vary depending upon the instructor. Prerequisites: E59, E80 and permission of the instructor. (Every other year; Spring)

**175. RIGID BODY DYNAMICS (3)**

*Bassman, DiMaggio.* Kinematics, mass distribution and kinetics of systems of particles and rigid bodies. Formulation of equations of motion with: Newton/Euler equations; angular momentum principle; power, work, and energy methods. Numerical solutions of nonlinear algebraic and ordinary differential equations governing the behavior of multiple degree of freedom systems. Computer simulation of multi-body dynamic systems. Construction of physical systems for comparison with simulation. Prerequisite: E83 (taken previously or concurrently). (Fall)

**176. NUMERICAL METHODS IN ENGINEERING (3)**

*Cha.* This course focuses on the application of a variety of mathematical techniques to solve real-world problems that involve modeling, mathematical and numerical analysis, and scientific computing. Concepts, calculations and the ability to apply principles to physical problems are emphasized. Ordinary differential equations, linear algebra, complex analysis, numerical methods, partial differential equations, probability and statistics, etc., are among the techniques that would be applied to problems in mechanical, electrical, chemical and civil engineering. Examples are drawn from fluid mechanics, heat transfer, vibration of structures, electromagnetics, communications and other applied topics. Program development and modification are expected as well as learning to use existing code. (Every other year; Spring)

**179. DEFORMATION AND FRACTURE OF SOLIDS (3)**

*King.* Elements of stress and strain, elastic and plastic deformations of solid materials, fracture mechanics, strengthening mechanisms, thermal and thermo-mechanical processing, effects of microstructure, failure modes and analysis of service failures. Prerequisites: E83 and E106. (Every other year; Fall)

**190. SPECIAL TOPICS IN ENGINEERING (3)**

*Staff.* An upper division or graduate technical elective treating topics in engineering not covered in other courses, chosen at the discretion of the Engineering Department.

**191. ADVANCED PROBLEMS IN ENGINEERING**

*Staff.* Independent study in a field agreed upon by student and instructor. Credit hours to be arranged.

**201. ECONOMICS OF TECHNICAL ENTERPRISE (3)**

*Remer.* Time value of money, interest rates, depreciation and depletion, personal and corporate taxes, investment yardsticks such as present worth, rate of return, payback period and cost/benefit analysis, venture analysis and comparison of alternative projects, cost estimation and inflation, personal economics and investments, current business economic topics, tempering economics with judgment. (Fall)

**202. ENGINEERING MANAGEMENT (3)**

*Little, Remer.* Introduction to the concepts of modern management including the scientific, behavioral and functional schools of thought, motivational models, leadership styles,

organizational structures, project management, and other areas of student interest. (Not to be substituted for any technical elective required for the major.) Prerequisite: senior standing or permission of instructor. (Spring)

**205. SYSTEMS SIMULATION (3)**

*Bright.* An examination of the use of high-speed digital computers to simulate the behavior of engineering and industrial systems. Both continuous and discrete systems are treated. Prerequisites: E101–102. (Fall)

**206. OPTIMIZATION TECHNIQUES IN ENGINEERING DESIGN (3)**

*Dym, Little.* Presentation of techniques for making optimum choices among alternatives; applications to engineering design problems. Prerequisite: E205. (Spring)

**231. ADVANCED TRANSPORT PHENOMENA (3)**

*Staff.* Integrated approach to the subjects of fluid mechanics, heat transfer, and mass transfer, through the study of the governing equations common to all three fields. Applications drawn from a wide variety of engineering systems. Prerequisites: none.

**278. ADVANCED STRUCTURAL DYNAMICS (3)**

*Cha.* Free and forced response of continuous systems, including the vibration of strings, rods, shafts, membranes, beams and plates. One dimensional finite element methods: discretization of a continuum, selection of interpolation functions, and determining the element mass and stiffness matrices and the corresponding load vector. Introduction to special topics, including the effects of parameter uncertainties on the dynamics of periodic structures and model updating in structural dynamics. Prerequisite: E171. (Every other year; Spring)

## HUMANITIES, SOCIAL SCIENCES, AND THE ARTS

*Professors* Wright (Chair), Alves, Balseiro, Barron, Beckman (emeritus), de Laet, Dyson, Evans (on leave 2009–2010), Groves, Kamm, Lamkin, Mashek, Mayeri, Olson, Steinberg (on leave 2009–2010), Sullivan and Tan.

The members of the Department of Humanities, Social Sciences, and the Arts (HSA) seek to foster the intellectual and personal growth of Harvey Mudd College students by exposing them to the subjects and methods associated with our disciplines. We do this in order to promote an appreciation of different kinds of knowledge so as to enable critical analysis and synthesis, and to encourage the development of increased self knowledge, a humane concern for society, and an examined and evolving set of values.

Toward these ends, each student is assigned a humanities, social sciences, and the arts adviser who will help her/him plan a coherent program of study that reflects the educational goals of the department, as well as the particular interests of the student. The required program consists of Humanities 1 in the first semester, followed by 11 courses (beginning in the spring semester of the first year) that are individually selected in consultation with the adviser.

In order to achieve depth and intellectual development in some area of the humanities, social sciences or the arts, each student must complete a concentration of at least four courses in a single HSA discipline or interdisciplinary field chosen from the distinct areas of study offered at The Claremont Colleges (see the list of approved concentrations on the department's website). The concentration represents progress in a field of study, and even though that field might be interdisciplinary, the concentration should typically advance beyond introductory level courses. A concentration in the fine or performing arts must include at least two courses that focus on theory, criticism, or historical analysis. Students who intend to concentrate in areas not covered by the department's faculty should plan their program carefully in order to be able to fulfill all requirements. Courses that form the concentration may also satisfy other departmental requirements.

In order to obtain breadth in the humanities, social sciences and the arts and an understanding of the varieties of approaches that inform these disciplines, each student must fulfill the distribution requirement by completing coursework in three different areas:

1. **Arts, Languages and Literatures:** Disciplines could include Art, Dance, Drama, Film, Literature (in any language), Foreign Languages, Music. One of the two courses in this distribution area must focus on theory, criticism or historical analysis.
2. **Humanities:** Disciplines could include Classics, History, History of Ideas, Philosophy, Religious Studies.
3. **Social Sciences:** Disciplines could include Anthropology, Economics, Government, International Relations, Political Studies, Psychology, Sociology.

The concentration completes one of these distribution areas. For instance, a student concentrating in anthropology has met the distribution requirement for social sciences. Beyond the area represented by the concentration, students must take two courses in different disciplines or interdisciplinary fields in each of the remaining distribution areas. The anthropology concentrator, then, could meet the remaining distribution requirements with courses in art history and dance (which would complete the arts, languages, and literatures distribution) and courses in history and religious studies (which would complete the humanities distribution).

The appropriate distribution credit for courses in all fields depends on the discipline of the instructor and/or the focus of the course. A student registering for courses should consult with her/his adviser about appropriate distribution. For students concentrating in interdisciplinary fields (such as American Studies, Asian American Studies, Africana Studies, Chicano Studies, Environmental Studies, Gender Studies, Media Studies, and Science, Technology and Society),

the department will maintain a list of the appropriate distribution credit to be received for the concentration. Disciplinary history courses typically count within the parent discipline (that is, Art History counts as Art, Music History as Music and so on).

It is the department's intention that every course it offers and every course it will accept from the other Claremont Colleges could satisfy one of the distribution requirements. Courses taken to meet distribution requirements may also be used to satisfy other departmental requirements.

The department is responsible for ensuring that exploration of the humanities, the social sciences and the arts constitutes an integral component of the life of the HMC community. This means that HMC students and faculty should explore these disciplines together to a significant extent. Accordingly, the department requires that at least six of a student's humanities and social sciences courses (including Humanities 1) be taken with departmental faculty. Remaining coursework may be done at the other Claremont Colleges, and the department encourages students to take advantage of this opportunity.

In addition, the department encourages students to include course work in their humanities, social sciences and the arts programs that represents an exposure to cultural diversity, and it is committed to offering courses that meet this goal.

To promote academic and cultural experiences that cannot be directly obtained at HMC, the department will waive one departmental requirement for students who study abroad or who concentrate in an area not regularly supported by coursework at HMC. However, unless transferring to HMC, a student may not take fewer than five departmental courses.

Students should plan their programs and strategies for satisfying all of the HSA requirements as early as possible. Students are strongly encouraged to take at least one HSA course each semester in order to fulfill these requirements and in recognition of the fact that the humanities, social sciences and the arts form a central and ongoing part of the Harvey Mudd College curriculum. The department tries to offer a balanced mix of introductory level and upper-division courses each semester. Students may also arrange for directed readings with individual faculty members, subject to their permission, in order to pursue particular interests that are not covered by regular courses.

## **HUMANITIES, SOCIAL SCIENCES, AND THE ARTS COURSES**

### **HUMANITIES AND SOCIAL SCIENCES**

#### **1. INTRODUCTION TO THE HUMANITIES AND SOCIAL SCIENCES (4)**

*Staff.* An introduction to college-level studies in the humanities and social sciences focusing on the development of essential reading, critical thinking, research and especially writing skills. (Fall)

#### **190. SENIOR EXPERIENCE (3)**

*Staff.* A project-oriented course, open only to seniors. Such projects may involve: internships, recitals, performances and artistic productions; independent research projects; and senior tutorials. See the "Department of Humanities, Social Sciences, and the Arts Advising Handbook" for more details. Prerequisite: departmental approval of student proposal, permission of instructor.

### **AMERICAN STUDIES**

#### **103. INTRODUCTION TO AMERICAN CULTURES (3)**

*Staff.* An interdisciplinary introduction to principal themes in American culture taught by an intercollegiate faculty team.

#### **115. PRINT AND AMERICAN CULTURE (3)**

*Groves.* Covers numerous developments in American print culture through the careful

examination of both textbooks and artifacts (period books, magazines, newspapers, letters, diaries, advertisements and so on).

## ANTHROPOLOGY

### 110. LIFE: KNOWLEDGE, BELIEF AND CULTURAL PRACTICES (3)

*de Laet.* An exploration of cultural attitudes toward life and the human body: from Melanesian origin myths to the human genome project; from the first autopsies to cloning and genetic manipulation; from early body snatchings to the trade in bodies and body parts in the global economy. The question of what constitutes life is subject to controversy, and reveals cultural differences in practices, knowledges and beliefs. This course aims to help students develop a sophisticated and informed attitude towards cultural difference.

### 111. INTRODUCTION TO THE ANTHROPOLOGY OF SCIENCE AND TECHNOLOGY (3)

*de Laet.* An introduction to science and technology as cultural phenomena and a hands-on initiation into anthropology. While applying basic anthropological methods in the academic environment, students gain an understanding of science and technology as a culturally, socially and historically specific way of constructing knowledge. In other words, rather than taking for granted the ways in which we make knowledge, this course makes those ways “strange.”

## ART

### 50. BEGINNING BLACK AND WHITE PHOTOGRAPHY (3)

*Staff.* A studio art course in the basic procedures of Black and White photography from handling the camera through dark room work, leading to the production of high quality photographic images. The photo assignments emphasize different aspects of seeing through the camera and creating the raw material to which darkroom techniques can be applied. Class meetings, every other week, are critiques in which these images are discussed and alternative artistic conceptions and treatments are suggested.

### 60. WORKSHOP IN HAND PRESS PRINTING (1.5)

*Groves.* This workshop introduces students to the basic vocabulary and practices of typesetting, typography, and printing for and on an iron hand press. Work includes a skill-building project and a student-designed semester project. Students may repeat the course once.

### 100. INTRODUCTION TO DIGITAL PHOTOGRAPHY (3)

*Staff.* A studio art course using digital cameras to create fine art images. Covers camera use, computer workflow in Photoshop and output to print. Shooting assignments with study of work of important photographers from 19th century to contemporary. Discussion of aesthetics, composition and content. Weekly review and in-class critiques of students' work. Final show of print and projected images of each student's best work.

### 150. INTERMEDIATE BLACK AND WHITE PHOTOGRAPHY (3)

*Staff.* An intermediate studio art course in Black and White photography as a fine art. Covers advanced darkroom techniques, development of an artistic vision, creation of a substantial portfolio and preparation of archival fine prints. Class meetings, every week, consist of darkroom work and critiques. Concludes with a show of each student's best work.

## ART HISTORY

### 158 VISUALIZING CHINA (3)

*Tan.* Explores the political, social and cultural landscape of contemporary China through art (painting, sculpture/installation, photography, performance and videos). Theories of modern and postmodern art will be introduced in the analysis of visual materials.

**CHINESE****1 A,B. ELEMENTARY CHINESE (3)**

*Tan.* First-year course in Chinese language. Students will engage in conversation, pattern drills, reading and character-writing. 1A is offered in fall; 1B in the spring.

**ECONOMICS****53. PRINCIPLES OF MACROECONOMICS (3)**

*Evans.* Provides a fundamental understanding of the national economy. Topics include theories of unemployment, growth, inflation, income distribution, consumption, savings, investment and finance markets, and the historical evolution of economic institutions and macroeconomic ideas.

**54. PRINCIPLES OF MICROECONOMICS (3)**

*Sullivan.* Provides methods of investigating the individual behavior of people, businesses and governments in a market environment. Topics include elementary models of human economic behavior and resource allocation, and the evolution of market institutions and their impact upon society.

**103. THE GREAT ECONOMISTS (3)**

*Staff.* Surveys the significant contributions of a noted economist.

**104. FINANCIAL ECONOMICS (3)**

*Evans.* The principles of money and banking from the viewpoint of both business person and banker. Topics include the operation of commercial banks, related financial institutions, the development of the banking system, international finance, governmental fiscal and monetary policy, and the relations of money and credit to prices. Prerequisite: Economics 53.

**108. GOVERNMENT AND FISCAL MONETARY POLICY (3)**

*Evans.* Includes an in-depth examination of the federal budget, deficits and the debt, budgetary enforcement, line-item spending, tax policy and theories of the impact of government economic activity upon the rest of the economy. Monetary policy emphasizes the policies and activities of the Federal Reserve System, efforts to influence interest rates, money growth and credit, and studies of policy options.

**136. FINANCIAL MARKETS AND MODELING (3)**

*Evans.* Modern financial strategy seeks to reduce market risk through the use of complex instruments called derivatives. This course introduces students to the world of futures, options and other derivatives. Topics to be covered include a survey of the markets and mathematical models of risk and volatility. Prerequisite: Economics 104 or equivalent.

**140: THE ECONOMICS OF WOMEN, FAMILY AND WORK (3)**

*Sullivan.* An introduction to research and theory in the rapidly growing field of work and family studies. Inherently interdisciplinary, the study of work/family intersections involves the literatures of sociology, anthropology, psychology, legal studies, and history, as well as economics. Topics to be considered include: the relationship between parental work and child development; the economic affects of care-giver status; gender differentials in the workplace; family-related public policy; the division of household labor, and work and health. Taught in seminar style and largely discussion-based.

**142. DEVELOPMENT ECONOMICS (3)**

*Sullivan.* A critical introduction to the major orthodox and heterodox theories of development economics and to a selection of alternative strategies. Central objectives include identification of the determinants of economic growth and the distinction of growth from development.



**150. POLITICAL ECONOMY OF HIGHER EDUCATION (3)**

*Sullivan.* An exploration of topics central to the political economy of contemporary American higher education. Organized as a seminar, the course is also a workshop in which students develop reading lists, influence the selection of subtopics and lead discussions. Likely topics include the academic labor market, admissions and marketing issues, college sports, and the role of government funding. Particular attention will be paid to forces that shape the education of scientists, mathematicians, and engineers.

**153. INTERMEDIATE MACROECONOMICS (3)**

*Staff.* A reexamination of the principles of macroeconomics at a more advanced level. The use of formal models for macroeconomic analysis and application to topical problems. Prerequisite: Economics 53. Economics 54 is recommended but not required.

**154. INTERMEDIATE MICROECONOMICS (3)**

*Staff.* An advanced treatment of micro-economic theory using formal mathematical models for analysis. Optimization models of human behavior and resource use in a market environment are developed, analyzed and applied to a topical economic allocation problem. Prerequisite: Economics 54.

**HISTORY****80. SCIENCE AND TECHNOLOGY IN THE ANCIENT AND MEDIEVAL WORLDS (3)**

*Olson, staff.* Scientific institutions, scientific thought and technological systems from the earliest civilizations through Classical Greece and the Hellenistic world, and their continuation and transformation in Roman, Arabic and Western Medieval civilizations. Special attention given to Plato, Aristotle, Euclid and Ptolemy.

**81. SCIENCE AND TECHNOLOGY IN THE EARLY MODERN WORLD (3)**

*Olson, staff.* Scientific institutions, scientific thought and technological systems during the Scientific Revolution, from the Renaissance, the emergence of print culture, and the growth of world trade through the French and first industrial revolutions. Attention given to Paracelsus, Galileo, Descartes, Newton, Linnaeus, Lavoisier.

**82. SCIENCE AND TECHNOLOGY IN THE MODERN WORLD (3)**

*Olson, staff.* Scientific institutions, scientific thought and technological systems from the early 19th century through the mid-20th century as science and technology emerged as defining characteristics of "Western" culture. Attention given to the work and impact of Faraday, Darwin, Pasteur, Einstein, Freud and Heisenberg.

**127. TWENTIETH-CENTURY U.S. HISTORY (3)**

*Barron.* An analysis of U.S. history from the Progressive Era to the present, with particular emphasis on social, economic and cultural developments and their relationships to political change.

**128. IMMIGRATION, ETHNICITY AND RACE IN THE U. S. (3)**

*Barron.* A study of the experiences of different ethnic groups in the U.S. from the colonial period to the present that addresses the meanings of cultural diversity in American history.

**131. THE JEWISH EXPERIENCE IN AMERICA (3)**

*Barron.* A consideration of the interactions between Jews and American society from the colonial period to the present. Topics include Anti-Semitism, American responses to the Holocaust, the United States and Israel, Black-Jewish relations, and the meanings of Jewish identity in contemporary America.

**132. THE CALIFORNIA EXPERIENCE (3)**

*Barron.* An exploration of California's history from the pre-colonial period to the present that pays special attention to the experiences of the different groups who have populated the state as well as California's environmental history and the state's changing political dynamics.

**183. SCIENCE AND TECHNOLOGY IN AMERICAN CULTURE (3)**

*Olson.* An exploration of the ways in which science and technology have shaped the American landscape and mindspace as well as the reciprocal ways in which American contexts have directed scientific and technological developments. Covers the colonial and early modern period during which the “inventory sciences,” including botany and geology were pursued for their presumed economic benefits and during which enlightenment scientific ideas helped to shape our governmental institutions. Discussion also includes the 19th and early 20th centuries, which saw the spread of railroads, electrification and automobiles and an obsession with evolution, efficiency and eugenics. Concludes with recent themes connected with military technologies, including the atomic bomb, energy sources, environmental issues and biotechnology.

**LITERATURE****103. THIRD CINEMA (3)**

*Balseiro.* Emerging in Latin America in the 1960s and 1970s, the notion of Third Cinema takes its inspiration from the Cuban revolution and from Brazil’s Cinema Novo. Third Cinema is the art of political film making and represents an alternative cinematic practice to that offered by mainstream film industries. Explores the aesthetics of film making from a revolutionary consciousness in three regions: Africa, Asia and Latin America.

**104. AN INTRODUCTION TO MIDDLE ENGLISH LITERATURE (3)**

*Groves.* For students interested in developing a basic ability to translate and pronounce Middle English. Works studied will include: the first fragment of Chaucer’s “The Canterbury Tales”; “Sir Orfeo”; “Sir Gawain and the Green Knight”; and selections from Malory’s “Le Morte D’Arthur.”

**105. THE LAND AND AMERICAN LITERATURE (3)**

*Groves.* Explores how landscape is depicted in American literary texts and the relationship between those texts and other modes of representation (painting, cartography, photography and film).

**107. CREATIVE WRITING (3)**

*Balseiro.* A workshop for individual writers of fiction, poetry or screenwriting. The purpose is to write and constructively critique your own and another’s writings. Assignments include character, time, narrative, point of view, plot and structure. Instructor permission required.

**110. SHAKESPEARE (3)**

*Groves.* Covers selected dramatic and lyric works by Shakespeare with some attention to other Elizabethan and Jacobean writers. Final project: a public performance of a Shakespeare play.

**117. MAJOR AUTHORS (3)**

*Staff.* An intensive study of the work and literary development of one or two major authors. Readings drawn from the authors’ works and related critical, biographical and historical texts. Specific instances are listed below.

**117A. DICKENS, HARDY AND THE VICTORIAN AGE (4)**

*Groves, Eckert.* An intensive study of the work and literary development of Charles Dickens and Thomas Hardy. Readings drawn from the authors’ works and related critical, biographical, and historical texts. Class travels to England over winter break; travel expenses are the responsibility of the student. (Fall and winter break)

**144. POE GOES SOUTH: THE FANTASTIC SHORT STORY (3)**

*Balseiro.* A consideration of Poe’s influence on the development of the fantastic short story in Latin America. Topics include: Poe’s reception in Europe and in the Southern Cone, Poe’s influence in the literature of magic realism in 20th-century Latin America.

**145. THIRD-WORLD WOMEN WRITERS (3)**

*Balseiro.* Focuses on the relationships between gender and identity in the writings of Third-World women as well as theoretical background on Third-World feminisms. Authors include Nawal El Saadawi, Alifa Rifaat, Mariama Ba, Bessie Head, Ana Lydia Vega and Jamaica Kincaid.

**146. TWENTIETH-CENTURY SOUTH AFRICAN LITERATURE (3)**

*Balseiro.* An introduction to the interactions between literature, politics and history in 20th-century South Africa. Readings include drama, poetry, fiction and biography, as well as several films and documentaries.

**147. WRITERS FROM AFRICA AND THE CARIBBEAN (3)**

*Balseiro.* An examination of the themes of nation, exile, race and gender in works by Chinua Achebe, Wole Soyinka, Ayi Jwei Armah, Yusuf Idriss, Ngugi wa Thiong'o, Nadine Gordimer, George Lamming, Jean Rhys and Rosario Ferre, among others. Theoretical background on Third-World literature will also be covered.

**155. POST-APARTHEID NARRATIVES (3)**

*Balseiro.* This seminar maps the literary terrain of contemporary South Africa. Through an examination of prose, poetry and visual material, this course offers some of the responses writers have given to the end of apartheid, to major social events such as the hearings of the Truth and Reconciliation Commission, and to the idea of a "new" South Africa.

**MEDIA STUDIES****50. LANGUAGE OF FILM (3)**

*Mayeri.* Introduction to film analysis, exploring the language of film through weekly screenings and discussions. The craft of filmmaking—screenwriting, cinematography, mise-en-scene, sound, editing—from silent films, to classical Hollywood cinema, to independent film, documentary, and animation. Consideration of film as an art form, as reflection of the culture at large, and as a force for change.

**60. DOCUMENTARY: FACT AND FICTION (3)**

*Mayeri.* Examines the propaganda and poetry of documentary film. In weekly screenings, students will see films on a range of topics: from ethnographic adventures with other cultures to allegorical tales about our animal relatives. This class will explore documentary craft, history, and politics, and analyze the ethics of representing others.

**127. THE HARMONY OF SOUND AND LIGHT (3)**

*Alves.* New technology has created exciting new opportunities in the arts of abstract film, video, and computer animation. This course will explore theories of abstraction from music into the visual arts and film, analyzing the works of such pioneers as Oskar Fischinger and John Whitney. Students will create their own computer images and animations of "visual music."

**144. A HISTORY OF SPECIAL EFFECTS (3)**

*Mayeri.* Hovering between reality, fantasy, and nightmare, visual illusions have enraptured the masses for hundreds of years - from St. Peter's Basilica to "The Matrix." This course will trace several intersections of art and technology—the emergence of illusionism in Renaissance painting, the origin of the proscenium theater in Baroque opera, the development of special effects before and through cinema, and into our increasingly televised and mediated public space. Using art, film, and cultural history and theory, we will analyze the social, political, and aesthetic dimensions of spectacle.

**170. DIGITAL CINEMA (3)**

*Mayeri*. Intermediate/advanced video course, exploring the creative potential of digital video techniques, such as compositing, animation, and motion graphics. Students develop digital projects and participate in critiques. Lectures, discussions, and screenings enhance students' exposure to art and cinema. Prerequisite: MS182 Introduction to Video Production or equivalent.

**173. EXILE IN CINEMA (3)**

*Balseiro*. A thematic and formal study of the range of cinematic responses to the experience of exile. Exile is an event, but how does it come about and what are its ramifications? Exile happens to individuals but also to collectivities. How does it effect a change between the self and society, homeland and site of displacement, mother tongue and acquired language? This course examines how filmmakers take on an often painful historical process through creativity.

**182. INTRODUCTION TO VIDEO PRODUCTION (3)**

*Mayeri*. Students learn how to make their own videos, using professional video cameras and editing systems. Weekly, hands-on workshops will cover the entire production process—storyboarding, shooting, lighting, recording sound and editing in Final Cut Pro. Students will complete several group exercises and individual projects, and participate in critiques of professional media and each other's work. Video is explored as a medium for expression, persuasion, humor, storytelling and art-making. Prerequisite: MS50 Language of Film or MS49 Introduction to Media Studies.

**MUSIC****48. ELECTRONIC MUSIC ENSEMBLE (1)**

*Alves*. Rehearsal and performance of new and recent compositions for synthesizers and other instruments. Instrumentation and musical styles may vary. Though some synthesizers may be provided, in most cases students will be expected to own their own instruments. Prerequisite: ability to play an instrument and read music. Audition may be required for instructor permission.

**49. AMERICAN GAMELAN ENSEMBLE (1)**

*Alves*. Rehearsal and performance of new compositions for instruments adapted from the gamelan, a Javanese orchestra of metallophones and gongs. No prior experience on these instruments is required. Prerequisite: Ability to read music, approval of instructor.

**63. MUSIC OF THE PEOPLES OF THE WORLD (3)**

*Alves*. The fundamentals of music and listening through a survey of traditional music around the world as well as cross-cultural influences. Neither an ability to read music nor any other background in music is required.

**81. INTRODUCTION TO MUSIC: SOUND AND MEANING (3)**

*Alves, Kamm, staff*. This course explores important works of Western art music from diverse historical epochs through listening and analysis. Elements of music, basic musical terminology and notation are discussed. Attention is given to the relation of the arts—especially music—to culture and society.

**84. JAZZ IMPROVISATION (1.5)**

*Keller (Computer Science)*. The art of simultaneously hearing, composing and performing music. Chords, scales, chord progressions and tunes of modern jazz. Theory, listening, analysis and group practice in improvisation skills. Prerequisites: Music reading ability, ability to play most of the 12 major scales on an instrument, motivation to play jazz, permission of the instructor. (Repeatable for credit)

**88. INTRODUCTION TO COMPUTER MUSIC (3)**

*Alves.* The basics of using software on a general purpose computer to synthesize and manipulate digital sounds. Neither a background in music nor the ability to read music is required. A background in computers is helpful but not required.

**117. TWENTIETH-CENTURY MUSIC (3)**

*Alves.* An investigation of contemporary music through performances, analyses, recordings and discussions of representative compositions from late Romanticism and such 20th-century styles as Neo-classicism, Serialism and Minimalism, as well as aleatoric and electronic techniques. Prerequisite: The ability to read music. Offered in conjunction with the Joint Music Program.

**173. CONCERT CHOIR (1)**

*Kamm.* A study through rehearsal and performance of choral music selected from the 16th century to the present, with emphasis on larger, major works. (Both semesters; joint offering of CMC, HMC, Pitzer and Scripps.) Prerequisite: successful audition.

**174. CHAMBER CHOIR (1)**

*Kamm.* A study of choral music from 1300 to the present, with emphasis on those works composed for performances of a choral chamber nature. (Both semesters; joint offering of CMC, HMC, Pitzer and Scripps.) Prerequisite: successful audition.

**175. THE CLAREMONT CONCERT ORCHESTRA (1)**

*Lamkin (Scripps).* The study through rehearsal, with discussion as needed, and performance, of styles and techniques appropriate for the historically accurate performance of instrumental works intended for the orchestra. Repertoire will include works from mid-18th century to the present with special emphasis on the classical and romantic periods. (Both semesters; joint offering of CMC, HMC, Pitzer and Scripps.) Prerequisite: successful audition.

**PHILOSOPHY****108. KNOWLEDGE, SELF AND VALUE (3)**

*Wright.* An introduction to philosophy covering representative issues in epistemology, the metaphysics of human nature and theory of value. Readings are drawn from historical and contemporary sources.

**121. ETHICAL THEORY (3)**

*Wright.* A survey of contemporary philosophical thinking about morality, concentrating on theories of normative ethics but with some attention to issues in metaethics. The course explores consequentialist, deontological, egoistic, and virtue-based normative theories, as well as debates about the impact of a commitment to morality on personal projects and relationships.

**122. ETHICS: ANCIENT AND MODERN (3)**

*Wright.* A comparative study of the works of several major moral philosophers, beginning in antiquity with Plato and Aristotle and ending in the nineteenth century with Nietzsche's critique of modern morality. Other figures studied include Hume, Kant and Mill, and may also include Aquinas, Hobbes or Spinoza.

**124. MORALITY AND SELF-INTEREST (3)**

*Wright.* A study of historical and contemporary arguments for the harmony of morality and enlightened self-interest, along with some of the main challenges raised against such arguments by their critics. Reading assignments may include selections from Plato, Aristotle, Sidgwick, Prichard, Ayn Rand, Rosalind Hursthouse, Derek Parfit, David Gauthier and others.

**125. ETHICAL ISSUES IN SCIENCE AND ENGINEERING (3)**

*Wright.* After briefly exploring concepts and theories in normative ethics, this course examines a representative set of ethical issues confronting researchers and practitioners in the natural and formal sciences and in engineering. Issues covered will vary but may include animal experimentation, genetic engineering, internet privacy, the responsibility of engineers to foresee and prevent harm and others.

**130. POLITICAL PHILOSOPHY (3)**

*Wright.* The major traditions of political thought, with emphasis on the modern era, including natural rights theory, social contract theory, and the philosophic foundations of political liberalism.

**POLITICAL STUDIES****114. COMPARATIVE ENVIRONMENTAL POLITICS (3)**

*Steinberg.* An examination of the political challenges faced by environmental advocates in diverse countries around the globe. Drawing on the fields of comparative politics and public policy, topics include comparative political institutions, environmental movements, corruption, authoritarian regimes, democratization, lesson-learning across borders, policy reform, gender analysis, decentralization and European unification.

**140. GLOBAL ENVIRONMENTAL POLITICS (3)**

*Steinberg.* Analyzes the political dynamics driving global environmental problems and current attempts to address them. Concepts from political science and public policy are applied to issues such as ozone depletion, climate change, trade in endangered species, treaty formation and effectiveness, transnational activism and multi-level governance.

**188. POLITICAL INNOVATION (3)**

*Steinberg.* Political Innovation. Steinberg. Under what conditions do novel political ideas become realities? Explores the origins and impacts of political innovations large and small—from the framing of the Constitution to the development of major social policies, the creation and reform of government agencies and non-profit organizations and experimentation with new forms of social protest and political mobilization.

**PSYCHOLOGY****53. INTRODUCTION TO PSYCHOLOGY (3)**

*Mashek.* An overview of the field of psychology, its principles, content and methods. Special reference to classical studies and significant experiments.

**108. INTRODUCTION TO SOCIAL PSYCHOLOGY (3)**

*Mashek.* The study of the way individuals think about, influence and relate to one another. Sample topics include: conformity, persuasion, social cognition, self-justification, prejudice and attraction.

**150. PSYCHOLOGY OF CLOSE RELATIONSHIPS (3)**

*Mashek.* An introduction to the leading theoretical perspectives employed by social psychologists in the study of close romantic relationships. Participants will examine a number of relationship-relevant constructs (e.g., love, commitment, intimacy, breakups) through the lenses offered by these different theories.

**RELIGIOUS STUDIES****183. GHOSTS AND THE MACHINES (3)**

*Dyson.* This course explores the interrelations between occult mediumship, modern media and technology in Europe and the United States from the nineteenth-century through the

present. The aim of the course is to explore how the Enlightenment and its offspring, modern technology, in their seemingly stark material and rational promises of progress, have never rid themselves fully of the paranormal and irrational. To explore the multiple relations between ghosts and the machines, topics for the course include: ghostly visions and magic lantern phantasmagoria; American spiritualism and the telegraph; phrenology and the rise of the archive; psychical research and stage magic; radio's disembodied voices; and spirit photography and light therapies; psychic television; magic on film.

#### **184. SCIENCE AND RELIGION: A CRITICAL LOOK AT THEIR INTERACTION (3)**

*Olson, Cave (Chemistry)*. A seminar that examines a variety of interpretative strategies for approaching science/religion interactions; explores the historical patterns of interaction from the Bronze Age to the present; then concludes with an extended exploration of the place of science in the works of a major contemporary theologian such as Wolfhart Pannenberg.

### **SCIENCE, TECHNOLOGY AND SOCIETY**

#### **1. INTRODUCTION TO SCIENCE, TECHNOLOGY AND SOCIETY (3)**

*de Laet*. An introduction to the interactions among science, technology and society. Examines the different concepts of rationality and the values that underlie scientific and technological endeavors as well as the centrality of value conflict in technological controversies.

#### **114. SOCIAL AND POLITICAL ISSUES IN TECHNICAL PROJECTS (3)**

*de Laet*. A seminar offered to students taking Clinic. Preparation of a major paper analyzing the ethical and/or social issues of the student's Clinic project or the product or application for which the project is a part. Reading assignments on the interaction between society and technology and case studies of specific examples.

#### **185. SCIENCE AND ENGINEERING FROM AN "OTHER" POINT OF VIEW (3)**

*Olson*. Seeks to expand our understanding of the character and consequences of science and engineering by exploring how they have been and are viewed by representatives of groups, which have felt excluded or exploited, especially women, people of color, and underclass peoples of the "third world." Asks why relatively few women, members of some ethnic groups in the U.S., and members of Third World cultures participate in scientific and engineering professions, including questions about whether there are features of scientific and engineering institutions, conceptual structures, attitudes, and methodologies, which have encouraged and continued to encourage or amplify sexist, racist and imperialist behaviors.

### **SOCIAL SCIENCES**

#### **124. U.S. SCIENCE AND TECHNOLOGY POLICY (3)**

*Olson*. From the establishment of the United States to the present, issues involving the promotion, regulation or utilization of science and technology have constituted a significant concern of national policy makers. Course begins with an historical overview of the contexts for and character of federal involvement in science and technology, then turns to an analysis of a small number of student-selected current issues involving a major scientific and/or technological component, ranging from policies that regulate or promote scientific activities—such as stem cell research or research into alternative energy sources—through social policies such as health care policies, policies relating to global competitiveness, and national security policies. Environmental issues will be excluded unless they are focused on human health and safety issues because they are well covered in other courses in the curriculum.

#### **147. ENTERPRISE AND THE ENTREPRENEUR (3)**

*Evans*. Concepts and practices applicable to working as or with the manager of an enterprise. Some emphasis on enterprise formation and on management in high-technology firms.

**180. TROPICAL FORESTS: POLICY AND PRACTICE (3)**

*Steinberg.* This seminar takes stock of the past two decades of social science research on tropical forests, examining the scale of deforestation, its causes and consequences, and the track record of attempted solutions. Special emphasis is placed on the ways in which values, institutions and political-economic forces shape the decisions that will determine the fate of the forests.

**SPECIAL TOPICS AND DIRECTED READING COURSES****179. SPECIAL TOPIC COURSES (3)**

*Staff.* Special topics courses—one-time or very occasional course offerings—are designated with the number 179. They may be offered in any discipline within the humanities and social sciences.

**197–198. DIRECTED READING COURSES (1-3)**

*Staff.* Students may arrange for directed readings with individual faculty members in the humanities and social sciences, subject to their permission, in order to pursue particular interests that are not covered by regular courses. Directed reading courses, designated with the number 197 (Fall) or 198 (Spring), may be taken in any discipline within the humanities and social sciences. The college limits such courses to juniors and seniors. See the discussion of “Directed Reading Courses” in the “Academic Regulations” section of this catalogue for other restrictions.

**SPECIAL INTERDEPARTMENTAL AND INTERCOLLEGIATE PROGRAMS**

The Department of Humanities, Social Sciences, and the Arts participates in a number of interdepartmental and intercollegiate programs that provide suitable areas for concentration and offer courses that may be of interest to HMC students:

**AFRICANA STUDIES**

The Intercollegiate Department of Africana Studies offers a multidisciplinary curriculum that examines the experiences of African, African American and Caribbean people from the liberal arts perspective. Courses accommodate the needs of majors and non-majors, providing significant preparation for careers in education, social work, public policy, law, medicine, business, international relations and advanced research. Consult Professors Isabel Balseiro or Talithia Williams.

**AMERICAN STUDIES**

American Studies is a multidisciplinary program that introduces students to the complexities of the American experience and encourages them to think critically about American culture. An essential component of the American Studies curriculum is Introduction to American Cultures, which is team-taught by members of the intercollegiate faculty. Consult Professors Hal Barron or Jeffrey Groves.

**ASIAN-AMERICAN STUDIES**

The Intercollegiate Asian American Studies Program offers an interdisciplinary approach to exploring the hitherto neglected experience of Asians in the U.S. The courses are open to all students of The Claremont Colleges, and they provide undergraduates with an understanding of the diversity and complexity of this segment of United States society. Consult Professors Hal Barron or Chang Tan.

**CHICANO STUDIES**

The Chicano Studies Intercollegiate Department, the academic program of the Chicano Studies Center, offers a curriculum with a multidisciplinary approach to the study, research, interpretation and investigation of the Chicano/Latino experience. The courses are open to all students of The Claremont Colleges. In recognition of the vital presence of Chicanos and other Latinos in the West, Southwest, and increasingly the entire nation, Chicano studies provides



significant preparation for students pursuing careers in education, social work, public policy, law, medicine, business and scholarly research. Consult Professor Isabel Balseiro.

**ENVIRONMENTAL STUDIES**

The HMC Center for Environmental Studies coordinates courses and research in all departments of the college, and provides links to major ongoing programs of environmental studies at other Claremont Colleges. A strong advising program administered by the center helps students arrange programs that take advantage of courses in their majors as well as concentrations in the humanities and social sciences program, leading to a strong emphasis in environmental studies as a part of the Harvey Mudd College degree. Consult Professor Paul Steinberg and see [www.environmentcenter.hmc.edu](http://www.environmentcenter.hmc.edu).

**MEDIA STUDIES**

Media Studies is an intercollegiate program offered in coordination with the other Claremont Colleges. Harvey Mudd students may concentrate in video production as a fine art or media studies as a discipline in the humanities, although students with particular interests in communication, digital media or other specialized fields may also pursue them through elective courses and by designing a special concentration. Consult Professors William Alves or Rachel Mayeri.

**MUSIC**

In addition to its own offerings in music, Harvey Mudd College participates in the Joint Music Program with Claremont McKenna, Pitzer and Scripps Colleges. Courses are offered in music history and theory, as well as private or class instruction in performance and chamber music at the Scripps College Music Department. Consult Professors William Alves, Charles Kamm or Michael Lamkin.

**POLITICAL STUDIES**

Political Studies examine political values, interests, institutions, power and the processes of governing. Courses explore these questions using a variety of methodological approaches. Consult Professor Paul Steinberg.

**RELIGIOUS STUDIES**

The intercollegiate program in Religious Studies recognizes the importance and legitimacy of personal involvement in the study of religion, but it does not represent or advocate any particular religion as normative. Rather, its aim is to make possible an informed knowledge and awareness of the fundamental importance of the religious dimension in all human societies—globally and historically. Consult Professors Erika Dyson or Richard Olson.

**SCIENCE, TECHNOLOGY AND SOCIETY (STS)**

The STS program is designed to deepen students' understanding of both the context in which science and technology develop and the social consequences of scientific and technological change. Work in STS should not only enhance prospective scientists' and engineers' abilities to exercise influence within and on behalf of their professional communities, but also to assess the probable social impacts of their work. In addition, the program is intended to provide background for graduate work or career choices in such fields as history of science and technology, philosophy of science, public policy, law, medicine, science writing, science librarianship or secondary school science teaching. The college's interdepartmental Hixon Forum for Responsive Science and Engineering works directly and cooperatively with the Claremont STS program. Consult Professors Marianne de Laet or Richard Olson.

**THEATER**

Theater is one of the liberal arts and serves students from the five undergraduate colleges. It includes acting, design, directing, theater history and dramatic literature, and the practice of theater. Students concentrating in theater become proficient in bringing creative solutions to complex problems. They also develop sensitivity to the interpersonal relationships inherent in the collaborative process. Thus, they are prepared for a wide variety of careers in organizations and enterprises that value these qualities. The program is housed in excellent facilities at Pomona College. Consult Professor Jeffrey Groves.

**WOMEN'S STUDIES**

Women's Studies at HMC is part of an interdisciplinary and intercollegiate program that focuses on the nature and scope of women's achievement, promotes open and rigorous inquiry about women and sex roles, and questions cultural assumptions about women's place. This program also explores such areas as the relationship between gender and society historically and cross-culturally; the changing roles and concepts of women; and women's participation in major social institutions. Consult Professor Isabel Balseiro.



## MATHEMATICS

(See also Joint Major in Computer Science and Mathematics, and Mathematical Biology)

*Professors* Bernoff (Chair), Benjamin, Borrelli (emeritus), Castro, Coleman (emeritus), Goroff, Gu, Henriksen (emeritus), Jacobsen, Karp, Krieger (emeritus), Levy, Martonosi, Orrison, Pippenger, Su, Tucker (2007–2010), Whitcher (2009–2011), Williams and Yong.

A mathematics degree from Harvey Mudd College will prepare students for a variety of careers in business, industry or academics. Mathematical methods are increasingly employed in fields as diverse as finance, biomedical research, management science, the computer industry and most technical and scientific disciplines. To support the academic and professional goals of our majors, we offer a wide selection of courses in both pure and applied mathematics. This selection is enhanced by courses offered in cooperation with the other Claremont Colleges, including graduate courses at the Claremont Graduate University. The culmination of the degree is the senior capstone research experience; every student will experience a taste of the life of a professional mathematician as part of a team in the Mathematics Clinic Program or working individually on a Senior Thesis.

An educational innovation of HMC, the Clinic Program brings together teams of students to work on a research problem sponsored by business, industry or government. Teams work closely with a faculty adviser and a liaison provided by the sponsoring organization to solve complex real-world problems using mathematical and computational methods. The Clinic teams present their results in bound final reports to the sponsors and give several formal presentations on the progress of the work during the academic year.

In addition to the Clinic Program, students will have many opportunities to do mathematical research with faculty as an independent study, a summer research experience, or as a Senior Thesis. Active areas of mathematical research at HMC and The Claremont Colleges include algebra, algebraic geometry, algorithms and computational complexity, combinatorics, differential geometry, dynamical systems, fluid mechanics, graph theory, number theory, numerical analysis, mathematical biology, mathematics education, operations research, partial differential equations, real and complex analysis, statistical methods and analysis, and topology. HMC students may do their Senior Thesis with an HMC faculty member or any mathematician at The Claremont Colleges, which considerably expands the available opportunities and areas of research.

The course of study for a mathematics degree has five components: The Major Core, Computational Mathematics, Clinic or Thesis, Colloquium and the Elective Program. Each of these components to the major program is described below.

### THE MAJOR CORE

A set of core courses is required of each mathematics major. These courses cover a range of fundamental fields of mathematics and position the student to pursue any one of a variety of elective programs to finish the degree. The Major Core consists of Math 55 (Discrete Mathematics), Math 131 (Mathematical Analysis I), Math 157 (Intermediate Probability), Math 171 (Abstract Algebra I) and Math 180 (Applied Analysis).

### COMPUTATIONAL MATHEMATICS

Computational techniques are essential to many fields of modern mathematics and to most mathematical applications in business and industry. One course in computational mathematics is required of all mathematics majors, selected from the following list: Math 164 (Scientific Computing), Math 165 (Numerical Analysis), Math 167 (Complexity Theory), Math 168 (Algorithms), Biology 188 (Computational Biology) or CS 81 (Computability and Logic).

### CLINIC OR THESIS

Two semesters of Mathematics Clinic (Math 193) or two semesters of Senior Thesis (Math 197) are required and normally taken in the senior year. Clinic and thesis are important capstone experiences for each mathematics major; they represent sustained efforts to solve a complex problem from industry or mathematical research. To do a senior thesis, students must prepare a senior research proposal with the help of their thesis adviser. The proposal will describe the intended senior research project and must be submitted to the Department of Mathematics for approval before the end of the junior year. Clinic teams will be formed in the fall according to the requirements of the projects and student preferences. Students who do Clinic must work on the same Clinic project both semesters.

### COLLOQUIUM

All mathematics majors must take one semester of Math Forum (Math 198) and one semester of Mathematics Colloquium (Math 199), generally in the junior year. In the forum, students prepare and present talks on mathematical topics taken from the literature. As a requirement for the math forum, students must submit a tentative description of their proposed elective program to the department by the end of the fall semester of the junior year.

### THE ELECTIVE PROGRAM

To complete the degree, three elective mathematics courses totalling at least seven credit hours are required. The elective program will be designed by the student in consultation with his or her adviser. To assist students in designing their elective program, the department has prepared a variety of sample programs. These sample programs list courses that support a wide range of career goals in academics, business or industry. About half of our graduates immediately join the workforce and about half enter graduate school. Several sample elective programs are listed below. In each of these samples, the first two courses are strongly recommended; at least one additional course is to be selected in order to complete the elective program. (CS = Computer Science, CMC = Claremont McKenna College, CGU = Claremont Graduate University, PO = Pomona College). We emphasize that sample elective programs are advisory. Students may follow a sample program or design one of their own.

**Pure Mathematics:** 132, 172 and at least one elective from 104, 106, 123, 135, 136, 142, 143, 147, 173, 175, 185, CGU 331, CGU 332, CGU 334.

**Applied Mathematics:** 136, 181 and at least one elective from 118, 119, 120, 132, 164, 165, 173, 182, 185, 187, 189, CGU 362, CGU 368, CGU 382.

**Probability and Statistics:** 152, 156 and at least one elective from 106, 132, 158, 159, 173, 187, CGU 351, CGU 355.

**Operations Research:** 156, 187 and at least one elective from 104, 106, 132, 152, 158, 159, 165, 168, 188.

**Actuarial or Financial Mathematics:** 109, 156 and at least one elective from 152, 158, 159, 165, 187, CGU 355, Econometrics (CMC 125, 126; CGU 382, 383, 384; PO 167).

**Theoretical Computer Science:** CS 81, 168 and at least one elective from 104, 106, 107, 123, 165, 167, 172, 175, CS 151, CS 152, CS 156.

**Scientific Computing:** 164, 165 and at least one elective from 118, 119, 136, 168, 173, 181, 182, 185, CS 156, CGU 362, CGU 368, CGU 382.

**ADVISING**

The mathematics faculty works closely with each mathematics major to develop a coherent program of elective courses that meets the student's professional and academic goals. The department meets once each year to discuss and evaluate student programs and to discuss student progress.

**FACILITIES**

The Department of Mathematics and the college provide excellent computational facilities. The department's Scientific Computing Laboratory houses workstations supporting classroom activities and student and faculty research in numerical analysis, algorithms, parallel computing, and scientific computing, addressing diverse problems in mathematical modeling (such as problems in fluid mechanics and mathematical biology), operations research and statistical analysis. Additional resources include Beowulf-style distributed parallel-computing clusters and multiprocessor, large-memory, parallel compute servers. The department supports a wide variety of commercial and free/open-source mathematical software packages such as Mathematica, Maple, MATLAB, R, and SAGE.

**OTHER MATHEMATICAL ACTIVITIES AT HMC AND IN CLAREMONT**

There are many opportunities outside of course work to enjoy and participate in mathematics. Some of these activities are described below.

**The William Lowell Putnam Examination.** The Putnam Exam is a national collegiate mathematics competition. Over 2,500 students from more than 400 institutions take the exam. It is a very challenging, 12-question exam lasting six hours (three hours in the morning and three in the afternoon). The problems on the exam can be solved using elementary methods so that students can take the exam every year they are at college. About 70 HMC students take the exam each year, one of the highest participation rates in the country. The HMC Putnam team has done very well in the competition. In the 2003 Putnam Mathematical Competition, the HMC team placed fifth nationwide, the only undergraduate college in the last 30 years to have done so. The Putnam Seminar (Math 191) meets weekly and is open to all students. This is a one-unit course that will help to prepare students for the competition.

**Weekly Mathematics Colloquium.** The Claremont Colleges Mathematics Colloquium meets once per week. Most of the colloquium speakers are mathematicians from around the country who speak about their research or give talks of general mathematical interest. To encourage undergraduates to attend, all speakers are encouraged to design their talk to be accessible to undergraduate mathematics majors.

**Mathematics Seminars.** Several weekly seminars on special mathematical topics are offered in Claremont each year. Recent seminars include combinatorics, analysis, applied mathematics, wavelet theory, monte carlo methods, population dynamics and topology. Faculty, CGU graduate students and advanced undergraduate students attend the seminars.

**Mathematical Competition in Modeling (MCM).** The MCM competition is sponsored by the Consortium for Mathematics and its Applications and the Society for Industrial and Applied Mathematics. Each year, the MCM contest proposes two challenging open-ended problems in applied mathematics. Competing schools form teams of three students to work on the problems over a long weekend. Teams cannot consult with any person on their solution, but otherwise can use any resource available to them: computers, reference literature from the library or Internet resources. Each year, HMC has between two and six teams competing in the MCM, out of over 400 teams internationally. HMC has earned the highest award of Outstanding more than any other institution in the competition.

### Some Recent Clinic Projects

As described above, Clinic teams work together for two semesters to solve an open problem from business, industry or government. Listed below are a few examples of recent Clinic projects and the names of the sponsors.

- Cardinal Health. *Modeling Fluid Transport in Subcutaneous Tissue*
- Hewlett-Packard Labs. *Characterization and Sources of Printer Color Instability*
- Los Alamos National Laboratories. *Mathematical and Computational Modeling of Tumor Development*
- National Renewable Energy Laboratory. *Advanced Modeling of Renewable Energy Market Dynamics*
- Overture Services, Inc. *Improved Relevance Ordering for Web Search*
- Sandia National Laboratories. *Improving GPS Algorithms*
- ViaSat, Inc. *Elliptic Curve Cryptography Scheme for Asymmetric Key Generation*

### Some Recent Senior Theses

Several students write a senior thesis each year. It is common that theses result in papers that are submitted to mathematical journals for publication. Below are titles of several recent senior theses:

- An Investigation of Rupture in Thin Fluid Films
- Mathematical Model of the Chronic Lymphocytic Leukemia Microenvironment
- Mathematical AIDS Epidemic Model: Preferential Anti-Retroviral Therapy Distribution in Resource Constrained Countries
- Connections Between Voting Theory and Graph Theory
- A Fast Fourier Transform for the Symmetric Group
- The Negs and Regs of Continued Fractions
- Turing Pattern Dynamics for Spatio-Temporal Models with Growth and Curvature
- Kolmogorov Complexity of Graphs
- Foraging Fruit Flies: Lagrangian and Eulerian Descriptions of Insect Swarming
- Optimal Control of a Building During an Earthquake
- Mathematical Models of Image Processing

## MATHEMATICS COURSES

(Includes mathematics courses frequently taken by HMC students at the other Claremont Colleges)

### 11. CALCULUS (2)

*Benjamin, Jacobsen, Karp, Levy, Williams.* Limits, derivatives and differentiation rules; partial derivatives; gradients and directional derivatives; introduction to calculus of complex-valued functions; infinite series, Taylor series, convergence tests; fundamental theorem of calculus; techniques of integration; double and triple integrals. Prerequisites: One year of calculus at the high school level. (Offered Fall, both halves)

### 12. INTRODUCTION TO LINEAR ALGEBRA (2)

*Benjamin, de Pillis, Gu, Karp, Martonosi, Orrison, Pippenger, Su, Tucker, Williams, Yong.* Complex numbers; proofs by contradiction and induction; matrix representation of systems of equations, matrices, operations, determinants, row and column spaces; vectors, dot and cross products; vector descriptions of lines and planes; linear independence and dependence, bases; eigenvalues and eigenvectors; examples of discrete dynamical systems. Prerequisites: One year of calculus at the high school level. (Offered Fall, both halves)

### 13. DIFFERENTIAL EQUATIONS (1.5)

*Bernoff, Castro, de Pillis, Jacobsen, Levy, Su, Yong.* Modeling physical systems, first-order ordinary differential equations, existence, uniqueness, and long-term behavior of solutions; bifurcations; approximate solutions; second-order ordinary differential equations and their

properties, applications; first-order systems of ordinary differential equations. Prerequisite: Mathematics 11; or the equivalent. (Offered Spring, both halves)

**14. MULTIVARIABLE CALCULUS I (1.5)**

*Castro, Gu, Karp, Orrison, Su, Yong.* Review of basic multivariable calculus; optimization and the second derivative test; higher order derivatives and Taylor approximations; line integrals; vector fields, curl, and divergence; Green's theorem, divergence theorem and Stokes' theorem, outline of proof and applications. Prerequisite: Mathematics 11; or the equivalent. (Offered Spring, both halves)

**55. DISCRETE MATHEMATICS (3)**

*Benjamin, Bernoff, Orrison, Tucker.* Topics include combinatorics (clever ways of counting things), number theory, and graph theory with an emphasis on creative problem solving and learning to read and write rigorous proofs. Possible applications include probability, analysis of algorithms and cryptography. Prerequisites: Mathematics 12; or permission of the instructor. (Offered Fall and Spring)

**61. MULTIVARIABLE CALCULUS II (1.5)**

*Bernoff, Gu, Karp, Su, Yong.* Constrained optimization using Lagrange multipliers; conservative and nonconservative vector fields; Green's theorem; parameterized surfaces and surface integrals; divergence theorem, outline of proof and applications; Stokes' theorem, outline of proof and applications, unification of major vector theorems. Prerequisites: Mathematics 14. (Offered first half of Fall semester)

**62. INTRODUCTION TO PROBABILITY AND STATISTICS (1.5)**

*Benjamin, Martonosi, Orrison, Su, Williams.* Sample spaces, events, axioms for probabilities; conditional probabilities and Bayes' theorem; random variables and their distributions, discrete and continuous; expected values, means and variances; covariance and correlation; law of large numbers and central limit theorem; point and interval estimation; hypothesis testing; simple linear regression; applications to analyzing real data sets. Prerequisites: Mathematics 12. (Offered second half of Fall semester)

**63. LINEAR ALGEBRA II (1.5)**

*Benjamin, de Pillis, Gu, Martonosi, Orrison.* General vector spaces and linear transformations; rank-nullity theorem; orthogonal expansion and Fourier coefficients; change of basis and similarity; generalized eigenvalues and eigenvectors; diagonalization of symmetric matrices; applications of eigenvalues to systems of ordinary differential equations; LU, QR, and singular value decomposition theorems; Jordan canonical forms. Prerequisites: Mathematics 12. (Offered first half of Spring semester)

**64. DIFFERENTIAL EQUATIONS II (1.5)**

*Bernoff, Castro, de Pillis, Jacobsen, Levy, Martonosi, Yong.* Linear systems of homogeneous ordinary differential equations, matrix exponential and non-homogeneous linear systems; non-linear systems; equilibrium points and their stability; phase portraits. Prerequisites: Mathematics 12 and Mathematics 13. (Offered second half of Spring semester)

**104. GRAPH THEORY (3)**

*Benjamin, Orrison, Pippenger.* An introduction to graph theory with applications. Theory and applications of trees, matchings, graph coloring, planarity, graph algorithms and other topics. Prerequisites: Mathematics 12 and Mathematics 55. (Offered alternate years)

**106. COMBINATORICS (2)**

*Benjamin, Orrison, Pippenger.* An introduction to the techniques and ideas of combinatorics, including counting methods, Stirling numbers, Catalan numbers, generating functions, Ramsey theory and partially ordered sets. Prerequisites: Mathematics 55; or permission of instructor. (Offered alternate years)



**107. SET THEORY (3)**

*Bull (Pomona)*. Naive set theory, Zermelo-Fraenkel axioms and the axiom of choice; ordinal and cardinal arithmetic; construction of real numbers. Prerequisites: Mathematics 12. (Offered alternate years)

**108. HISTORY OF MATHEMATICS (3)**

*Grabiner (Pitzer)*. A survey of the history of mathematics from antiquity to the present. Topics emphasized will include: the development of the idea of proof, the “analytic method” of algebra, the invention of the calculus, the psychology of mathematical discovery, and the interactions between mathematics and philosophy. Prerequisites: Mathematics 11. (Offered alternate years)

**109. INTRODUCTION TO THE MATHEMATICS OF FINANCE (3)**

*Aksay (CMC)*. This course emphasizes the math used in the valuation of derivative securities. Topics will include partial differential equations (diffusion equation), mathematical modeling of financial derivatives (calls and puts), and numerical methods for solving differential equations; Black-Scholes Model. Prerequisites: Mathematics 63. (Offered alternate years)

**115. FOURIER SERIES AND BOUNDARY VALUE PROBLEMS (3)**

*Bernoff, Castro, Jacobsen, Levy, Yong*. Sturm-Liouville theory, orthogonal expansions, convergence properties of Fourier series, separation of variables for partial differential equations, regular singular point theory, Bessel functions and Legendre polynomials. (May not be included in a mathematics major program. Students may not receive credit for both Mathematics 115 and 180.) Prerequisites: Mathematics 64. (Offered Fall)

**118. MATHEMATICAL BIOLOGY I (2) (Also listed as BIOLOGY 118)**

*de Pillis, Jacobsen, Adolph (Biology), Nadim (CGU/KGI)*. Mathematical models of biological processes emphasizing continuous models. May include models in epidemiology, population dynamics, cancer modeling, and disease treatment modeling. Prerequisites: Mathematics 64, Biology 52; or permission of instructor. (Offered first half of Spring semester)

**119. MATHEMATICAL BIOLOGY II (2) (Also listed as BIOLOGY 119)**

*de Pillis, Jacobsen, Adolph (Biology), Nadim (CGU/KGI)*. Mathematical models of biological processes emphasizing discrete and continuous models. May include one- and two-locus population genetics, metapopulations, and matrix population models as well as models in physiology and neurobiology. Prerequisites: Mathematics 64, Biology 52; or permission of instructor. (Offered second half of Spring semester)

**120. CHIRALITY (2)**

*Flapan (Pomona)*. A structure is chiral if it is different from its mirror image. This interdisciplinary course introduces students to topological and geometric symmetry and provides descriptions of chirality in molecular systems. Connections will be made between the chemical and mathematical theories of chirality. Molecules with interesting topological features will be introduced and their structural behavior discussed. Prerequisites: Mathematics 12. (Offered alternate years in Spring semester)

**123. LOGIC (3)**

*Bull (Pomona)*. Propositional and first order predicate logic. The completeness, compactness and Lowenheim/Skolem theorems. Decidable theories. Applications to other areas of mathematics, e.g., nonstandard analysis. Prerequisites: Mathematics 12. (Offered jointly at Pomona in alternate years)

**131. MATHEMATICAL ANALYSIS I (3)**

*Castro, Karp, Su, S. Grabiner (Pomona), Askoy (CMC)*. Countable sets, least upper bound, and metric space topology including compactness, completeness, connectivity, and uniform convergence. Related topics as time permits. Prerequisites: Mathematics 12 and Mathematics 14. (Offered jointly; Fall semester at Pomona, Spring semester at HMC and CMC)

**132. MATHEMATICAL ANALYSIS II (3)**

*Castro, Su, Radunskaya (Pomona)*. A rigorous study of calculus in Euclidean spaces including multiple Riemann integrals, derivatives of transformations and the inverse function theorem. Prerequisites: Mathematics 131. (Offered jointly; Fall semester at HMC, second semester at Pomona)

**136. COMPLEX VARIABLES AND INTEGRAL TRANSFORMS (3)**

*Gu, Jacobsen, Karp, Yong*. Complex differentiation, Cauchy-Riemann equations, Cauchy integral formulas, residue theory, Taylor and Laurent expansions, conformal mapping, Fourier and Laplace transforms, inversion formulas, other integral transforms, applications to solutions of partial differential equations. Prerequisites: Mathematics 64. (Offered Fall)

**137. GRADUATE ANALYSIS I (3) (Also listed as MATHEMATICS 331)**

*Castro, Krieger, Grabiner (Pomona), O'Neill (CMC)*. Abstract Measures, Lebesgue measure, and Lebesgue-Stieltjes measures on  $\mathbb{R}$ ; Lebesgue integral and limit theorems; product measures and the Fubini theorem; additional topics. Prerequisites: Mathematics 132. (Offered Fall)

**138. GRADUATE ANALYSIS II (3) (Also listed as MATHEMATICS 332)**

*Castro, Krieger, Grabiner (Pomona), O'Neill (CMC)*. Banach and Hilbert spaces;  $L^p$  spaces; complex measures and the Radon-Nikodym theorem. Prerequisites: Mathematics 137 or Mathematics 331. (Offered Spring)

**142. DIFFERENTIAL GEOMETRY (3)**

*Gu, Karp*. Curves and surfaces, Gauss curvature; isometries, tensor analysis, covariant differentiation with application to physics and geometry (intended for majors in physics or mathematics). Prerequisite: Mathematics 64. (Offered Fall)

**143. SEMINAR IN DIFFERENTIAL GEOMETRY (3)**

*Gu*. Selected topics in Riemannian geometry, low dimensional manifold theory, elementary Lie groups and Lie algebra, and contemporary applications in mathematics and physics. Prerequisites: Mathematics 131 or Mathematics 132 or Mathematics 142; recommended Mathematics 147; or permission of instructor. (Offered Spring)

**147. TOPOLOGY (3)**

*Pippenger, Su, Flapan (Pomona)*. Topology is the study of properties of objects preserved by continuous deformations (much like geometry is the study of properties preserved by rigid motions). Hence, topology is sometimes called "rubber-sheet" geometry. This course is an introduction to point-set topology with additional topics chosen from geometric and algebraic topology. It will cover topological spaces, metric spaces, product spaces, quotient spaces, Hausdorff spaces, compactness, connectedness and path connectedness. Additional topics will be chosen from metrization theorems, fundamental groups, homotopy of maps, covering spaces, the Jordan curve theorem, classification of surfaces and simplicial homology. Prerequisites: Mathematics 131; or permission of instructor. (Offered jointly with Pomona; Spring semester)

**148. KNOT THEORY (3)**

*Hoste (Pitzer)*. An introduction to theory of knots and links from combinatorial, algebraic, and geometric perspectives. Topics will include knot diagrams,  $p$ -colorings, Alexander, Jones, and HOMFLY polynomials, Seifert surfaces, genus, Seifert matrices, the fundamental group, representations of knot groups, covering spaces, surgery on knots, and important families of knots. Prerequisites: Mathematics 147 or Mathematics 171; or permission of instructor. (Offered alternate years)

**152. STATISTICAL THEORY (3)**

*Williams, Hardin (Pomona)*. An introduction to the general theory of statistical inference, including estimation of parameters, confidence intervals and tests of hypotheses. Prerequisites: Mathematics 157 or Mathematics 151; or permission of instructor. (Offered jointly; Spring semester at Pomona and CMC)

**156. STOCHASTIC PROCESSES (3)**

*Martonosi, Krieger.* Continuation of Math 157. This course is particularly well suited for those wanting to see how probability theory can be applied to the study of phenomena in fields such as engineering, management science, the physical and social sciences, and operations research. Topics include conditional expectation, Markov chains, Poisson processes, and queuing theory. Additional applications chosen from such topics as reliability theory, Brownian motion, finance and asset pricing, inventory theory, dynamic programming, and simulation. Prerequisites: Mathematics 63 and Mathematics 157; or permission of the instructor. (Offered jointly; Fall semester at HMC)

**157. INTERMEDIATE PROBABILITY (2)**

*Benjamin, Martonosi, Pippenger, Su, Williams.* Continuous random variables, distribution functions, joint density functions, marginal and conditional distributions, functions of random variables, conditional expectation, covariance and correlation, moment generating functions, law of large numbers, Chebyshev's theorem and central-limit theorem. Prerequisites: Mathematics 62; or permission of instructor. (Offered first half of Spring semester)

**158. STATISTICAL DATA ANALYSIS (3)**

*Martonosi, Williams, Hardin (Pomona).* An introduction to analysis of variance (including one-way and two-way fixed effects ANOVA) and linear regression (including simple linear regression, multiple regression, variable selection, stepwise regression and analysis of residual plots). Emphasis will be both on methods and on applications to data using statistical software. Prerequisites: Mathematics 62; or AP Statistics or permission of instructor. (Offered second half of Spring semester, alternate years)

**159. DESIGN AND ANALYSIS OF EXPERIMENTS (2)**

*Martonosi, Williams.* Prior to conducting an experiment, a scientist or engineer must properly structure the trials in order to draw meaningful conclusions from the data s/he collects. This course addresses, from a statistical perspective, how experiments should be designed so that the effects of the factors being tested can be distinguished from one another and from the variability inherent in the system. We will consider several design types, from practical and mathematical standpoints, such as Randomized Blocks, Latin Squares, Two-Level Factorial and Fractional Factorial designs, Response Surface Methods, Random Factors, and Robust Design. Students will use statistical software to analyze real data and complete a term project. Prerequisites: Mathematics 62; or equivalent. (Offered in alternate years, second-half of spring semester)

**164. SCIENTIFIC COMPUTING (3)**

*Bernoff, de Pillis, Levy, Yong.* Computational techniques applied to problems in the sciences and engineering. Modeling of physical problems, computer implementation, analysis of results; use of mathematical software; numerical methods chosen from: solutions of linear and nonlinear algebraic equations, solutions of ordinary and partial differential equations, finite elements, linear programming, optimization algorithms and fast-Fourier transforms. Prerequisites: Mathematics 64 and Computer Science 60; or permission of instructor. (Offered Spring)

**165. NUMERICAL ANALYSIS (3)**

*Bernoff, Castro, de Pillis, Yong.* An introduction to the analysis and computer implementation of basic numerical techniques. Solution of linear equations, eigenvalue problems, local and global methods for non-linear equations, interpolation and approximate integration. Prerequisites: Mathematics 64; or permission of instructor. (Offered Fall)

**167. COMPLEXITY THEORY (3) (Also listed as COMPUTER SCIENCE 142)**

*Pippenger, Libeskind-Hadas (Computer Science), Bull (Pomona).* Specific topics include finite automata, pushdown automata, Turing machines, and their corresponding languages and gram-

mars; undecidability; complexity classes, reductions, and hierarchies. Prerequisites: Computer Science 81. (Offered Fall)

**168. ALGORITHMS (3) (Also listed as COMPUTER SCIENCE 140)**

*Pippenger, Sweedyk (Computer Science), Libeskind-Hadas (Computer Science)*. Algorithm design, computer implementation, and analysis of efficiency. Discrete structures, sorting and searching, time and space complexity, and topics selected from algorithms for arithmetic circuits, sorting networks, parallel algorithms, computational geometry, parsing, and pattern-matching. Prerequisites: Mathematics 55 and Computer Science 60 and Mathematics 131. (Offered Fall and Spring)

**171. ABSTRACT ALGEBRA I (3)**

*Benjamin, Karp, Orrison, Shabriari (Pomona), Sarkis (Pomona)*. Groups and isomorphism theorems. Rings and other structures. Prerequisites: Mathematics 12 and Mathematics 55; or permission of instructor. (Offered jointly; Fall semester at HMC and CMC, Spring semester at Pomona)

**172. ABSTRACT ALGEBRA II: GALOIS THEORY (3)**

*Orrison, Su, Shabriari (Pomona), Sarkis (Pomona)*. Selected topics in the theories of rings, modules, groups, and fields, such as Galois theory of equations and the structure of finitely generated modules over Euclidean and/or principal ideal domains with application to linear algebra and finitely generated abelian groups. Prerequisites: Mathematics 171. (Offered jointly; Spring semester at HMC)

**173. ADVANCED LINEAR ALGEBRA (3)**

*Gu, Orrison*. Topics from among the following: Similarity of matrices and the Jordan form, the Cayley-Hamilton theorem, limits of sequences and series of matrices; the Perron-Frobenius theory of nonnegative matrices, estimating eigenvalues of matrices; stability of systems of linear differential equations and Lyapunov's Theorem; iterative solutions of large systems of linear algebraic equations. Prerequisites: Mathematics 131; or equivalent. (Offered jointly in alternate years)

**174. ABSTRACT ALGEBRA II: REPRESENTATION THEORY (3)**

*Karp, Orrison, Su*. The topics covered will include group rings, characters, orthogonality relations, induced representations, applications of representation theory, and other select topics from module theory. Prerequisite: Math 171. 3 credit hours. This course is independent from Math 172 and may be taken by students who have taken Math 172. (Offered jointly; Spring by HMC and Pomona Colleges)

**175. NUMBER THEORY (3)**

*Benjamin, Touse (Scripps)*. Properties of integers, congruences, Diophantine problems, quadratic reciprocity, number theoretic functions, primes. Prerequisites: Mathematics 55; or permission of instructor. (Offered Spring; offered jointly Fall semester at Scripps)

**180. APPLIED ANALYSIS (3)**

*Bernoff, Castro, Jacobsen, Levy*. Selected topics from Fourier series, Fourier and Laplace transforms, ordinary and partial differential equations. Prerequisites: Mathematics 131. (Offered Fall)

**181. DYNAMICAL SYSTEMS (3)**

*Bernoff, Jacobsen, Levy, Radunskaya (Pomona)*. Existence and uniqueness theorems for systems of differential equations, dependence on data, linear systems, fundamental matrices, asymptotic behavior of solutions, stability theory, and other selected topics, as time permits. Prerequisites: Mathematics 115 or Mathematics 180. (Offered jointly; Fall semester at Pomona, Spring semester at HMC in alternate years)

**182. PARTIAL DIFFERENTIAL EQUATIONS (3)**

*Bernoff, Castro, Jacobsen, Levy*. Theory and applications of quasi-linear and linear equations of first order, including systems. Theory of higher order linear equations, including classical

methods of solutions for the wave, heat, and potential equations. Prerequisites: Mathematics 115 or Mathematics 180. (Offered Spring; offered in alternate years)

**185. INTRODUCTION TO WAVELETS AND THEIR APPLICATIONS (2)**

*Jacobsen, Yong.* An introduction to the mathematical theory of wavelets, with applications to signal processing, data compression and other areas of science and engineering. Prerequisites: Mathematics 115 or Mathematics 180; (Fourier series) or permission of instructor.

**187. OPERATIONS RESEARCH (3)**

*Benjamin, Martonosi, Shahriari (Pomona).* Linear, integer, non-linear and dynamic programming, classical optimization problems, and network theory. Prerequisites: Mathematics 12. (Offered jointly; Fall semester at HMC/CMC, alternate years)

**188. SOCIAL CHOICE AND DECISION MAKING (3) (Also listed as INTEGRATIVE EXPERIENCE 198)**

*Su.* Basic concepts of game theory and social choice theory, representations of games, Nash equilibria, utility theory, non-cooperative games, cooperative games, voting games, paradoxes, Arrow's impossibility theorem, Shapley value, power indices, "fair division" problems, and applications. Prerequisites: Mathematics 63; recommended Mathematics 55; or permission of instructor. (Offered alternate years in Spring semester)

**189. SPECIAL TOPICS IN MATHEMATICS (1-3)**

*Staff.* A course devoted to exploring topics of current interest to faculty or students. Recent topics have included: Algebraic Geometry, Algebraic Topology, Complex Dynamics, Fluid Dynamics, Games and Gambling, Mathematical Toys, and Riemann Zeta Functions. Prerequisites: permission of instructor.

**191. PUTNAM SEMINAR (1)**

*Bernoff, Pippenger, Su.* This seminar meets one evening per week during which students solve and present solutions to challenging mathematical problems in preparation for the Putnam Examination, a national undergraduate mathematics competition. (Offered Fall)

**192. PROBLEM SOLVING SEMINAR (1)**

*Bernoff.* This seminar meets one evening per week during which students solve and present solutions to problems posed in mathematics journals, such as the American Mathematical Monthly. Solutions are submitted to these journals for potential publication. (Offered Spring)

**193. MATHEMATICS CLINIC (3)**

*Gu and staff.* Participation in projects or problems with a substantial mathematical and/or computational content. Students typically work in teams of two to four, with appropriate faculty supervision. Problems vary considerably, depending upon student interest and program of study, but normally require computer implementation and documentation. All work required for completion of Mathematics Clinic must be completed in a form acceptable to the clinic advisor by noon on Monday of the week prior to graduation. (Offered Fall and Spring)

**196. INDEPENDENT STUDY (1-5)**

*Staff.* Readings in special topics. Prerequisites: permission of department. (Offered Fall and Spring)

**197. SENIOR THESIS (3)**

*Staff.* A research or expository paper based on independent work done under the supervision of a faculty member. The paper must be submitted to the mathematics department in a form suitable for publication in a mathematics journal. Prerequisites: permission of department. (Offered Fall and Spring)

**198. UNDERGRADUATE MATHEMATICS FORUM (1)**

*Castro, Jacobsen, Levy, Martonosi, Orrison, Yong.* The goal of this course is to improve students' ability to communicate mathematics, both to a general and technical audience. Students will present material on assigned topics and have their presentations evaluated by students and

faculty. This format simultaneously exposes students to a broad range of topics from modern and classical mathematics. Prerequisites: Required for all majors; recommended for all joint CS-math majors and mathematical biology majors, typically in the junior year. (Offered Fall and Spring)

**199. MATH COLLOQUIUM (0)**

*Jacobsen, Martonosi, Orrison.* Students will attend weekly Claremont Math Colloquium, offered through the cooperative efforts of the mathematics faculty at the Claremont Colleges. Most of the talks discuss current research in mathematical sciences, and are accessible to undergraduates. (Offered Fall and Spring)

In addition to the courses described above, the graduate program in mathematics at the Claremont Graduate University offers a variety of courses. Graduate courses most often taken by advanced students at HMC include:

331. MEASURE AND INTEGRATION

332. FUNCTIONAL ANALYSIS

334. ADVANCED COMPLEX ANALYSIS

351. TIME SERIES ANALYSIS

362. NUMERICAL METHODS FOR PDES

382. PERTURBATION AND ASYMPTOTICS

**PHYSICAL EDUCATION**

*Professors Sutton (Chair), Burton, Calichman, Candaele, Goldhammer, Graves, Griffiths, Hipple, Lonzo, Miles, M. Retzlaff, S. Retzlaff, Sanchez, Scalmanini, Settles, Town.*

**COURSES**

HMC students must complete three semester-long Physical Education (PE) courses to graduate. One of these three is a required physical fitness course for which students register in their first year; the other two are electives. No unit credit is given for these courses. Students must register for these courses through the Harvey Mudd College Registrar's Office.

**PHYSICAL FITNESS COURSE**

Information about physical fitness; testing of physical strengths and weaknesses; aerobic training; development of the skills for a lifelong physical fitness program; introduction of students to the Claremont-Mudd-Scripps (CMS) PE/Athletic program, faculty, and facilities. The Harvey Mudd College Registrar distributes a list of approved fitness courses to first-year students each semester. These approved Joint PE (JP) fitness courses are taught by CMS PE Department full-time faculty. Season-long participation in an intercollegiate or club sports team approved by the CMS Athletic Department counts for the physical fitness course requirement, but the season-long participation should occur in the student's first year.

**ELECTIVE COURSES**

Semester-long courses in activities such as tennis, badminton, golf, bicycling, self defense, aerobics, running programs, and weight training with free weights and machines. Fitness training with an associated ROTC program or completion of a physical education course at Pomona College also fulfills a PE elective requirement. One season-long participation in an approved intercollegiate or club sports team may count for the two required elective courses.

## PHYSICS

*Professors* Townsend (Chair), Chen, Donnelly, Eckert, Edwards, Esin, Haskell, Lynn, Lyzenga, Saeta, Sahakian and Sparks.

The physics program at Harvey Mudd College provides depth and breadth in both classical and modern physics through lecture-discussion courses, laboratories and joint student-faculty research. The program is designed to serve as a strong foundation for graduate work or employment in physics and other technical fields.

A set of core courses is required of all physics majors; in addition, a variety of elective courses enables students to select a program to suit their interests and their educational and employment objectives. Laboratory courses in both introductory and advanced physics include experience with electronics, classical and modern optics, solid-state physics, and atomic and nuclear physics. Special courses and reading courses provide the opportunity for study in advanced areas normally offered only in graduate programs.

Each student is encouraged to do individual experimental or theoretical research in an area of his/her special interest, in conjunction with a faculty member. Current student-faculty research areas include observational astronomy, astrophysics, biophysics, computational physics, field theory, general relativity and cosmology, geophysics, laser and atomic spectroscopy, magnetism, particle physics, quantum optics, quantum theory and solid-state physics. In some of the optional programs, physics majors may elect to do research in biology or chemistry or participate in Computer Science, Engineering, Mathematics or Physics Clinic team projects.

A physics major must satisfactorily complete the following courses: Physics 52, 54, 111, 116, 133, 134, 151, 195 (taken twice), 196 (taken twice), Mathematics 115 or 180. In addition, a physics major must satisfactorily complete the courses in one of the sets listed below. The first set constitutes the standard program in physics, but majors with a particular interest in one of the physics-related fields may substitute that set of courses for the standard program. A final oral and written report of completed research, Clinic or independent project work is required for all physics majors. The Physics 195/196 Colloquium requirement is waived for any semester during which a student is away on a study abroad program.

### STANDARD PROGRAM

Two half-courses; Physics 117, 181; and at least 3 units of Physics 191–192.

### OPTIONAL PROGRAMS

**Applied Physics:** Physics 117; two physics half-courses; Physics 181; and 3 units of Physics 191-192 or an approved Clinic.

**Astrophysics:** Astronomy 62; Physics 117; Physics 181 or Astronomy 101; two astronomy or physics half-courses; and at least 3 units of Physics 191–192.

**Biophysics:** Physics 174; Physics 181 or an approved biology laboratory; three of the following—two approved biology courses, Physics 117, Chemistry 56; and at least 3 units of Physics 191-192 or Biology 161-162.

**Chemical Physics:** Chemistry 51; Physics 117; Physics 161; Chemistry 168; Physics 181 or an approved chemistry laboratory; and at least 3 units of Physics 191–192 or Chemistry 151–152.

**Education:** Education 170G at Claremont Graduate University, to be taken in the junior year or earlier; 3 units of Physics 183–184; and 9 units of approved technical electives to add breadth. Recommended courses include Astronomy 62; Physics 166; Physics 170 or Computer Science 60; Biology 108; and Chemistry 51 or 103.

**Geophysics:** Physics 154 or 117; 166; 181; and at least 3 units of Physics 191–192 and one approved geology course.

**Mathematical Physics:** One physics half-course; Physics 117 or Physics 154, two additional courses, to be chosen from Physics 117, Physics 154, and mathematics courses numbered 100 or higher that are not included in the physics major requirements; and at least 3 units of Physics 191–192 or Mathematics 197 or an approved Clinic. Note: Physics 170 can be substituted for Physics 133 in this option provided Physics 170 is not used to meet the physics half-course requirement.

**Physics and Computers:** Physics 117 or two physics half-courses; Physics 170; Computer Science 60; at least 3 units of Physics 191–192 or an approved Clinic; two electives chosen from Mathematics 165, Engineering 157, or any computer science course numbered 70 or higher. Students planning a career or graduate studies in computer applications to problems in physics or engineering would particularly benefit from Physics 117 and Mathematics 165. Students planning graduate studies in computer science should take Computer Science 105 and additional computer science courses as time permits.

Changes in any of the above programs may be made by petition to the Department of Physics.

Most physics majors go on to graduate work in physics; allied fields such as astronomy, biophysics, geophysics, oceanography and optics; or applied areas such as computer science, electronics or engineering. Others undertake advanced study in medicine or law, or seek immediate employment in a variety of technical fields. Students who intend to go on to graduate study are advised to include Physics 154 and either Physics 161 or 168 in their program.

## PHYSICS COURSES

### 23. SPECIAL RELATIVITY AND AN INTRODUCTION TO QUANTUM MECHANICS (2)

*Townsend, staff.* Time dilation, length contraction, Lorentz transformations, spacetime, relativistic momentum and energy; the wave and particle nature of light, the principles of quantum mechanics as seen in the sum-over-paths approach to the subject. (Fall)

### 24. MECHANICS AND WAVE MOTION (3)

*Staff.* Kinematics, dynamics, linear and angular momentum, work and energy, harmonic motion, waves and sound. (Spring)

### 28. PHYSICS LABORATORY (1)

*Staff.* Experiments in mechanics using digital electronic measuring devices. Corequisite with Physics 24. (Spring)

### 51. ELECTROMAGNETIC THEORY AND OPTICS (3)

*Donnelly, Esin, Sparks, staff.* An introduction to electricity and magnetism leading to Maxwell's electromagnetic equations in differential and integral form. Selected topics in physical optics. Prerequisites: Physics 23–24 and Mathematics 14. (Fall)

### 52. QUANTUM PHYSICS (3)

*Staff.* The development and formulation of quantum mechanics, and the application of quantum mechanics to topics in atomic, solid state, nuclear and particle physics. Prerequisites: Physics 51; Mathematics 63 and 64 or concurrently. (Spring)

### 53. ELECTRICITY AND OPTICS LABORATORY (1)

*Lynn, staff.* Electrical and magnetic techniques in such measurements as an absolute determination of electric current and the earth's magnetic field; RC and RLC circuits; experiments



in physical optics, including image formation, Fraunhofer diffraction and spectroscopy. Prerequisite: Physics 51 or concurrently. (Fall)

#### 54. MODERN PHYSICS LABORATORY (1)

*Staff.* Classical experiments of modern physics, including thermal radiation and Rutherford scattering. Nuclear physics experiments, including alpha, beta and gamma absorption, and gamma spectra by pulse height analysis. Analysis of the buildup and decay of radioactive nuclei. Prerequisites: Physics 53, Physics 52 or concurrently. (Spring)

#### 80. TOPICS IN PHYSICS (3)

*Saeta, staff.* An area of physics is studied, together with its applications and social impact. Possible areas include energy and the environment, and global warming and climate change. Active participation and group activities are stressed. Prerequisite: Physics 51. (Spring)

#### 111. THEORETICAL MECHANICS (3)

*Saeta.* The application of mathematical methods to the study of particles and of systems of particles; Newton, Lagrange and Hamilton equations of motion; conservation theorems; central force motion, collisions, damped oscillators, rigid body dynamics, systems with constraints, variational methods. Prerequisites: Physics 23–24 and Mathematics 12, 13 and 14. (Fall)

#### 116. QUANTUM MECHANICS (3)

*Townsend.* The elements of nonrelativistic quantum mechanics. Topics include the general formalism, one-dimensional and three-dimensional problems, angular momentum states, perturbation theory and identical particles. Applications to atomic and nuclear systems. Prerequisites: Physics 52. (Spring)

#### 117. STATISTICAL MECHANICS AND THERMODYNAMICS (3)

*Lyzenga.* Classical and quantum statistical mechanics, including their connection with thermodynamics. Kinetic theory of gases. Applications of these concepts to various physical systems. Prerequisites: Physics 52 and Mathematics 62. (Fall)

#### 133. ELECTRONICS LABORATORY (1)

*Chen, Sparks.* An intermediate laboratory in electronics involving the construction and analysis of rectifiers, filters, transistor and operational amplifier circuits. Prerequisite: Physics 53. (Fall)

#### 134. OPTICS LABORATORY (2)

*Haskell, staff.* A laboratory-lecture course on the techniques and theory of classical and modern optics. Topics of study include diffraction, interferometry, Fourier transform spectroscopy, grating spectroscopy, lasers, coherence of waves and least-squares fitting of data. Prerequisites: Physics 51, 53. (Spring)

#### 151. ELECTROMAGNETIC FIELDS (3)

*Edwards.* The theory of static and dynamic electromagnetic fields. Topics include multipole fields, Laplace's equation, the propagation of electromagnetic waves, radiation phenomena and the interaction of the electromagnetic field with matter. Prerequisites: Physics 111 or 116 and Mathematics 115. (Fall)

#### 154. FIELDS AND WAVES (3)

*Lyzenga.* The theory of deformable media. Field equations for elastic and fluid media and for conducting fluids in electromagnetic fields. Particular emphasis on body and surface wave solutions of the field equations. Prerequisite: Mathematics 115. (Spring)

#### 161. TOPICS IN QUANTUM THEORY (2)

*Lynn.* Scattering, including the Born approximation and partial wave expansion. Path integrals. Time-dependent perturbation theory. Quantum theory of the electromagnetic field. Prerequisite: Physics 116. (Fall)

**162. SOLID STATE PHYSICS (2)**

*Chen.* Selected topics in solid-state physics, including lattice structure, lattice excitations, and the motion and excitations of electrons in metals. Prerequisite: Physics 117 or equivalent. (First half of Spring)

**164. PARTICLE PHYSICS (2)**

*Edwards.* Topics in high-energy physics including the fundamental interactions, space-time symmetries, isospin, SU(3) and the quark model and the standard model. Prerequisite: Physics 116. (First half of Spring)

**166. GEOPHYSICS (2)**

*Lyzenga.* Special topics in geophysical methods and their application to construction of earth models. Prerequisite: Physics 23–24.

**168. ELECTRODYNAMICS (2)**

*Staff.* Selected topics in electrodynamics including wave propagation in material media. Prerequisite: Physics 151. (First half of Spring.)

**170. COMPUTATIONAL METHODS IN PHYSICS (2)**

*Staff.* Typical numerical methods for solving a wide range of problems of current interest in physics. Examples are drawn from mechanics, electromagnetism, quantum mechanics, statistical mechanics, solid state and chemical physics. Prerequisites: Physics 52 and the ability to program. (Spring)

**172. GENERAL RELATIVITY AND COSMOLOGY (2)**

*Sabakian.* The principle of equivalence, Riemannian geometry, and the Schwarzschild and cosmological solutions of the field equations. Prerequisite: Physics 111 or permission of instructor. (Second half of Spring)

**174. BIOPHYSICS (2)**

*Haskell.* Selected topics in biophysics reflecting active research in the field. Possible topics: imaging techniques, membrane biophysics, sensory transduction, motility. Seminar format. Prerequisite: Biology 52, Physics 51. (Second half of Spring)

**178. SPECIAL TOPICS IN PHYSICS (1-2)**

*Staff.* The study of an area in physics not covered in other courses, chosen each year at the discretion of the Department of Physics. Prerequisites: Depend upon the topic offered.

**181. ADVANCED LABORATORY (2)**

*Haskell.* Experiments are selected from the fields of nuclear and solid-state physics, utilizing multichannel and time coincidence nuclear instrumentation and x-ray, optical spectrophotometer and thermoluminescent observations of the properties of solids. Prerequisite: Physics 134. (Fall)

**183, 184. TEACHING INTERNSHIP (3)**

*Staff.* An Introduction to K–12 classroom teaching and curriculum development. Internship includes supervision by an appropriate K–12 teacher and a member of the physics department and should result in a report of a laboratory experiment, teaching module, or other education innovation or investigation. Internship includes a minimum of three hours per week of classroom participation. Prerequisite: Education 170G at Claremont Graduate University, or corequisite by permission of instructor. (Fall and Spring)

**191, 192. RESEARCH (1-3)**

*Staff.* Original experimental or theoretical investigations in physics undertaken in consultation with a faculty member. Projects may be initiated by the student or by a faculty member. Present faculty research areas include astronomy, atomic and nuclear physics, optics, solid-state and low-temperature physics, general relativity, quantum mechanics, particle physics, geophysics and biophysics. (Fall and Spring)

**193, 194. PHYSICS CLINIC (3)**

*Haskell.* Team projects in applied physics, with corporate affiliation. Prerequisite: Upper-division standing. (Fall and Spring)

**195, 196. PHYSICS COLLOQUIUM (0)**

*Staff.* Oral presentations and discussions of selected topics, including recent developments. Participants include physics majors, faculty members and visiting speakers. Required for all junior and senior physics majors. No credit.

**197, 198. READINGS IN PHYSICS (1-3)**

*Staff.* Directed reading in selected topics. Open to seniors only. 1–3 credit hours per semester.

**Astronomy****62. INTRODUCTION TO ASTROPHYSICS (3)**

*Esin.* A general survey of modern astrophysics. Topics covered include electromagnetic radiation, gravitation, stellar structure and evolution, the interstellar medium and the birth of stars, supernovae and the death of stars (including the physics of neutron stars and black holes), synthesis of the elements, and the formation, structure and evolution of galaxies and of the universe. Offered jointly with Pomona and Joint Sciences. Prerequisite: Physics 51 or equivalent. (Spring)

**101. OBSERVATIONAL ASTRONOMY (3)**

*Esin.* Complete survey of the techniques of observational astronomy, including optical, infrared, radio and X-ray astronomy. Four to six observational projects, including observations using The Claremont Colleges Table Mountain Observatory, plus computer projects analyzing radio and infrared data. Observational techniques used include CCD photometry, stellar spectroscopy, radio interferometry and analysis of infrared satellite data. In addition to observational techniques, the course will also cover the physics of basic emission mechanisms at the various wavelengths. Offered jointly with Pomona and Joint Sciences. Prerequisite: Astronomy 62 or permission of the instructor. (Fall)

**120. STAR FORMATION AND THE INTERSTELLAR MEDIUM (2)**

*Staff.* A survey of formation of stars and planets in the universe, the galactic interstellar medium, and the theoretical and observational aspects of understanding the physical state of matter in the galaxy. Topics include formation and detection of extrasolar planets and protostars, radio and infrared diagnostics of star forming regions and interstellar clouds, optical emission and absorption-line studies of the interstellar medium, and the role of supernovae in evolution of the interstellar medium and star formation. Offered jointly with Pomona and Joint Sciences. Prerequisites: Astronomy 62, Physics 52 or equivalent. (Offered alternate years; Spring)

**121. COSMOLOGY AND EXTRAGALACTIC ASTROPHYSICS (2)**

*Staff.* Examines the large-scale structures of the universe and the evolution of the universe from the Big Bang to the present epoch. Topics include alternate cosmologies, dark matter, cosmic background radiation, and formation and evolution of galaxies and clusters of galaxies. Offered jointly with Pomona and Joint Sciences. Prerequisites: Astronomy 62, Physics 52 or equivalent. (Offered alternate years; Spring)

**122. HIGH ENERGY ASTROPHYSICS (2)**

*Esin.* A survey of the physical processes and astrophysical systems that produce high-energy photons and presents a survey of the new ultraviolet, x-ray and gamma-ray observations. Topics include active galactic nuclei, black holes, neutron stars, supernova remnants and cosmic rays. Offered jointly with Pomona and Joint Sciences. Prerequisites: Astronomy 62, Physics 52 or equivalent. (Offered alternate years; Spring)

**123. STELLAR STRUCTURE AND EVOLUTION (2)**

*Staff:* A rigorous treatment of stellar atmospheres and radiative transfer. Topics include spectral line formation, stellar energy generation, evolution on and away from the main sequence, and the internal structures of stars and other self-gravitating objects. Offered jointly with Pomona and Joint Sciences. Prerequisites: Astronomy 62, Physics 52 or equivalent. (Offered alternate years; Spring)

**124. PLANETARY ASTROPHYSICS (2)**

*Staff:* The physics and chemistry of the planets, their natural satellites and the small bodies of the solar system. Topics include evolution and dynamics of planetary atmospheres; planetary interiors, alteration processes on planetary surfaces; the formation and dynamics of the solar system, evolution of small bodies and extra-solar systems. Half-course. Prerequisites: Physics 101, Astronomy 1 or 62 and Mathematics 60. Offered jointly with HMC and Joint Sciences. (Offered alternate years)

**INTERDISCIPLINARY PROGRAMS****JOINT MAJOR IN CHEMISTRY AND BIOLOGY**

The disciplines of biology and chemistry are undergoing remarkable and converging transformations. In response to these new developments, Harvey Mudd College has established a unique opportunity for undergraduate students at the interface of biology and chemistry.

The goal is to enable students to think at the interface, to effortlessly move back and forth between chemistry and biology. They will have the background to appreciate the biological context of their research questions and they will have mastered the chemistry fundamentals that underlie the properties and reactions of biomolecules. These successful students will be able to make connections and have insights that are difficult to obtain without a thorough training in both chemistry and biology. The program in Chemistry and Biology will capture the imaginations of talented HMC students and reinforce their abilities to think across disciplines.

Many schools have used the terms “biochemistry” or “biological chemistry” and some of the newer programs call themselves “chemical biology.” But since the boundaries between chemistry and biology as separate disciplines are rapidly dissolving, and students can choose to steer their studies in many directions, we chose to call it simply the “Joint Major in Chemistry and Biology.”

**The Joint Major:**

**CHEMISTRY 51. PHYSICAL CHEMISTRY**

**CHEMISTRY 53. PHYSICAL CHEMISTRY LABORATORY**

**CHEMISTRY 56. CARBON COMPOUNDS**

**CHEMISTRY 58. CARBON COMPOUNDS LABORATORY**

**CHEMISTRY 103. CHEMICAL ANALYSIS**

**CHEMISTRY 105. ORGANIC CHEMISTRY**

**CHEMISTRY 109. CHEMICAL ANALYSIS LABORATORY**

**CHEMISTRY 111. ORGANIC CHEMISTRY LABORATORY**

**BIOLOGY 54. BIOLOGY LABORATORY**

**BIOLOGY/CHEMISTRY 182. CHEMISTRY IN LIVING SYSTEMS**

**BIOLOGY/CHEMISTRY 184. METHODS IN BIOCHEMISTRY**

**BIOLOGY 111. MOLECULAR BIOLOGY LABORATORY**

**BIOLOGY 113. MOLECULAR BIOLOGY**

**BIOLOGY/CHEMISTRY 189. TOPICS IN BIOCHEMISTRY AND MOLECULAR BIOLOGY**

One course selected from:

**BIOLOGY 101. COMPARATIVE PHYSIOLOGY**

**BIOLOGY 108. ECOLOGY AND ENVIRONMENTAL BIOLOGY**

**BIOLOGY 109. EVOLUTION**

Five elective credits of upper level Biology courses, to be selected by the student in consultation with her/his adviser. Prior permission from the Department of Biology is required.

Two successive semesters of Biology 191–192 Biology Colloquium and Chemistry 199 Chemistry Seminar (four semesters total).

Two semesters (at least 6 credits total) of Senior Thesis Research (Biology 193–194, or Biology 195–196, or Chemistry 151–152). The senior thesis will have two readers, a mentor from one department and a co-reader from the other department.

NOTE: In order to optimize their opportunities and to enable individual flexibility, students may request to count other courses not currently listed as Biology electives. These other courses might include new Biology courses developed at HMC, cross-listed HMC courses (e.g., topics in biological engineering), and appropriate courses offered by other Claremont Colleges. Prior approval, granted by the faculties of Biology and Chemistry, will be required to substitute electives.

### **JOINT MAJOR IN COMPUTER SCIENCE AND MATHEMATICS**

The Joint Major in Computer Science and Mathematics is cooperatively administered by the Computer Science and Mathematics Departments. The purpose of the Joint Major is to provide a program of study tailored to students who are interested in the interdisciplinary connections between computer science and mathematics. Depending on how electives are selected, the program described below would position successful majors for graduate studies in either computer science or mathematics, or for immediate employment.

The Joint Major in Computer Science and Mathematics degree program has various components: the kernel courses in computer science and mathematics; more advanced courses in computer science and in mathematics; Clinic; and electives. Each of these components is described as follows.

Four kernel courses in computer science and mathematics:

**MATHEMATICS 55. DISCRETE MATHEMATICS**

**COMPUTER SCIENCE 60. PRINCIPLES OF COMPUTER SCIENCE or**

**COMPUTER SCIENCE 42. PRINCIPLES AND PRACTICES OF COMPUTER SCIENCE**

**COMPUTER SCIENCE 81. COMPUTABILITY AND LOGIC**

**MATHEMATICS 168 or CS 140. ALGORITHMS**

Three computer science courses:

**COMPUTER SCIENCE 70. DATA STRUCTURES AND PROGRAM DEVELOPMENT**

**COMPUTER SCIENCE 105. COMPUTER SYSTEMS**

**COMPUTER SCIENCE 131. PROGRAMMING LANGUAGES**

Three mathematics courses:

**MATHEMATICS 131. ANALYSIS I**

**MATHEMATICS 165. NUMERICAL ANALYSIS or MATH 164: SCIENTIFIC COMPUTING**

**MATHEMATICS 171. ABSTRACT ALGEBRA I**

**Clinic**

Two semesters are required, ordinarily taken during the senior year. Joint Majors will work on a Clinic project either from mathematics, computer science or on an interdisciplinary project. Software Development, CS 121, is strongly recommended for students wishing to take CS Clinic.

**Electives**

Eight units of upper division technical electives: these electives can be from mathematics, computer science or other departments (but must include at least two units of mathematics and at least two units of computer science), and must be chosen with approval of the faculty advisers so that a coherent program is formed. Two semesters of senior thesis research can count towards this requirement. Note that Complexity Theory can be taken as either Math 167 or CS 142.

**Colloquia**

Students are required to attend two semesters of Computer Science Colloquium (CS 193–196), one semester of Mathematics Colloquium (Math 199) and one semester of Math Forum (Math 198).

Students in the Joint Major program will have faculty advisers from both the mathematics and the computer science departments. For further descriptions of the computer science and mathematics programs, please refer to their separate sections in this catalogue.

**MATHEMATICAL BIOLOGY**

Mathematical and computational components are vital to many areas of contemporary biological research, such as genomics, molecular modeling, structural biology, ecology, evolutionary biology, and systems analysis of neurobiology, physiology and metabolism. Students interested in the interface between biology and mathematics may pursue the Mathematical Biology Major, which is jointly administered by the Departments of Biology and Mathematics.

The Mathematical Biology Major prepares graduates for further study in either biology or applied mathematics or for employment in industry. HMC's Common Core provides mathematical biology majors with a strong multidisciplinary foundation, and the college offers many opportunities for students to engage in interdisciplinary research in biomathematics and quantitative biology. Students who choose this major become immersed in the scientific and intellectual cultures of both biology and mathematics, and the major is sufficiently flexible to allow students to concentrate in a particular area of mathematical biology. Students in this major have both a Biology adviser and a Mathematics adviser, who will help them plan a program tailored to their interests and goals.

**Mathematical Biology Major Requirements**

Mathematics (10 units)—

**MATHEMATICS 55. DISCRETE MATH (3)**

**MATHEMATICS 131. ANALYSIS I (3)**

Two mathematics electives (4 units); recommended courses include

**MATHEMATICS 106. COMBINATORICS**

**MATHEMATICS 120. CHIRALITY**

**MATHEMATICS 151. PROBABILITY**

**MATHEMATICS 152. MATHEMATICAL STATISTICS**

**MATHEMATICS 156. STOCHASTIC PROCESSES**

MATHEMATICS 158. APPLIED STATISTICS  
 MATHEMATICS 159. DESIGN AND ANALYSIS OF EXPERIMENTS  
 MATHEMATICS 173. ADVANCED LINEAR ALGEBRA  
 MATHEMATICS 180. APPLIED ANALYSIS  
 MATHEMATICS 181. DYNAMICAL SYSTEMS  
 MATHEMATICS 182. PARTIAL DIFFERENTIAL EQUATIONS  
 MATHEMATICS 185. WAVELETS  
 MATHEMATICS 187. OPERATIONS RESEARCH  
 MATHEMATICS 188. SOCIAL CHOICE AND DECISION MAKING

Biology (15 Units)—

**BIOLOGY 54. BIOLOGY LABORATORY (1 UNIT)**

Three of the following five courses (9 units)

**BIOLOGY 101. COMPARATIVE PHYSIOLOGY**  
**BIOLOGY 108. ECOLOGY AND ENVIRONMENTAL BIOLOGY**  
**BIOLOGY 109. EVOLUTIONARY BIOLOGY**  
**BIOLOGY 113. MOLECULAR BIOLOGY**  
**BIOLOGY 115. NEUROBIOLOGY**

Two biology electives (one seminar and one lab, 5 units)

Computation (3 units)—

One of the following:

**MATHEMATICS 164. SCIENTIFIC COMPUTING (3) or**  
**MATHEMATICS 165. NUMERICAL ANALYSIS (3) or**  
**MATHEMATICS 168/CS 140. ALGORITHMS (3) or**  
**BIOLOGY 188. COMPUTATIONAL BIOLOGY (3) or**

Another computation course with approval of the advisors

Mathematical Biology (4 units)—

**MATHEMATICS 118. MATHEMATICAL BIOLOGY I (2)**  
**MATHEMATICS 119. MATHEMATICAL BIOLOGY II (2)**

Additional Requirements (9 units)—

One technical elective, chosen in consultation with student's adviser (3 units)

The elective will typically be an additional mathematics or biology course, but can be another technical course that strengthens the student's area of interest. A few examples of the possible courses are:

**BIOLOGY 153. BIostatISTICS**  
**COMPUTER SCIENCE 60. PRINCIPLES OF COMPUTER SCIENCE or**  
**COMPUTER SCIENCE 65: PRINCIPLES AND PRACTICES OF COMPUTER SCIENCE**  
**COMPUTER SCIENCE 152. NEURAL NETWORKS**  
**CHEMISTRY 51. PHYSICAL CHEMISTRY: THERMODYNAMICS AND KINETICS**  
**CHEMISTRY 56. CARBON COMPOUNDS**  
**BIOLOGY/CHEMISTRY 182. CHEMISTRY IN LIVING SYSTEMS**

Two semesters of Senior Thesis Research (Biology 193–194 or Mathematics 197) or Clinic (6 units)

### Colloquia

**BIOLOGY 191–192: BIOLOGY COLLOQUIUM** (two semesters) and

**MATHEMATICS 198, 199:** Two semesters of Math Colloquium (Math 199) or one semester of Math 199 and one semester of Math Forum (Math 198).

For further information, contact the mathematical biology advisers Professors Stephen Adolph (Biology), Lisette de Pillis (Mathematics), and Jon Jacobsen (Mathematics).

## OTHER PROGRAMS

### INDIVIDUAL PROGRAM OF STUDIES

Some students find that concentration in one of the majors offered at HMC does not meet their educational goals. As an alternative, any student may devise an individual program of study (IPS) designed to serve his/her academic interests. An IPS program is initiated by the student; it must be consistent with the nature and strengths of the college, but it may cross departmental and even college lines.

An individual program of study must have the following characteristics:

(1) The program must be constructed predominantly from the disciplines of science and engineering and be consistent with the purposes of Harvey Mudd College. It must differ from the other majors in a significant way and must have the approval of a faculty member and the dean of faculty. Each student in the program must have two faculty advisers, one from the Humanities, Social Sciences, and the Arts Department and one from one of the technical departments.

(2) The program should contain at least 14 courses (42 credit hours) that make up a coherent set. Flexibility to choose among a large number of courses should not be at the expense of depth of concentration. Thus, at least two of the courses of this requirement should be taken in each of the last four semesters, and at least three of the courses should constitute a sequence.

(3) At least seven of the courses submitted under requirement (2) above must be taken at Harvey Mudd College.

(4) A student may not enter IPS after the sixth semester without prior approval by the Scholarly Standing Committee.

Many individual programs of study are interdisciplinary in nature. For example, a program may center on a field combining two of the traditional majors or on a field in science or engineering that is only partially covered by one of the majors. Alternatively, a program may seek to relate mathematics, physical science or engineering to an area of the social sciences or humanities. As illustrations of these possibilities, students have designed programs in architecture, environmental studies, geology, and politics and technology.

### OFF-CAMPUS MAJOR

Students may also choose to complete an off-campus major at one of the other Claremont Colleges in order to satisfy the “major” component of the curriculum. In this case, the student must also complete a minor in one of the Harvey Mudd College major-granting departments, along with all other graduation requirements, including the Common Core, the Integrative Experience and the program in Humanities, Social Sciences, and the Arts.

An off-campus major (OCM) is overseen by the Associate Dean for Academic Affairs. A student contemplating an OCM in lieu of a regular HMC major should consult with the Associate Dean about the application process. Since the requirements of the other college may be less than the HMC requirements for an OCM (10 courses), it is important that the student begin this consultation early. All students taking off-campus majors will be required to write a senior thesis or engage in some approved capstone experience (e.g., research, Clinic, internship) as well as completing a technical minor with one of the HMC major departments. In



cases where courses in the off-campus major overlap with either or both of the HMC humanities and social sciences concentration or the HMC minor, up to four overlapping courses may be allowed to satisfy more than one of these departmental graduation requirements. Students are not allowed to seek off-campus majors that are offered as on-campus HMC majors.

## MINORS

A minor is available only to students electing an OCM in lieu of a regular HMC major.

**Biology:** Biology 52 (required in Core), Biology 54, four additional biology courses, at least one of which must be accompanied by a lab.

**Chemistry:** A minor in chemistry shall consist of a coherent group of at least four courses beyond the required Core in two or more areas of chemistry, i.e. analytical, biochemistry, inorganic, organic and physical. The minor must include laboratory experiences in at least two different areas beyond general chemistry (Chemistry 21–22) and be approved by the minor advisor. (Chemistry 56 and Chemistry 58 together count as one course.)

**Computer Science:** Math 55, Computer Science 60 or Computer Science 65, Computer Science 140; one of the following: Computer Science 105, Computer Science 121, Computer Science 131, Computer Science 142; and any other upper division Computer Science course chosen with the consultation and approval of the minor advisor.

**Engineering:** The Engineering minor follows the same three-part model as the major. Students must complete seven engineering courses, as follows:

- Engineering Sciences (2): One of E82, E83, E84, E85, or E106 and one follow-on course in the same discipline as the first; and
- Engineering Systems (2): E59 (taken as part of the college's Common Core); and E101 and Design and Professional Practice (3); One of E4 or E111; and E8 and E80.

**Mathematics:** The student will propose a program designed in consultation with his/her mathematics adviser. Proposals must be approved by the Department of Mathematics Curriculum Committee and should consist of any four upper division Mathematics courses (to include Math 55) which form a coherent concentration or survey program. At least three must be HMC or HMC cooperative courses. Mathematics Clinic and Senior Thesis are normally excluded.

**Physics:** Physics 52, Quantum Physics (three units), and at least nine additional units of physics or astronomy chosen with the help of a physics adviser.

## DUAL DEGREE PROGRAMS

Harvey Mudd College is currently participating in four dual degree programs with other members of The Claremont Colleges:

### 3-2 Program in Economics and Engineering with Claremont McKenna College

HMC offers a 3-2 Program in Economics and Engineering in cooperation with Claremont McKenna College. The program is designed for students who want a liberal arts background, with emphasis on economics and management, and an engineering major. The students spend their first three years at Claremont McKenna College studying mathematics, science, economics, management and general education courses. At the end of the junior year, they may apply as transfer students. Accepted students must complete HMC's requirements for general education and for the engineering major. Because curricular expectations for the 3-2 transfer program are specific, potential applicants are strongly encouraged to consult with the Harvey Mudd College Office of Admission as well as the chairperson of the Department of Engineering.

**3-2 Program in Engineering with Scripps College**

HMC also has a 3-2 program in Engineering with Scripps College. The 3-2 Program with Scripps College does not include the emphasis on economics. The students reside at Scripps College for their first three years and cover a broad range of courses with emphasis in mathematics and science. Students accepted into the 3-2 program must complete HMC's requirements for general education and for the engineering major. Because curricular expectations for the 3-2 transfer program are specific, potential applicants are strongly encouraged to consult with the HMC Office of Admission as well as the chairperson of the Department of Engineering.

**4+1 B.S. + M.B.A. Program**

Harvey Mudd College has an arrangement with the Peter F. Drucker and Masatoshi Ito Graduate School of Management at the Claremont Graduate University whereby qualified students can earn an M.B.A. within 15 months of graduation from HMC. Participation in this program will require early planning so that courses appropriate to both the HMC and Drucker requirements will be taken. Interested students should consult with Professor Gary Evans before the middle of their sophomore year.

**4+1 B.S. + M.S.I.S. Program**

Harvey Mudd College has an arrangement with the School of Information Science at the Claremont Graduate University whereby qualified students can earn an M.S.I.S. in the year after their graduation from HMC. Interested students should discuss this option with their faculty adviser during their sophomore year. The adviser and the student should then consult with the dean of the School of Information Science.

**GRADUATE COURSES FOR UNDERGRADUATES**

Most graduate courses are open to qualified undergraduates with the permission of the instructor.

The following course is open to all undergraduates at The Claremont Colleges:

**EDUCATION 170G. INTRODUCTION TO PUBLIC SCHOOL TEACHING**

Students interested in pre-college teaching should contact the Teacher Education Program at CGU to arrange for courses that will meet the requirements for a teaching credential in California.

**AEROSPACE STUDIES/AFROTC**

The following courses are offered on the Harvey Mudd College campus by instructors from the Air Force ROTC under an agreement with the University of Southern California. A total of six credit units from either Aerospace Studies 300-301 or 400-401 (whichever the HMC student takes in the senior year) can be used toward the credit hour requirements for HMC graduation, but the credits received by those units are not computed as part of the HMC grade point average. All courses are recorded with a letter grade, except Leadership Laboratory courses which are on a pass/fail basis. See the Air Force ROTC site for more information on the program and available scholarships or contact the Detachment 060 Unit Admissions Officer at 213.740.2670.

**100-101. THE AIR FORCE TODAY (1; 0 for HMC student)**

*Staff.* AS 100 is a survey course which explores major topics relating to the Air Force and defense. It focuses on the organizational structure and missions of Air Force organizations; officership and professionalism; and includes an introduction to communicative skills. A weekly Leadership Laboratory affords students an opportunity to practice Air Force customs and courtesies, including physical fitness and drill and ceremonies.

**200–201. USAF AIR AND SPACE POWER (1; 0 for HMC student)**

*Staff:* AS 200 focuses on factors contributing to the development of air power from its earliest beginnings through two world wars, the evolution of air power concepts and doctrine, and an assessment of communicative skills. An additional Leadership Laboratory consisting of Air Force customs and courtesies, Air Force environment, drill and ceremonies, and field training orientation is mandatory.

**300–301. AIR FORCE LEADERSHIP AND MANAGEMENT (3; 0 for HMC student unless taken in senior year)**

*Staff:* AS 300 is a study of leadership and quality management fundamentals, professional knowledge, leadership ethics and communicative skills required of an Air Force junior officer. Case studies are used to examine Air Force leadership and management situations as a means of demonstrating and exercising practical applications of the concepts being studied. A mandatory Leadership Laboratory complements this course by providing advanced leadership experiences in officer-type activities, giving students the opportunity to apply leadership and management principles of this course.

**400–401. NATIONAL SECURITY FORCES IN CONTEMPORARY AMERICAN SOCIETY (3; 0 for HMC student unless taken in senior year)**

*Staff:* AS 400 examines the need for national security, analyzes the evolution and formulation of the American defense policy, strategy and joint doctrine; investigates the methods for managing conflict; overviews regional security, arms control and terrorism. Special topics of interest focus on the military professionalism. Within this structure, continued emphasis is given to the refinement of communicative skills. An additional Leadership Laboratory consisting primarily of advanced leadership experience in officer-type activities is mandatory.

While no credit is given, students in Air Force ROTC must also pass the following courses:

**110–111. LEADERSHIP LABORATORY I**

*Staff:* Introduction to the military experience focusing on customs and courtesies, physical fitness and competitive sports, drill and ceremonies, and the environment of an Air Force officer.

**210–211. LEADERSHIP LABORATORY II**

*Staff:* Introduction to the military experience focusing on customs and courtesies, physical fitness and competitive sports, drill and ceremonies, and the environment of an Air Force officer.

**310–311. LEADERSHIP LABORATORY III**

*Staff:* Practical introduction to Air Force leadership. Course focuses on military communicative skills, group dynamics, and applications of theories of leadership and management and physical fitness and competitive sports.

**410–411. LEADERSHIP LABORATORY IV**

*Staff:* Advanced Air Force leadership experiences. Course focuses on the practical development of the Air Force officer through command and staff positions with the Cadet Corps. Curriculum includes continuing emphasis on physical fitness and competitive sports.

**510–511. LEADERSHIP LABORATORY V****610–611. LEADERSHIP LABORATORY VI****710–711. LEADERSHIP LABORATORY VII****810–811. LEADERSHIP LABORATORY VIII**

# REGULATIONS

## ACADEMIC REGULATIONS

*Academic regulations are established by the faculty. Unless otherwise indicated in the college catalogue, exceptions to these regulations require the approval of the Scholarly Standing Committee. Written petitions for exceptions should be submitted to the Registrar for the committee. It is the student's responsibility to make certain that all degree requirements are satisfied. Students may elect to complete the graduation requirements stated in any catalogue in effect during their enrollment at the college, but they may not mix provisions from various catalogues.*

## GRADUATION REQUIREMENTS

In order to be recommended by the faculty for the Bachelor of Science degree, students are required to complete satisfactorily a minimum of 128 credit hours of courses (including approved transfer credits for courses taken at other colleges). Students must complete the requirements of each of the four parts of the curriculum as listed in the Academic Program section of this catalogue. They must also complete the physical education requirement.

A student enrolled for at least 12 credit hours in one semester is considered a full-time student for that semester. In order to qualify for a degree, a student must spend his/her last four semesters full-time and complete satisfactorily at least 12 credit hours in the last of these semesters. For those considering study abroad, see Study Abroad.

No student may be enrolled at Harvey Mudd College for more than 10 semesters.

To graduate, a student must earn a final cumulative grade point average (GPA) of C (2.000) or better. This cumulative GPA determines rank in class at graduation. In addition, he/she must earn a cumulative GPA of 2.000 or better in all courses required by the major, an individual program of studies or a technical minor for the off-campus major.

A student who wishes to graduate at the end of a specific semester must make an application to do so. This application is due with the pre-registration materials for that final semester, but it must be submitted no later than the end of the official final semester pre-registration period as indicated on the college academic calendar. Applications that are received later than this time will be interpreted as applying to the semester following that semester.

A student is recommended by the faculty for a degree only when she/he has completed all academic obligations to the college. A diploma is awarded by the Board of Trustees only when the student has satisfied all disciplinary and financial obligations to the college. The HMC Student Handbook contains more information regarding student disciplinary obligations in the Non-Academic Graduation Requirement policy.

## GRADING REGULATIONS

The final grade of a student in each course is determined by the instructor. All grades are due to the Office of the Registrar by the appropriate (regular or senior) deadline date announced in the catalogue. The deadline also applies to the grade "Incomplete" (INC) unless otherwise approved by the Associate Dean for Academic Affairs. (See the description of "Incomplete Grade.") In case an error has been made in determining, reporting or recording the grade in a course taken at the college, a change of grade form must be submitted to the Registrar by the instructor. If the change of grade occurs beyond the end of the following semester, the Registrar must submit the request for change to the Scholarly Standing Committee for its approval.

Protests about grades in courses taken at other Claremont Colleges are handled by the procedures of the college sponsoring the course, except in cases of alleged academic dishonesty.

For first-year students in their first semester of residence at HMC, all courses numbered below 50 are graded on the High Pass, Pass and No Credit scale. All courses numbered 50 and above are graded on the letter grade scale.

First-year courses are those numbered below 50. Lower division courses are those numbered 50 to 99. Upper division courses are those numbered 100 and above.

**Grade Descriptions.** Grades indicate both performance in the work of the course and comprehension of the subject matter. They are defined as follows:

- A** Excellent; 4 grade points per unit of credit.
- B** Good; 3 grade points per unit of credit.
- C** Fair; 2 grade points per unit of credit.
- D** Barely passing; 1 grade point per unit of credit.
- F** Failure; no grade points.
- N** The grade given at the end of the first semester of a two-semester course. The final grade is assigned at the end of the second semester. A two-semester course as designated by the Curriculum Committee is defined as a year-long two-course sequence.

**P** Passing; satisfactory performance and mastery of course material for first-semester, first-year courses and when course grades are given on a pass/fail or pass/no credit basis.

**HP** High Pass; superior performance and mastery of course material; first-semester, first-year courses only.

**NC** No Credit; first-semester, first-year courses courses and when course grades are given on pass/no credit basis. Students must repeat first-year courses until the course is passed.

**INC** Incomplete; The student's work for the course has not been completed, an extension of time to complete the course has been approved by the instructor and the Associate Dean for Academic Affairs, and a grade has not been reported.

**W** Withdrawn; The course was dropped after the Last Day to Drop.

Grades of A-, B+, B-, C+, C-, and D+ may also be awarded for courses graded on the letter grade system. There is no grade of A+ or D-.

During the course, a code of IP (In Progress) is listed for a course in the grade field for reporting purposes. If no grade is submitted at the end of the course, a code of NR (Not Reported) is listed until a final grade is submitted by the instructor.

Other codes which may appear on a transcript for a course include:

- AP** Placement Credit; unit credit awarded.
- EX** Passed by examination; unit credit awarded.

**Computation of Grade Point Averages.** Courses graded P, HP, NC or N are omitted in computing grade point averages. A grade of INC is computed with zero grade points until changed and is not included in the calculation of the semester or cumulative grade point averages. Any grade of F is included when computing the grade point average, even if the course is taken again with a passing grade. In computing grade point averages for transfer students, all HMC courses are counted regardless of when they were taken. Courses at the other Claremont Colleges are counted only if taken while enrolled as an HMC student. Grade point averages are truncated after the third decimal place.

**Incomplete Grade.** An Incomplete is given only with the approval of the instructor and the Associate Dean for Academic Affairs. An Incomplete is given only when illness or special circumstances justify the granting of the additional time for completion of the work. A student's performance in the course up to the time he/she became ill or when his/her work was otherwise disrupted is considered in granting an Incomplete. The Incomplete is removed if all work is completed by the time agreed upon by the instructor, the student and the Associate Dean for Academic Affairs and a final grade has been submitted by the instructor to the Registrar's Office. If the outstanding coursework is not submitted to the instructor by the agreed upon deadline, an Incomplete becomes an F or NC depending on the grading option.

**Changing of Courses—Add/Drop/Withdrawal.** A student may drop from any course without it being listed on his/her transcript so long as he or she remains enrolled in at least 12

credit hours and the drop occurs before the deadline determined by the academic calendar. If the course is part of the Core Program, the student must obtain the signature of the Associate Dean for Academic Affairs for the purpose of verifying consultation. After the official drop deadline a student may request a withdrawal from a course by submitting a petition to the Scholarly Standing Committee through the Office of the Registrar. If the committee grants the withdrawal the transcript will show a grade of W under the course in question. If the withdrawal is denied, the student must remain in the course and the grade earned is recorded on the transcript.

**Involuntary Disenrollment.** Students who, after warning from their instructor, continue to engage in conduct that results in the substantial impairment of teaching or learning in a course, may be involuntarily disenrolled from the course by the Dean of Faculty. The full text of the policy on Involuntary Disenrollment from a Course appears in the HMC Student Handbook.

**Completion of Required Course Work.** The last due date for the submission of work required to complete a course may be set by the instructor, but may not be later than the date set by the Registrar for the final examination in the course whether or not a final is given on the date assigned.

**Pass/Fail.** After the first semester of the first year, a student may select one course or the equivalent of 3 units (in addition to physical education courses) each semester for which he/she will receive a grade of P (Pass) or F (Fail). However, none of the technical core requirements may be taken on a pass/fail basis (except by departmental approval). In addition, departments may establish regulations about which of the courses required for the major may be taken on a pass/fail basis. Not more than one course (or the equivalent of 3 units) each academic year from among any one department's course offerings may be selected on the pass/fail basis. Approval in writing must be obtained from the course instructor and the student's adviser. The selection of a pass/fail course or the change to letter grades cannot be made after the last day for dropping from a course without academic penalty. A pass/fail course is omitted in computing grade averages unless the grade is "F." The grade "Pass" is equivalent to C– or better in a course regularly graded.

**Course Deficiencies.** Students are required to take their approved fitness PE course during the first year. After the first year, students must attempt all deficient first-year core courses (Chemistry 21, 22, 25 and 26, Computer Science 5, Humanities 1, Math 11, 12, 13 and 14, and Physics 23, 24 and 28) each time they are offered. All such courses must be passed before the beginning of the junior year. All core courses must be attempted by the end of the fifth semester. If a student fails or withdraws from any of Math 61, 62, 63 or 64, Physics 51 or 53, Biology 52, or Engineering 59, the student must re-attempt that course at least once each academic year until it is passed. Beginning with the fifth semester, students must attempt all deficient core courses each time they are offered during the academic year. The required Integrative Experience course may be taken in any semester and is exempt from these guidelines.

**Grade Reports.** Grades are not sent to students at the end of each semester by the Registrar. Grades are viewable on the student and faculty portals.

## **NOTIFICATION OF STUDENT RIGHTS**

The Family Educational Rights and Privacy Act (FERPA) affords students certain rights with respect to their education records. These rights are as follows:

**The right to inspect and review the student's education records within 45 days of the day the college receives a request for access.**

Students should submit a written request to the Registrar identifying the record(s) they wish to inspect. The Registrar or, at the direction of the Registrar, another appropriate college staff member will make arrangements for access and notify the student of the time and place

where the records may be inspected. Applicants for admission who wish to review or to release to a third party their application documents (excepting letters of recommendation) should submit a written request to the Office of Admission identifying the records they wish to inspect (or have released to a designated third party).

**The right to request the amendment of the student's education records that the student believes is inaccurate or misleading.** Students may ask the college to amend a record that they believe is inaccurate or misleading. They should write the college official responsible for the record, clearly identify the part of the record they want changed and specify why it is inaccurate or misleading. If the college decides not to amend the record as requested by the student, the college will notify the student of the decision and advise the student of his or her right to a hearing regarding the request for amendment. Hearings will be conducted by the appropriate college hearing body (for example, the Scholarly Standing Committee for grade disputes).

**The right to consent to disclosures of personally identifiable information contained in the student's education records, except to the extent that FERPA authorizes disclosure without consent.** One exception, which permits disclosure without consent, is disclosure to school officials with legitimate educational interests. A school official is defined as a person employed by the college, one of the other Claremont Colleges, or the Claremont University Consortium in an administrative, supervisory, academic (including faculty); or support staff position (including Campus Safety and Student Health Center staff); a person or company with whom the college has contracted (such as an attorney, auditor or collection agent); a person serving on the board of trustees; or a person assisting another school official in performing his or her tasks. A school official has a legitimate educational interest if the official needs to review an education record in order to fulfill his or her professional responsibility.

Upon request, the college discloses education records without consent to officials of another school at which a student has informed the college that she/he seeks or intends to enroll. Some scholarship donors will require that students authorize disclosure to them of information pertaining to the student's academic progress. Acceptance of these scholarship funds from such donors will be considered as granting consent to the college to make these disclosures.

**The right to request that the college not disclose directory information.** At its discretion, Harvey Mudd College may confirm or disclose "directory information" to the general public. The college defines "directory information" in accordance with FERPA as follows:

1. Name
2. Campus mailing address
3. Major field of study
4. Dates of attendance and classification
5. Degrees and/or awards received
6. Previous academic institutions attended
7. Date of birth
8. Campus e-mail address

Under certain circumstances, home and campus telephone numbers may be released. The CMS Athletic Department may also release information about a student in compliance with normal practices for "team rosters," including height, weight and hometown. A 1996 Federal law known as the Solomon Amendment requires the College to release "recruiting information" to military recruiters. "Recruiting information" consists of directory information plus year in school, place of birth and telephone number. The only way to prevent your recruiting information from being released to the military is to request that your directory information not be released to anyone.

Students may request that their directory information not be released by signing a non-disclosure form within two weeks of the start of any semester. All written requests for non-disclosure of directory information by current students will be honored until such time that the student amends them. Alumni may request non-disclosure of directory information at any time; such requests will be honored until otherwise notified. Harvey Mudd College assumes that failure on the part of any student to specifically request the withholding of directory information indicates individual approval for disclosure.

**The right to file a complaint with the U.S. Department of Education concerning alleged failures by the college to comply with the requirements of FERPA.** The name and address of the Office that administers FERPA is

Family Policy Compliance Office  
U.S. Department of Education  
400 Maryland Avenue, S.W.  
Washington, DC 20202-5920

### HONORS AND AWARDS

Graduation with Distinction and High Distinction. These honors are awarded for scholarly achievement at Harvey Mudd College. Students qualify for distinction if they have obtained a cumulative grade point average of at least 3.300; and for high distinction if their cumulative grade point average is at least 3.700; or if, by vote of the faculty, they are selected to receive either award.

**Graduation with Honors.** The faculty, usually upon recommendation of a department, may award honors to a graduating student for outstanding achievement. A copy of a department's criteria may be obtained from the department chair.

**Dean's List.** The Dean's List consists of the names of those students who have obtained a grade point average of 3.000 or better while taking 15 or more units of credit, at least 12 of which are graded by letter grades A to F. Those students on the Dean's List have a citation on their transcript for the corresponding semester.

**Letters of Commendation.** Letters of commendation may be used to recognize exceptional student achievement in courses. Such letters are cited on students' transcripts. First-year students with high academic achievement are given formal recognition by the Associate Dean for Academic Affairs.

### ACADEMIC STANDING

The record of every student is reviewed at the end of each semester and at any other time that such a review seems pertinent. The Scholarly Standing Committee examines the records of those students who are not making satisfactory progress toward a degree. Such students are subject to notification and change of academic status as outlined in the following sections. Criteria for determining "satisfactory progress" include the grade point average in courses required for the major, the overall grade point average and grades for the latest semester's work. The notification sent to the student includes the reasons for the action and the prerequisites for return to regular status.

A student's academic standing is considered by faculty members and administrators when hiring or appointing students to time-consuming jobs and to positions where they serve as role models such as proctors, orientation directors and sponsors, graders, tutors or consultants.

**Warning.** The status "On Warning" is applied to students whose academic deficiencies do not warrant more stringent action. Students placed "On Warning" remain in good academic standing, but are thereby notified that improved performance is expected. Ordinarily, a student whose semester GPA falls between 1.800 and 2.000 is placed "On Warning." A student with a core course deficiency is also placed "On Warning" until the deficient course is passed.

**Probation.** Probation is a formal change of academic status, appearing on academic



records, for example, and indicating that the student must make substantial improvement or face the possibility of being declared ineligible to re-register. A student on probation is considered not in good standing. Ordinarily, a student whose semester GPA falls below 1.800 is placed on "Probation."

**Ineligible To Re-Register (ITR).** A student in one of the following categories may be declared ineligible to re-register at Harvey Mudd College:

1. A student who is on probation and who fails to make substantial improvement in his/her academic record. (The amount of improvement expected is generally specified at the time probationary status is imposed.)
2. A student who satisfactorily completes fewer than eight units during any semester. (Students receiving a grade of Incomplete may have their evaluations postponed until the Incomplete is finished.)
3. A student whose cumulative grade point average is less than 2.000, or whose semester grade point average falls below 2.000 for two successive semesters.
4. A junior or senior whose cumulative grade point average in the major is less than 2.000.
5. A student who has not passed all first-year core courses (Chemistry 21, 22, 25 and 26, Computer Science 5, Humanities 1, Math 11, 12, 13, and 14, Physics 23, 24 and 28, and the approved fitness PE course) before the beginning of the fifth semester.
6. A student who has not attempted all core courses by the end of the fifth semester (the Integrative Experience course is an exception and may be taken in any semester).
7. A student who fails any Core course three or more times.
8. A student who is deficient in a Core course and has not registered for that course as specified in the Course Deficiencies section (page 102).

**Mid-Term Warnings.** Mid-term warnings may be given for unsatisfactory progress in a course.

**Athletic Eligibility.** To meet the eligibility requirements established by the college and the National Collegiate Athletic Association (NCAA), students who intend to participate in intercollegiate athletics must be enrolled in a minimum full-time program of study, maintain good academic standing and sustain satisfactory progress toward a degree. Any Harvey Mudd College student enrolled in 12 semester units (a full-time student) and not on academic probation meets these "full-time program," "good academic standing," and "satisfactory progress" requirements.

Any student who has been placed on academic probation is ineligible for participation. All students have the right to appeal to the Scholarly Standing Committee for release from probation prior to the end of the semester. While approval of such a request is rare, the decision of the Committee would be based on performance indicators (i.e. mid-term exams).

### **EVALUATION OF THE PREVIOUS EDUCATION AND TRAINING OF VETERANS**

In accordance with CFR§21.4253(d)(3), Harvey Mudd College will conduct an evaluation of the previous education and training of veterans, grant appropriate credit, shorten the veteran or eligible person's duration of degree course proportionately, and notify the Veterans Administration and student accordingly.

### **STANDARD OF PROGRESS FOR VETERANS**

In accordance with CFR§21.4253(d)(1)(I), any veteran or eligible person who remains on probation for grade point deficiency below a 2.000 cumulative GPA beyond two semesters, will have his/her veteran's benefits discontinued. Certification of benefits will also be terminated.

### **ADVANCED PLACEMENT AND CREDIT BY EXAMINATION**

In general even introductory courses at HMC go significantly beyond a normal AP course.

As a result success in AP courses does not guarantee advanced placement here, although some departments offer opportunities to place out of certain courses. The rules for advanced placement are listed on each department's web site.

### **CREDIT EARNED BY HMC PLACEMENT EXAMINATIONS**

A student in the college may also earn credit for some courses by examination. Since the courses that may be challenged are at the discretion of the department chair, a student must obtain the permission of the chair or his/her assignee before noon of the first day of classes of the semester in which he/she wishes to be examined. A high level of mastery of the material covered in the course must be demonstrated for credit to be earned. The standard is set high because it is believed that there is more than just knowledge of content to be gained from engaged participation in a course. A student may attempt to receive credit for a given course by examination only once.

**Chemistry:** Two proficiency examinations are available for those students who believe they have a strong chemistry background. A high standard of performance on the first examination earns placement into Chemistry 22 with unit credit for Chemistry 21. A high standard of performance on the second examination earns unit credit for Chemistry 22. The first examination is typically offered during the first week of classes and the second examination is offered by prior arrangement.

**Mathematics:** Advanced placement for courses can be earned by examination prior to enrolling in the course. These exams are arranged in consultation with a representative of the Department of Mathematics, typically prior to the start of the Fall semester.

**Physics:** Passing a departmental exam earns credit for Physics 24 and possibly Physics 23.

**Transfer Credit for Transfer Students:** Credit is given to transfer students for course work completed at other colleges that is reasonably equivalent to work offered at Harvey Mudd College. The amount of such credit is determined by the appropriate departments. Only C or better work is transferable.

Transcripts are evaluated at the time of admission so that students are informed at the time of acceptance what unit credit they have been awarded. Students will be asked to furnish course descriptions to facilitate this evaluation process. Courses underway are evaluated "subject to successful completion." Occasionally, transfer students are asked to take departmental examinations to establish credit.

When portions of the required Humanities, Social Sciences, and the Arts (HSA) program remain to be taken, up to half of these may be taken at other Claremont Colleges. In special cases of advanced admission to HMC where few, if any, required HSA courses remain, the student must take one HSA course per semester. These are elective courses and up to half of them may be taken at other Claremont Colleges.

### **COURSE ELECTIONS**

**Faculty Approvals.** Prior to course registration and when course changes are made, students must have their course selections approved by their faculty advisers. In addition, all course selections for humanities and social science electives must be approved by the student's adviser in the Department of Humanities, Social Sciences, and the Arts.

**Overloads.** In exceptional circumstances, a student with a record of successful academic performance may take more than 18 credit hours in a semester. The guidelines for overload approval are as follows:

*Overloads for First-year.* First-year students must request permission for overloads through a written petition to the Associate Dean for Academic Affairs. Petition instructions and deadlines are available from the Office of Academic Affairs.

*Overloads for Sophomores, Juniors and Seniors.*

1. For overloads of 19 1/2 units or fewer: Overload approval requires the signature(s) of

your academic advisers and a petition approved by the Associate Dean for Academic Affairs. Approval is granted provided previous semester GPA is at least 3.000 and all advisers agree.

2. Overload is 20 to 21 units: Overload approval requires the signature(s) of your academic advisers and a petition approved by the Associate Dean for Academic Affairs. A GPA of 3.000 in the preceding semester is required, as is evidence of the exceptional circumstances arguing for an overload. The following may constitute exceptional circumstances:

- Unique opportunity to take complementary or synergizing courses
- Unique opportunity to work with a particular faculty member (i.e. a visitor) or course (i.e. an experimental offering)
- Scheduling difficulties created by future or past semesters abroad or on exchange
- Unit credit needs for graduation within eight or more semesters.

Students are free to make the case for other exceptional circumstances in their petitions. The simple desire to take a course, however, does not constitute an exceptional circumstance, nor does evidence of a student's ability to "handle" additional coursework. The decision made by the Associate Dean for Academic Affairs regarding overload petitions is final.

3. Overload of more than 21 units: Granted only for the justification of unit credit needed for graduation in eight or more semesters and only then with the recommendation of all academic advisers.

Petition forms are available from the Office of the Associate Dean for Academic Affairs.

**Course Changes.** A required course may be replaced by a course in a different area of study only with the consent in advance of the Scholarly Standing Committee and the chairs of the departments concerned.

**Off-Campus Registration.** Students may register for courses open to them in the other Claremont Colleges. Courses taken at the Claremont Graduate University are recorded with the units of credit indicated in its catalogue. Full courses taken at Claremont McKenna, Pitzer, Pomona and Scripps Colleges receive three units of credit, except those courses in science and mathematics for which a three-hour laboratory is indicated in the catalogue. In such cases, credit is determined by the appropriate HMC department. Unit credit for off-campus courses other than full courses is determined before registration by the Harvey Mudd College department involved.

Any course in which a student enrolls for credit, shown in the catalogue of any Claremont College, is indicated on the transcript with credit and grades recorded and is included in the calculation of the cumulative grade point average.

**Directed Reading Courses.** Directed reading courses are open to juniors and seniors only, and a student may take only one such course (or the equivalent of 3 units) each semester. Directed reading courses are also available during the summer by registration with the Claremont Summer Session. Such a course may not be used as a substitute for a required first-year or sophomore course.

**Summer School Credit for Transfer.** A student who wishes to attend a summer school outside of The Claremont Colleges and transfer credits to Harvey Mudd College must obtain permission in writing from the chair of the Harvey Mudd College department concerned prior to registering for the summer school. Upon completion of the summer session, the student should request the college to send an official transcript to the Registrar. Only C quality work or better is transferable. However, some departments set a minimum grade that must be received in summer school courses, if they are to be used for transfer credit. Approved summer school courses are placed on the student's Harvey Mudd College academic record and may be counted as fulfilling distributive requirements upon consent of the department chair. Unit credit at Harvey Mudd College for such courses is generally the same as for equivalent courses at HMC except where adjustments must be made by the Registrar to equalize credits with the semester system at Harvey Mudd College. The grade obtained in a summer school course outside of The Claremont Colleges is not counted in determining the student's cumulative grade point average.

**Foreign Languages.** There are no undergraduate requirements in foreign languages. Students planning to go to graduate school, however, are reminded that a reading knowledge of German, French or Russian may be required as part of a program leading to an advanced degree.

### CLASS ATTENDANCE

Students are expected to attend all classes and not to absent themselves without adequate reason. The regulation of class attendance is ultimately the responsibility of the faculty. Each instructor has the privilege of establishing specific regulations regarding attendance as may be appropriate for his or her particular course.

### LEAVES OF ABSENCE AND WITHDRAWALS

A student who plans to leave the college should arrange a voluntary withdrawal with the Dean of Students or the Associate Dean for Academic Affairs.

Leaves of absence for stipulated periods may be granted by the Dean of Students or the Associate Dean for Academic Affairs; readmission is usually automatic upon application to the deans unless specific requirements were established for the return from the leave.

A student who has withdrawn from the college and wishes to be readmitted must apply to the Scholarly Standing Committee.

A student who withdraws or takes a leave of absence from the college before the semester course drop deadline will be noted as having withdrawn or taken a leave of absence with the previous semester's standing. No courses are listed on the transcript for the semester.

A student who withdraws or takes a leave of absence from the college after the semester course drop deadline, but by the last day of classes for that semester, receives a grade of W in all courses. The Registrar ascertains whether or not the student was in good standing.

A student who withdraws or takes a leave of absence from the college after the last day of classes for a given semester will still receive the grades earned in those courses in which he/she was enrolled at the time of leaving.

### PROGRAM OF TRANSFER STUDIES

Under special circumstances, a student may apply to the Scholarly Standing Committee for admission to the program of transfer studies. The program of transfer studies provides a terminal semester during which the student is released from the usual course requirements in order to improve his/her academic standing and to prepare for transfer to another college at the end of the semester. Readmission to HMC is not normally permitted.

### GENERAL REGULATIONS

**Fees and Refunds.** All charges (tuition, room, board, fees and deposits) must be paid in cash (\$U.S.), by checks drawn on American or Canadian banks, or money order (international, if appropriate). Descriptions of fees and deposits follow; arrangement for payment must be made prior to the service.

**Course-Change Fee.** The fee for any change in registration that is initiated by the student is \$5 per Course Add/Drop form. There is no fee charged for registration changes made during pre-registration or before the start of the semester. There is no fee charged at any time for changes in registration for Physical Education classes. First-year, transfer, and foreign exchange students are not charged for changes in registration during their first two semesters.

**Transcript Fee.** A transcript request is submitted to the Office of the Registrar. A fee of \$2 is charged for each official transcript. A transcript is issued only when obligations to the college have been paid in full or satisfactory arrangements have been made to do so. A transcript is sent out only at a student's request. There is no charge for an unofficial transcript.

**Class Fees.** Individual classes may have additional fees associated with them. These fees

are listed in the Schedule of Classes that is issued prior to pre-registration each semester. Class fees will be posted to student accounts and will be completely refunded if drop is made on or before the last day to add classes. Class fees are non-refundable if drop/withdrawal is made after that date.

**Housing Deposit/New Students.** To reserve on-campus housing, all incoming first-year students must submit a \$150 housing deposit by June 15. This deposit is refundable up to July 15, half-refundable from July 15 to August 15 and non-refundable thereafter. The fee is held as a damage deposit and credited at the end of the academic year, less charges, if any.

**Housing Deposit/Returning Students.** Each year in March, every returning student who wishes to participate in room draw is required to pay a \$150 deposit. The fee is held as a damage deposit and is credited at the end of the following academic year, less charges, if any. A student who has completed the room draw procedure and then decides not to live on campus can contact Student Accounts for a refund. Also, students who will not live on campus for the fall semester may request that their deposit be held to cover spring housing or may request a refund and resubmit the deposit prior to the spring semester.

**Refunds for Changes in Courseload to Less than Full Time.** A student who wishes to change courseload to less than ten units must give notice by submitting a Course Add/Drop Form and a Scholarly Standing Committee Petition to the Office of the Registrar. Students whose petitions are approved within the first 30 days of the semester are refunded according to the number of units enrolled. No refunds are made after the first 30 days of the semester.

**Refunds for Withdrawals During the Term.** A student who wishes to withdraw from the college must give notice by completing a Withdrawal/Leave of Absence form with the Dean of Students or the Associate Dean for Academic Affairs, who then notifies the Registrar and the Office of Student Accounts. No refunds are made if the student withdraws without giving notice. A student receives a refund, less a pro rata reduction of any scholarship or grant, subject to the following:

1. 100 percent refund of charges and fees is made if withdrawal occurs before the first day of classes.
2. 75 percent refund of the tuition charge is made if withdrawal occurs before the 18th day of classes.
3. 50 percent refund of the tuition charge is made if withdrawal occurs after the first 17 days of classes, but by the 30th day of class.
4. No refund of the tuition charge is made after the 30th day of class.
5. Refund of the board charge is on a pro-rata basis.
6. No refund of the room charges or fees.
7. Refunds are made by the college within 30 days of completion of the Withdrawal/Leave of Absence form by the Dean of Students or the Associate Dean for Academic Affairs.

Questions regarding withdrawal should be directed to the Dean of Students or the Associate Dean for Academic Affairs. Questions regarding the college's refund policy or procedure should be directed to the Office of Student Accounts.

## **AUTOMOBILES AND MOTORCYCLES**

Every student living on or off campus who owns or operates an automobile, motorcycle, motor scooter, moped or motorbike on the campuses of The Claremont Colleges must register the vehicle with the Campus Safety Department at the opening of each semester. Vehicles must have liability insurance and there is a parking fee of \$20 per semester for students.

## **STUDENT HEALTH SERVICE**

The Claremont Colleges maintain a health service for students while college is in session. Three physicians and a staff of nurse practitioners provide office care at the Student Health

Service Monday through Friday, from 8:30 a.m. to 5:00 p.m. Charges are made for medicines, laboratory tests, special supplies and some elective treatment. Referrals for treatment by specialists in all fields can be arranged when needed. Outside consultation, hospitalization and surgery are arranged by the health service, but are not financed by the college and payment for them is a responsibility of the individual student. Health care service is available throughout the academic year with the exception of scheduled vacations. As part of its continuing wellness programs, the Health Service seeks to empower students to take responsibility for their own health and well-being.

An accident and hospital reimbursement plan is required for all students to protect against major costs if they are not covered by a family health insurance policy. This plan is designed to supplement the care provided by the health service. Premiums and coverage are described in a brochure available on the Student Health Service Web site.

### **MEDICAL REQUIREMENTS**

The medical certificate required of all applicants prior to admission includes a physical examination, a tuberculin test, an X-ray of the chest within the preceding six months of those with a positive tuberculin test, and active immunization against tetanus, diphtheria, measles and rubella. Immunization against hepatitis B, meningococcal meningitis and chicken pox is also strongly recommended.

### **INSURANCE**

The college does not assume responsibility for loss or damage to personal property belonging to students. Adequate insurance coverage is advised for everyone.

### **FINANCIAL AID**

As specified by law, Harvey Mudd College monitors its aid recipients to ensure that they are maintaining satisfactory academic progress toward completion of their degree. Students are normally expected to graduate after eight semesters of enrollment at HMC or, for students who transfer into HMC from another institution, after the pre-designated number of semesters required to complete graduation requirements. As HMC students are generally eligible for only four years (or eight semesters) of financial assistance, normal academic progress must be maintained to ensure a timely graduation. Financial aid recipients should complete an average of 32 units per year to meet the graduation requirement of 128 units in four years and to remain eligible for financial aid. However, if there are circumstances that prevent degree completion within eight semesters, a student may apply for up to two additional semesters to complete the degree with financial aid. A student who wishes to pursue such an extension should consult with the Associate Dean for Academic Affairs.

Need-based financial aid is offered to U.S. citizens and permanent residents from the federal government, some states (including California for residents), private organizations and Harvey Mudd College. HMC uses a national standard known as Institutional Methodology to determine eligibility for scholarship assistance. A limited amount of HMC need-based scholarship is also available to international students. While need for scholarship is determined annually, the maximum annual award for international students will be limited to the amount granted in the first year at HMC. An international student who does not apply for or does not receive aid as a freshman will not be considered for financial aid in future years at HMC due to the limited and highly competitive nature of our funding.

The Office of Financial Aid is required to coordinate all funds that a student receives to ensure that each student's financial need is met and that a student does not receive more financial aid than he/she qualifies for. For this reason, HMC has established policies on how the receipt of additional funds will affect financial aid eligibility. For example, if a student receives a Federal Pell Grant, a Cal Grant, other state grant, an HMC-sponsored National Merit

Scholarship or a Harvey S. Mudd Merit Award, the student's need-based HMC Scholarship award may be reduced by an equal amount. If a student receives a scholarship or grant from a private organization, financial aid eligibility will be adjusted according to a standard formula. All outside scholarship funds are added together and the following is applied: the first \$500 will reduce need-based student loans and/or Federal Work-Study funds. One-half of the remaining amounts will reduce need-based HMC Scholarship and the other half will further reduce need-based student loans and/or Federal Work-Study funds. Once need-based student loans and Federal Work-Study amounts have been completely eliminated, any additional outside scholarships may reduce the need-based HMC Scholarship only. However, in an effort to maximize financial aid eligibility, students may retain need-based loan and Federal Work-Study amounts up to their federal eligibility.

In an effort to improve our awards, beginning in the fall of 2008, incoming freshmen are eligible to reduce need-based student loans and/or Federal Work-Study funds with outside scholarship funds dollar to dollar. Once need-based student loans and Federal Work-Study amounts have been completely eliminated, any additional outside scholarships will reduce need-based Harvey Mudd Scholarships only. Rising sophomores, juniors, and seniors are not eligible under this new policy.

The financial aid process at HMC adheres to strict deadlines. Students must apply for financial aid by our published deadlines and submit all supporting documents in a timely manner. Failure to meet our published deadlines may jeopardize financial aid eligibility, as funds are awarded on a first come, first serve basis. A student who receives financial aid and withdraws from HMC during the semester will have his/her financial aid adjusted according to the actual period of enrollment and the terms of the aid program.

A student who becomes delinquent on student loan payments after he/she graduates or leaves HMC may have academic transcripts withheld until payments are made current. Appeals to financial aid decisions should be addressed to the Office of Financial Aid. Unresolved appeals may then be taken to the director of financial aid, the vice president and dean of admission and financial aid, and, finally, to the president of the college.

### **DELINQUENT ACCOUNTS**

Every student is responsible for meeting promptly any payment due the college. Satisfactory arrangements for payment of the total charges on a student account for each semester, less financial aid, must be made prior to the beginning of each semester per the Tuition Payment Agreement.

A student account not meeting the requirements set forth in the Tuition Payment Agreement is considered delinquent. A student whose account is delinquent is subject to a late fee charge of one percent (1%) of the delinquent amount. A student with a delinquent account may be assessed a late-registration penalty and may also be disenrolled, resulting in prohibition from class attendance, revocation of dining hall privileges and/or ineligibility to pre-register for the subsequent semester. Any student leaving HMC with an unpaid financial obligation will not be issued an official transcript of grades until settlement is made.





## FACULTY

**Stephen C. Adolph**, *Professor of Biology and Interim Chair, Department of Biology, 1993*. B.S., M.S., Stanford University; Ph.D., University of Washington. Lecturer, University of Texas, Austin; Visiting Assistant Professor, Middlebury College; Postdoctoral Research Associate, University of Wisconsin, Madison.

**Anna N. Ahn**, *Assistant Professor of Biology, 2005*. B.A., Ph.D., University of California, Berkeley. Visiting Scientist, Massachusetts Institute of Technology; Postdoctoral Research Fellow, Harvard University.

**Christine Alvarado**, *Assistant Professor of Computer Science, 2005*. A.B., Dartmouth College; S.M., Ph.D., Massachusetts Institute of Technology. Instructor, University of California, San Diego; Instructor, Massachusetts Institute of Technology.

**William Alves**, *Professor of Music, 1995*. B.M., B.S., Trinity University; M.M., D.M.A., University of Southern California. Lecturer, University of Southern California; Lecturer, Scripps College; Fulbright Senior Scholar, Institut Seni Indonesia, Yogyakarta.

**Shenda M. Baker**, *Professor of Chemistry, 1992*. B.A., Grinnell College; Ph.D., California Institute of Technology. Post-doctoral Fellow, Los Alamos National Laboratories.

**Isabel Balseiro**, *Alexander and Adelaide Hixon Professor of Humanities, 1993*. B.A., Barnard College, Columbia University; Ph.D., New York University. Visitor with Associate Status, African Studies Centre, University of Cambridge; Lecturer, Rutgers University.

**Hal S. Barron**, *Louisa and Robert Miller Professor of Humanities, 1979*. A.B., Oberlin College; M.A., Ph.D., University of Pennsylvania. Postgraduate Research Historian, University of California, Riverside; Visiting Associate Professor, Waseda University, Tokyo, Japan; Vernon Carstensen Award; Graves Award; NEH Summer Fellow (twice); Haynes Fellow; Newberry Library NEH Fellow; Huntington Library-Haynes Fellow; NEH Senior Fellow.

**Lori C. Bassman**, *Associate Professor of Engineering, 2000*. B.S.E., Princeton University; M.S., Ph.D., Stanford University. Associate Lecturer, University of Southern Queensland, Toowoomba, Australia; Research Assistant, Center for Integrated Systems, Stanford University; Teaching Assistant, Stanford University.

**Carl J. Baumgaertner**, *Clinical Professor of Engineering, 1987*. B.S., St. Thomas College. Postgraduate studies at University of Minnesota. Staff member, 3M Company; Chief Engineer, Manager, Director of Engineering, Honeywell, Inc.

**Arthur T. Benjamin**, *Professor of Mathematics, 1989*. B.S., Carnegie Mellon University; M.S., Ph.D., The Johns Hopkins University. Staff Member, National Security Agency, Washington, D.C.; Visiting Professor, California Institute of Technology.

**Andrew J. Bernoff**, *Professor of Mathematics and Chair, Department of Mathematics, 1998*. B.S. Applied Math, B.S. Physics, Massachusetts Institute of Technology; Ph.D. Trinity College, Cambridge. Member, Mathematical Sciences Research Institute, University of California, Berkeley; N.S.F. Postdoctoral Fellow, University of California, Berkeley; Assistant Professor, Northwestern University; Visiting Faculty, Duke University; Visiting Scientist, University of British Columbia.

**Anthony Bright**, *John Leland Atwood Professor of Engineering Science, 1986*. B.S., University of Manchester; M.S., Massachusetts Institute of Technology; Ph.D., University of Bradford. Instrument Engineer, Kellogg International, England; Visiting Researcher, UKAEA, Harwell, England; Lecturer, Teesside Polytechnic; Lecturer, Open University; Visiting Professor, University of Delaware.

**Eliot Bush**, *Assistant Professor of Biology, 2007*. B.S., Harvard University; Ph.D., California Institute of Technology. Postdoctoral Fellow, the University of Chicago.

**Mary Cardenas**, *Associate Professor of Engineering and Associate Dean for Academic Affairs, 1995*. B.S., Iowa State University; M.S., Ph.D., University of California, Santa Barbara. Member of Technical Staff, Rocketdyne, Rockwell International; Research Scientist, University of California, Santa Barbara.

**Alfonso Castro**, *Kenneth A. and Diana G. Jonsson Professor of Mathematics, 2003*. B.S., M.S., Universidad Nacional de Colombia; Ph.D., University of Cincinnati. Chair, Department of Applied Mathematics, Professor of and Director of the Division of Mathematics, University of Texas, San Antonio; Associate and Full Professor, University of North Texas; Program Director: Applied Mathematics and Classical Analysis, National Science Foundation; Associate Professor, Southwest Texas State University; Visiting Professor, Universidad de Brasília; Associate and Full Professor, Associate Chairman, Mathematics, Centro de Investigación del I.P.N., Mexico.

**Robert J. Cave**, *Professor of Chemistry and Vice President and Dean of Faculty, 1988*. B.S., Michigan State University; Ph.D., California Institute of Technology. National Science Foundation Predoctoral Fellow; Postdoctoral Fellow, Indiana University; Camille and Henry Dreyfus Teacher-Scholar; Research Associate, Brookhaven National Laboratory; Visiting Professor, Rutgers University; Associate Dean for Academic Affairs, Harvey Mudd College; Director of Study Abroad, Harvey Mudd College.

**Philip D. Cha**, *Professor of Engineering, 1991*. B.S., Cornell University; M.S., Ph.D., University of Michigan. Senior Research Engineer, Ford Motor Company. Visiting Professor, University of Michigan; Participating Guest, Lawrence Livermore National Laboratory.

**Chih-Yung Chen**, *Associate Professor of Physics, 1990*. B.S., Normal University of Eastern China; M.S., University of Manchester; Ph.D., Massachusetts Institute of Technology. High school Teacher, Dafang, Guizhou, China.

**G. William Daub**, *Seeley Wintersmith Mudd Professor of Chemistry, 1978*. B.A., Pomona College; Ph.D., Stanford University. Postdoctoral Fellow, Stanford University; Camille and Henry Dreyfus Teacher-Scholar; Visiting Professor, University of California, Irvine.

**Marianne de Laet**, *Associate Professor of Anthropology and Science, Technology and Society, 2001*. B.A., M.A., University of Leiden; Ph.D., University of Utrecht. Senior Research Fellow and Lecturer, California Institute of Technology; NWO postdoctoral fellow at Columbia University; Bamberger and Fuld Fellow, Institute for Advanced Study at Princeton; Fulbright Scholar, University of California, Santa Cruz.

**Lisette de Pillis**, *Professor of Mathematics and Director, Global Clinic, 1993*. B.A., University of California, San Diego; M.A., Ph.D., University of California, Los Angeles. Research Assistant, Chr. Michelsen Institute, Norway; Jet Propulsion Laboratory; Los Alamos National Laboratory.

**Samuel J. DiMaggio**, *Professor of Engineering, 2009*. B.S., M.S., Ph.D., Columbia University. Professor of Mechanical Engineering, Loyola Marymount University; Director, Space Exploration Technologies; Manager, The Aerospace Corporation.

**Zachary Dodds**, *Associate Professor of Computer Science, 1999*. B.A., M.S., Ph.D., Yale University. Research Fellow, Yale Center for Computational Vision and Control; Software Manager, HelpMate Robotics.

**Thomas D. Donnelly**, *Professor of Physics and Associate Dean for Faculty Development, 1997*. B.A. Middlebury College; Ph.D. University of California, Berkeley. Visiting Assistant Professor, Swarthmore College.

**Robert Drewell**, *Assistant Professor of Biology, 2006*. B.Sc., King's College, London; Ph.D., University of Cambridge. Assistant Professor, University of Nevada, Reno; Postdoctoral Fellow, California Institute of Technology; Postdoctoral Fellow, University of California, Berkeley.

**Ziyad H. Durón '81**, *Jude and Eileen Laspa Professor of Engineering and Chair, Department of Engineering, 1987*. B.S., Harvey Mudd College; M.S., Massachusetts Institute of Technology; Ph.D., California Institute of Technology. Engineer, Arco Oil and Gas Company, NASA Dryden Flight Research Center; Member of the Technical Staff, The Aerospace Corporation; Visiting Research Associate, California Institute of Technology.

**Clive L. Dym**, *Fletcher Jones Professor of Engineering Design, 1991*. B.C.E., Cooper Union; M.S., Polytechnic Institute of Brooklyn; Ph.D., Stanford University. Assistant Professor, State University of New York, Buffalo; Research Staff Member, Institute for Defense Analysis; Associate Professor, Carnegie Mellon University; Senior Scientist, Bolt, Beranek and Newman; Professor and Head, Department of Civil Engineering, University of Massachusetts; Visiting Associate Professor, Technion-Israel Institute of Technology; NATO Fellow, University of Southampton (England); Visiting Scientist, Xerox Palo Alto Research Center; Visiting Professor, Stanford University, Carnegie-Mellon University; Fellow: Acoustical Society of America, American Society of Civil Engineers, American Society of Mechanical Engineers.

**Erika W. Dyson**, *Assistant Professor of Religious Studies, 2009*. B.A., Mount Holyoke College; M.A., Columbia University, M. Phil, Columbia University; Ph.D., Columbia University.

**James C. Eckert**, *Professor of Physics, 1980*. B.S., M.A., Ph.D., University of Southern California. Instructor, Loyola Marymount University; Visiting Associate Professor, University of Minnesota.

**Adam J. Edwards**, *Assistant Professor of Physics, 2008*. B.S., University of California, Berkeley; M.S., Ph.D., Stanford University. Instructor, Pomona College.

**Michael A. Erlinger**, *Professor of Computer Science and Chair, Computer Science Department, 1981*. B.S., University of San Francisco; M.S., Ph.D., University of California, Los Angeles. Lecturer, University of California, Los Angeles; Technical Staff Member, Bell Telephone Laboratory; Senior Project Engineer, Hughes Aircraft Company; Member of the Technical Staff, The Aerospace Corporation.

**Ann Esin**, *Associate Professor of Physics, 2002*. B.S., Massachusetts Institute of Technology; A.M., Ph.D., Harvard University. Postdoctoral Fellow, Theoretical Astrophysics, California Institute of Technology; Visiting Assistant Professor, Harvey Mudd College.

**Gary R. Evans**, *Ruth and Harvey Berry Professor of Entrepreneurial Leadership and Director, Entrepreneurial Network, 1981*. B.A., California State University, Fresno; M.S., Ph.D., University of California, Riverside. Lecturer, University of California, Riverside.

**Daniel L. Goroff**, *Professor of Mathematics and Economics, 2005*. B.A., M.A., Harvard University; M.Phil., Cambridge University; Ph.D., Princeton University. Professor of the Practice of Mathematics, Associate Director, Derek Bok Center for Teaching and Learning, Harvard University; Vice President and Dean of the Faculty, Harvey Mudd College.

**Jeffrey D. Groves**, *Professor of Literature and Chair of the Faculty 2007–2010, 1988*. B.A., University of La Verne; M.A., Ph.D., The Claremont Graduate School. Instructor, Harvey Mudd College.

**Weiqing Gu**, *Professor of Mathematics and Director, Mathematics Clinic, 1996*. B.S., Shanghai Teachers University; M.S., Ph.D., University of Pennsylvania.

**David Money Harris**, *Associate Professor of Engineering, 1998*. S.B. and M. Eng., Massachusetts Institute of Technology; Ph.D., Stanford. Technical Staff Member, Sun Microsystems and Intel Corporation.

**Sarah L. Harris**, *Assistant Professor of Engineering, 2005*. B.S., Brigham Young University; M.S., Ph.D., Stanford University. Visiting Assistant Professor, Harvey Mudd College; Science Writer, WOSU Public Radio; Instructor, Research Assistant, Stanford University.

**Richard C. Haskell**, *Burton G. Bettingen Professor of Physics and Director, Physics Clinic, 1980*. B.S., Lehigh University; Ph.D., The Johns Hopkins University. NIH Postdoctoral Fellow, Muscular Dystrophy Postdoctoral Fellow, Associate Research Scientist, The Johns Hopkins University.

**Karl A. Haushalter**, *Associate Professor of Chemistry and Biology, 2003*. B.A., Rice University; Ph.D., Harvard University. Postdoctoral Fellow, University of California, San Diego; Visiting Lecturer, University of California, Irvine.

**Jon Jacobsen**, *Associate Professor of Mathematics, 2002*. B.S., M.S., California Polytechnic State University, San Luis Obispo; Ph.D. University of Utah. Adjunct Professor, University of California, San Diego; S. Chowla Research Assistant Professor, The Pennsylvania State University.

**Adam R. Johnson**, *Associate Professor of Chemistry, 1999*. B.A., Oberlin College; Ph.D., Massachusetts Institute of Technology. Postdoctoral Fellow, University of California; Visiting Scholar, California Institute of Technology.

**Charles Kamm**, *Assistant Professor of Music, Scripps College, 2005 (Joint Music Program)*. B.M., Earlham College; M.M., Michigan State University; M.M.A., Yale University.

**Dagan Karp**, *Assistant Professor of Mathematics, 2008*. B. Sc., M. Sc., Tulane University; Ph.D., University of British Columbia. Visiting Assistant Professor, The University of California, Berkeley.

**Kerry K. Karukstis**, *Joseph B. Platt Professor of Effective Teaching in Chemistry, 1984*. B.S., Ph.D., Duke University. National Institutes of Health Postdoctoral Fellow, University of California, Berkeley; Henry Dreyfus Teacher-Scholar; Visiting Research Scientist, Chemical Biodynamics Division, Lawrence Berkeley Laboratory.

**Robert M. Keller**, *Csilla and Walt Foley Professor of Computer Science and Director, Computer Science Clinic, 1991*. B.S., M.S., Washington University; Ph.D., University of California, Berkeley. Assistant Professor, Princeton University; Visiting Assistant Professor, Stanford University; Associate and Full Professor, University of Utah; Director of Research and Vice President, Research and Development, Quintus Corporation; Professor and Chair, Division of Computer Science, University of California, Davis; Visiting Scientist, Lawrence Livermore National Laboratory; Senior Staff Member, Jet Propulsion Laboratory; Technical Staff Member, The Aerospace Corporation.

**Joseph A. King**, *Professor of Engineering, 1986*. B.S., M.S., Ph.D., University of Oklahoma. Research and Teaching Assistant, University of Oklahoma; Production Metallurgist, Ladish Company and Cameron Iron Works; Consulting Engineer, Associated Metallurgists; Visiting Scientist, SCE Electrical Systems Research; Visiting Metallurgical Engineer, John Crane Belfab; Director, SCE/HMC Center for Excellence.

**Geoffrey Kuening**, *Associate Professor of Computer Science, 1998*. B.S., M.S., Michigan State University; Ph.D., University of California, Los Angeles. Computer Scientist, Lawrence Livermore Laboratory; Systems Programmer, Ball Computer Products; Senior Software Engineer, Digital Equipment Corporation; Manager of Operating Systems Development, Callan Data Systems; Principal Consultant, Interrupt Technology Corporation; Visiting Lecturer, University of California, Los Angeles.

**Michael Deane Lamkin**, *Professor of Music and Interim Dean of Faculty, Scripps College, 1977 (Joint Music Program)*. B.M.E., M.M., Baylor University; Ph.D., University of Iowa. Professor and Head of the Music Department, Martin College; Associate Conductor, American Institute of Graz; Associate Conductor and Managing Director, Classical Music Festival, Eisenstadt, Austria.

**Nancy K. Lape**, *Assistant Professor of Engineering, 2005*. B.S., University of Massachusetts, Amherst; Ph.D., University of Minnesota, Twin Cities. Postdoctoral Fellow, Laboratoire des Science du Génie Chimique, CNRS, Ecole Nationale Supérieure des Industries Chimiques; Graduate Research Fellow, Recitation Instructor, University of Minnesota.

**Rachel Levy**, *Assistant Professor of Mathematics, 2007*. B.A., Oberlin College; M.A., University of North Carolina at Chapel Hill; Ph.D., North Carolina State University. Postdoctoral Research Associate, Duke University; Graduate Research Assistant, North Carolina State University; Upper School Dean, Carolina Friends School; Educational Software Consultant, SAS Institute.

**Ran Libeskind-Hadas**, *Professor of Computer Science and Associate Dean for Diversity, Research, and Experiential Learning, 1993*. B.A., Harvard University; M.S., Ph.D., University of Illinois (GTE Fellow).

**Patrick Little**, *J. Stanley and Mary Wig Johnson Associate Professor of Engineering Management and Director, Engineering Clinic, 1996*. B.A., St. Johns University; M.S., D.Sc., Massachusetts Institute of Technology.

**Theresa Lynn**, *Assistant Professor of Physics, 2006*. B.A., Harvard-Radcliffe Colleges; M.A. and Ph.D., California Institute of Technology. Staff Scientist, Postdoctoral Scholar, Kellogg Radiation Laboratory, California Institute of Technology; Adjunct Assistant Professor, Harvey Mudd College; Co-founder, Caltech Project for Effective Teaching; Project Coordinator, California High School Cosmic Ray Observatory (CHICOS)

**Gregory A. Lyzenga '75**, *Professor of Physics, 1990*. B.S., Harvey Mudd College; Ph.D., California Institute of Technology. Postdoctoral Research Fellow, California Institute of Technology; Member Technical Staff, Technical Group Leader, Jet Propulsion Laboratory.

**Katherine N. Maloney**, *Assistant Professor of Chemistry, 2008*. B.S., Pacific Lutheran University; M.S., Ph.D., Cornell University. Postdoctoral Research Fellow, Scripps Institution of Oceanography.

**Susan E. Martonosi**, *Assistant Professor of Mathematics, 2005*. B.S., Cornell University; Ph.D., Massachusetts Institute of Technology. Research Assistant, MIT Global Airline Industry Center; Teaching Assistant, Sloan School of Business; High School Mathematics Teacher, U.S. Peace Corps, Republic of Guinea.

**Debra Mashek**, *Iris and Howard Critchell Assistant Professor of Psychology, 2005*. B.S., Nebraska Wesleyan University; M.A., Ph.D. State University of New York at Stony Brook. Research Assistant Professor, George Mason University; Postdoctoral Research Fellow, George Mason University.

**Rachel Mayeri**, *Associate Professor of Media Studies, 2002*. B.A., Brown University; M.F.A., University of California, San Diego. Adjunct Professor, University of California, San Diego.

**Catherine S. McFadden**, *Vivian and D. Kenneth Baker Professor in the Life Sciences, 1991*. B.S., Yale University; Ph.D., University of Washington. Postdoctoral Researcher, University of California, Davis; NATO Postdoctoral Fellow, Port Erin Marine Laboratory, Isle of Man; Research Associate, University College, Dublin.

**John I. Molinder**, *James Howard Kindelberger Professor of Engineering, 1970*. B.S., University of Nebraska; M.S., Air Force Institute of Technology; Ph.D., California Institute of Technology. Project Officer, USAF; Senior Engineer, Jet Propulsion Laboratory; Member of the Technical Staff, Jet Propulsion Laboratory; Visiting Professor, California Institute of Technology; Registered Professional Engineer, California.

**Melissa E. O'Neill**, *Associate Professor of Computer Science, 2001*. B.Sc., University of East Anglia; M.Sc., Ph.D., Simon Fraser University. Instructor, Simon Fraser University.

**Richard G. Olson '62**, *Professor of History and Willard W. Keith, Jr. Fellow in the Humanities, 1976*. B.S., Harvey Mudd College; A.M., Ph.D., Harvard University. Instructor, Tufts University; Assistant Professor, Associate Professor, Chairman, History Board of Studies, University of California, Santa Cruz; Woodrow Wilson Fellow; National Endowment for the Humanities Fellow; Lois and Arnold Graves Fellow; Haynes Fellow.

**Michael Orrison Jr.**, *Associate Professor of Mathematics, 2001*. A.B., Wabash College; A.M., Ph.D., Dartmouth College. Lecturer, Dartmouth College.

**Elizabeth J. Orwin '95**, *Associate Professor of Engineering, 2001*. B.S., Harvey Mudd College; M.S., Ph.D., University of Minnesota. Research Assistant, University of Minnesota.

**Nicholas Pippenger**, *Professor of Mathematics, 2006*. B.S., Shimer College; B.S., M.S., Ph.D., Massachusetts Institute of Technology. Professor of Computer Science, Princeton University; Professor of Computer Science, University of British Columbia; MIT Instrumentation Laboratory (now the Charles Stark Draper Laboratory); IBM Research; University of British Columbia; IBM Fellow, Almaden IBM Research Center.

**Jules B. Prag IV**, *Visiting Associate Professor, (2004-2010)*. B.B.A., M.A., University of Florida; M.A., Ph.D., University of Rochester. Assistant Professor, Claremont McKenna College, Visiting Associate Professor, Pomona College, Visiting Associate Professor, Claremont Graduate University.

**Donald S. Remer**, *Oliver C. Field Professor of Engineering Economics, 1975*. B.S., University of Michigan; M.S., Ph.D., California Institute of Technology. Engineering Economic and Planning Analyst, Senior Project and Process Engineer, Task Force Manager, Exxon Chemical

Company; Case Study Editor, The Engineering Economist; Member of the Technical Staff, Manager of Planning Analysis, Jet Propulsion Laboratory; Registered Professional Engineer, California.

**Peter N. Saeta**, *Professor of Physics, 1995*. B.S. Stanford University; Ph.D. Harvard University. Postdoctoral Fellow, AT&T Bell Laboratories; National Research Council Postdoctoral Fellow, National Institute of Standards and Technology.

**Vatche V. Sahakian**, *Associate Professor of Physics, 2003*. B.Sc., M.Sc., McGill University; Ph.D., University of Chicago. Postdoctoral Associate, Lecturer, Cornell University.

**Patricia D. Sparks**, *Professor of Physics, 1989*. B.A., Carleton College; M.S., Ph.D., Cornell University. Postdoctoral Fellow, University of California, Los Angeles; Lecturer, California State University, Fullerton; Visiting Scientist, University of California, Irvine.

**R. Erik Spjut**, *Professor of Engineering, 1988*. B.S., University of Utah; Ph.D., Massachusetts Institute of Technology. Assistant Professor, Massachusetts Institute of Technology.

**Paul F. Steinberg**, *Associate Professor of Political Science and Environmental Policy, and Director, Center for Environmental Studies, 2003*. B.A., University of California, Santa Barbara; M.P.A., Harvard University, John F. Kennedy School of Government; Ph.D., University of California, Santa Cruz. Visiting Scholar, Paul H. Nitze School of Advanced International Studies, Johns Hopkins University; Visiting Assistant Professor, Duke University; Founding Director, Conservation Policy and Governance Program, RARE Center for Tropical Conservation; policy adviser to The World Bank, Conservation International, World Conservation Union and Natural Resources Defense Council.

**Christopher A. Stone**, *Associate Professor of Computer Science, 2000*. B.S., M.S., Ph.D. Carnegie Mellon University.

**Francis E. Su**, *Professor of Mathematics, 1996*. B.S., University of Texas, Austin; A.M., Ph.D., Harvard University. Visiting Assistant Professor, Cornell University.

**Lisa M. Sullivan**, *Professor of Economic History, 1990*. B.A., Vassar College; M.A., Ph.D., University of Toronto. Assistant Professor, State University of New York, Fredonia; Research Fellow, Winterthur Museum; Associate Dean of Academic Affairs, Harvey Mudd College; Associate Dean for Faculty Development, Harvey Mudd College.

**Elizabeth A. Sweedyk**, *Associate Professor of Computer Science, 1999*. B.A., Michigan State University; B.S.E. M.S.E, University of Michigan; Ph.D. University of California, Berkeley. Instructor, University of Pennsylvania, Instructor, Rutgers University, Researcher, Sandia National Laboratories.

**Chang Tan**, *Assistant Professor of Chinese Language and Culture, 2008*. B.A., Beijing University; M.A., Ph.D. University of Texas at Austin. Visiting Professor, Southwestern University.

**John S. Townsend**, *Susan and Bruce Worster Professor of Physics and Chair, Department of Physics, 1975*. B.S., Duke University; M.A., Ph.D., The Johns Hopkins University. National Science Foundation Graduate Fellow, Associate Research Scientist and Lecturer, The Johns Hopkins University; Research Associate, Stanford Linear Accelerator Center, Stanford University; Visiting Associate, California Institute of Technology; Visiting Fellow, University of Southampton, England; Science Fellow, Center for International Security and Arms Control, Stanford University; Visiting Professor, Duke University.

**Jennifer G. Tucker**, *Hixon-Riggs Visiting Professor of Science, Technology, and Society, 2009-2010*. B.A., Stanford University; M. Phil., University of Cambridge; Ph.D., The Johns Hopkins University.

**Gerald R. Van Hecke '61**, *Donald A. Strauss Professor of Chemistry, 1970*. B.S., Harvey Mudd College; M.A., Ph.D., Princeton University. Teaching and Research Assistant, Princeton University; Chemist, Shell Development Company; Visiting Research Associate, University of Lille, France; Visiting Research Associate, Boston University Medical School; NAS Exchange Scientist: Institute of Physical Chemistry, Warsaw; Institute for Electron Physics, East Berlin; NASA/ASEE Faculty Fellow, Jet Propulsion Laboratory; University Guest Researcher, Osaka University; Guest Professor, University of Southampton; Camille and Henry Dreyfus Scholar; Certified Professional Chemist; National Certification Commission.

**Hal Van Ryswyk**, *Professor of Chemistry and Chair, Department of Chemistry, 1986*. B.A., Carleton College; Ph.D., University of Wisconsin. Visiting Associate Professor, Massachusetts Institute of Technology; Visiting Professor, Stanford University.

**David A. Vosburg**, *Assistant Professor of Chemistry, 2005*. B.A., Williams College; Ph.D., Scripps Research Institute. Jane Coffin Childs Postdoctoral Fellow, Harvard Medical School.

**Ruye Wang**, *Professor of Engineering, 1990*. M.S., Tianjin University, China; M.S., Ph.D., Rutgers University. Lecturer, Peking University, China.

**Mary E. Williams**, *Professor of Biology, 1995*. B.A., University of California, Berkeley; Ph.D., The Rockefeller University. Postdoctoral Fellow, University of California, Berkeley.

**Talithia D. Williams**, *Assistant Professor of Mathematics, 2008*. B.S., Spelman College; M.S., Howard University; M.A., Ph.D. Rice University; Lecturer, Rice University.

**Darryl Wright**, *Professor of Philosophy, and Chair, Department of Humanities, Social Sciences, and the Arts, 1991*. B.A., Princeton University; Ph.D., University of Michigan. Instructor, University of Michigan.

**Qimin Yang**, *Associate Professor of Engineering, 2002*. B.S., Zhejiang University; M.S., Beijing University of Posts and Telecommunication; Ph.D., Princeton University. Research Assistant, Princeton University.

**Darryl H. Yong '96**, *Associate Professor of Mathematics, 2003*. B.S., Harvey Mudd College; M.S., The Claremont Graduate School; Ph.D., University of Washington. Von Kármán Instructor, California Institute of Technology; Visiting Assistant Professor, Harvey Mudd College.



**JOINT ATHLETICS FACULTY**

Harvey Mudd College has cooperated with Claremont McKenna and Scripps Colleges since 1956 to provide students with state-of-the-art athletic facilities and coaches with expertise in 21 (10 men's, 11 women's) varsity sports. This joint program is known as CMS athletics (Claremont-Mudd-Scripps), and its primary purpose is to enhance student development and personal growth through participation in intercollegiate athletics. The entire CMS faculty is listed below, though only one-third of them are officially assigned to HMC at any time.

**Michael Sutton**, *Professor of Physical Education and Athletic Director, 1979*. B.A., Claremont McKenna College; M.S., United States Sports Academy. Head Men's Water Polo Coach, Head Men's and Women's Swim Coach, Claremont-Mudd-Scripps Colleges 1979–2000; Team Leader, United States Water Polo Men's Olympic and National Team, 1988–1992.

**Jodie Rae Burton**, *Professor of Physical Education and Head Women's Basketball Coach, Senior Woman Administrator, 1979*. B.S., M.S., California State Polytechnic University, Pomona. Teacher-Coach, Polytechnic School, Pasadena.

**Dan Calichman**, *Assistant Professor of Physical Education and Head Men's Soccer Coach, 2002*. B.A., Williams College. Head Coach, American Global Soccer School; Major League Soccer (player L.A. Galaxy, San Jose Earthquakes, New England Revolution).

**Rick Candaele**, *Associate Professor of Physical Education and Head Football Coach, 1993*. B.A., College of Idaho; M.E., College of Idaho. Head Football Coach, UC Santa Barbara.

**John Goldhammer**, *Associate Professor of Physical Education and Head Men's and Women's Cross Country and Track and Field Coach, 1984*. B.A., UC Santa Barbara. M.A., California State University, Los Angeles; Instructor and Track and Field Coach, Santa Barbara City College; Assistant Women's Track Coach and Men's Field Event Coach, UC Santa Barbara.

**Dianna Graves**, *Assistant Professor of Physical Education and Head Women's Volleyball Coach, 2001*. B.A., Claremont McKenna College; M.A., Claremont Graduate University. Research Associate, City of Hope; teacher, Ontario-Montclair School District.

**Charles Griffiths**, *Assistant Professor of Physical Education and Head Men's and Women's Swimming Coach, 2001*. B.A., Denison University. Assistant Men's and Women's Swim Coach, Denison University.

**Betsy Hipple**, *Instructor of Physical Education and Head Women's Softball Coach, 2005*. B.S., Northeastern University; M.S., University of Utah. Head Softball Coach, Hunter College (City University of New York).

**Greg Lonzo**, *Assistant Professor of Physical Education and Head Men's and Women's Water Polo Coach, 2001*. Pepperdine, 2002, three time NCAA Water Polo All-American. CMS Interim head coach, 2007-08. CMS Assistant Coach 2004-05. Head coach Riverside Water Polo Club, 2002-2007.

**Ginger Miles**, *Head Women's Lacrosse Coach and Instructor of Physical Education, 2009*. B.A., University of Virginia. Volunteer Assistant Coach and Admissions Counselor, Office of Undergraduate Admissions, University of Virginia; Coach, Blue Ridge Lacrosse Club; Coach, Virginia Western Region squad, 2008 Commonwealth games; Assistant Coach, Western Albemarle High school, Virginia.

**JOINT ATHLETICS FACULTY, continued**

**Maxanne Retzlaff**, *Associate Professor of Physical Education and Head Women's Tennis Coach, 1992.* B.S., St. John's University; M.S., Manhattan College.

**Steven Retzlaff**, *Assistant Professor of Physical Education and Assistant Football Coach, 1993.* B.S., University of California, Santa Barbara; M.S. candidate, S.W. Post, Long Island University. Assistant Football Coach, Hofstra University.

**Keri Sanchez**, *Assistant Professor of Physical Education and Head Women's Soccer Coach, 2003.* B.A., University of North Carolina, Chapel Hill; M.A., University of Oregon. WUSA player and Assistant Coach, University of Oregon.

**Kenneth Scalmanini**, *Assistant Professor of Physical Education and Head Men's Basketball Coach, 1999.* A.A., Santa Rosa Junior College; B.S., California State Polytechnic University, Pomona; M.S. candidate, Azusa Pacific University. Assistant Men's Basketball Coach, CMS.

**Paul Settles**, *Assistant Professor of Physical Education and Head Men's Tennis Coach, 2004.* B.A., University of Pennsylvania, M.A. Phil, Cambridge University. Director of Player Services, ATP, Ponte Vedra, FL.

**Randall Town**, *Associate Professor of Physical Education and Head Men's Baseball Coach, 1987.* A.A., West Hills Junior College; B.A., M.A., California State University, Stanislaus. Instructor of Physical Education and Assistant Baseball Coach, California State University, Stanislaus.



## HMC EMERITI

- Jack L. Alford**, *Professor of Engineering Emeritus*, 1959.
- Tad A. Beckman**, *Professor of Philosophy Emeritus*, 1961.
- Graydon D. Bell**, *Senior Professor of Physics Emeritus*, 1957.
- Robert L. Borrelli**, *Professor of Mathematics Emeritus*, 1964.
- Courtney S. Coleman**, *Professor of Mathematics Emeritus*, 1959.
- Iris C. Critchell**, *Instructor of Aeronautics Emerita*, 1962.
- Nathaniel Davis**, *Professor of Humanities Emeritus*, 1983.
- Deren Finks**, *Dean of Admission Emeritus*, 1988.
- Mack Gilkeson**, *Professor of Engineering Emeritus*, 1961.
- John Greever**, *Professor of Mathematics Emeritus*, 1961.
- Thomas M. Helliwell**, *Professor of Physics and Dean Emeritus*, 1962.
- Melvin Henriksen**, *Professor of Mathematics Emeritus*, 1969.
- Robert T. Ives**, *Associate Professor of Mathematics Emeritus*, 1958.
- Henry A. Krieger**, *Professor of Mathematics Emeritus*, 1968.
- Mitsuru Kubota**, *Professor of Chemistry Emeritus*, 1959.
- Betty Lumpkin**, *Registrar Emerita*, 1961.
- James E. Monson**, *Professor of Engineering Emeritus*, 1961.
- Philip C. Myhre**, *Professor of Chemistry Emeritus*, 1960.
- Daniel C. Petersen**, *Professor of Physics Emeritus*, 1974.
- J. Richard Phillips**, *Professor of Engineering Emeritus*, 1966.
- Alden F. Pixley**, *Professor of Mathematics Emeritus*, 1962.
- Joseph B. Platt**, *Senior Professor of Physics and Founding President Emeritus*, 1956.
- William K. Purves**, *Professor of Biology Emeritus*, 1977.
- David S. Sanders**, *Professor of Literature Emeritus*, 1959.
- William H. Sandmann**, *Professor of Physics Emeritus*, 1963.
- J'nan Morse Sellery**, *Professor of Literature Emerita*, 1970.
- Sedat Serdengecti**, *Professor of Engineering Emeritus*, 1961.
- Wing Cheung Tam**, *Professor of Engineering and Computer Science Emeritus*, 1974.
- B. Samuel Tanenbaum**, *Professor of Life Sciences and Engineering and Dean Emeritus*, 1975.
- Jack H. Waggoner Jr.**, *Associate Professor of Physics Emeritus*, 1961.
- F. Sheldon Wettack**, *Professor of Chemistry and Dean Emeritus*, 1993.
- Harry E. Williams**, *Professor of Engineering Emeritus*, 1960.
- Robert P. Wolf**, *Professor of Physics Emeritus*, 1963.
- Thomas Woodson**, *Senior Professor of Engineering Emeritus*, 1969.

## SENIOR ADMINISTRATION

### PRESIDENT OF THE COLLEGE

**Maria M. Klawe**, *President, 2006*. B.Sc. and Ph.D., University of Alberta, Canada. Academic positions at University of British Columbia, University of Toronto and Oakland University. Research Scientist and Manager, IBM Almaden Research Center, California; Computer Science Department Head, Vice President of Student and Academic Services, and Dean of Science, University of British Columbia; Dean of Engineering and Professor of Computer Science, Princeton University.

### PRESIDENT'S CABINET

**Karen Angemi**, *Director of the President's Office and Secretary to the Board, 2003*.

**Marc L. Archambault**, *Vice President for College Advancement, 2006*. B.A. Physics, B.A. English, Saint Michael's College; Certificate of Fundraising Management, Center on Philanthropy, Indiana University. Senior Director for Advancement for Discovery Park and University Foundation Relations, Purdue University; Associate Director, Grants and Contracts, University of Houston; Executive Director, W.M. Keck Center for Computational Biology; Promotions Manager, University of Chicago Press.

**Thyra L. Briggs**, *Vice President for Admission and Financial Aid, 2007*. B.A., Connecticut College. Dean of Enrollment, Sarah Lawrence College; Dean of Admission, Associate Director of Admission, Assistant Director of Admission, Admission Counselor, Sarah Lawrence College.

**Marguerite A. Browning**, *Vice President and Dean of Students, 2009*. B.A., University of Massachusetts, Boston; Ph.D., Massachusetts Institute of Technology. Associate Professor Emeritus, Council of the Humanities and Program in Linguistics, Princeton University. Master of Wilson College, Princeton University. Director of the Program in Linguistics, Princeton University.

**Robert J. Cave**, *Vice President for Academic Affairs and Dean of Faculty and Professor of Chemistry, 1988*. B.S., Michigan State University; Ph.D., California Institute of Technology. National Science Foundation Predoctoral Fellow; Postdoctoral Fellow, Indiana University; Camille and Henry Dreyfus Teacher-Scholar; Research Associate, Brookhaven National Laboratory; Visiting Professor, Rutgers University; Associate Dean for Academic Affairs, Harvey Mudd College; Director of Study Abroad, Harvey Mudd College.

**Andrew R. Dorantes**, *Vice President for Administration and Finance/Treasurer, 2003*. B.S., M.B.A., California State Polytechnic University, Pomona. Adjunct Faculty Member, Azusa Pacific University; Partner, Capin Crouse LLP.

**Joseph Vaughan**, *Chief Information Officer and Vice President of Computing and Information Services, 2008*. B.A., Trinity College, Dublin; C. Phil, M.A., University of California, Los Angeles. Director/Humanities CIO, UCLA Center for Digital Humanities; Chief Administrative Officer, Dodd Humanities Group, UCLA; Co-founder and Head of Studies, Piccadilly Idiomas, Madrid, Spain.

# ACADEMIC CALENDAR 2009–2010

## FALL 2009

### FIRST SEMESTER (70 DAYS + 5 DAYS FINALS)

August 27	Thurs	Residence halls open for new students; orientation begins
August 30	Sun	Residence halls open for returning students; first meal - dinner
August 31	Mon	Registration for returning students
September 1	Tues	First semester classes begin at 8:10 a.m.
September 2	Wed	Financial registration - Green Room (8:45 a.m.-3:30p.m.)
September 3	Thurs	Convocation 4:15 p.m.
September 7	Mon	Labor Day - offices closed
September 14	Mon	Last day to add full semester and first half semester courses
October 2	Fri	Last day to drop first half semester courses Last day to declare first half semester courses Pass/Fail
October 16	Fri	Fall break begins after last class; first half semester courses end
October 21	Wed	Fall break ends 8:00 a.m. Second half semester classes begin
November 3	Tues	Last day to add second half semester courses
November 20	Fri	Last day to drop full semester and second half semester courses Last day to declare full semester and second half semester courses Pass/Fail
November 25	Wed	Thanksgiving recess begins after last class
November 30	Mon	Thanksgiving recess ends 8:00 a.m.
December 1–7	Tues-Mon	Pre-registration for Spring 2010 (dates subject to change)
December 11	Fri	Last day of first semester classes
December 14	Mon	Final examinations begin
December 18	Fri	Final examinations end; last meal - lunch
December 19	Sat	Residence halls close 8:00 a.m.
December 23	Wed	Grades due to registrar by noon
January 4	Mon	Fall grades viewable on the portal

## SPRING 2010

### SECOND SEMESTER (71 DAYS + 5 DAYS FINALS)

January 17	Sun	Residence halls open 8:00a.m. for all students
January 18	Mon	Martin Luther King Day, offices closed; first meal - brunch
January 19	Tues	Registration for returning students Second semester classes begin 8:10a.m.
January 20	Wed	Financial registration - Green Room
February 1	Mon	Last day to add full semester and first half semester courses
February 19	Fri	Last day to drop first half semester courses Last day to declare first half semester courses Pass/Fail
March 5	Fri	First half semester classes end
March 8	Mon	Second half semester classes begin
March 12	Fri	Spring vacation begins after last class
March 22	Mon	Spring vacation ends 8:00 a.m.
March 26	Fri	César Chávez Day, offices closed; no HMC classes
March 29	Mon	Last day to add second half semester courses
April 16	Fri	Last day to drop full semester and second half semester courses Last day to declare full semester and second half semester courses Pass/Fail
April 27-30	Tues-Fri	Pre-registration for Fall 2010 (dates subject to change)
April 30	Fri	Last day of HMC second semester courses (CMC, PO, PZ, SC - 5/5)
May 3-5	Mon-Wed	Student presentations; no HMC classes
May 5	Wed	Last day of classes at CMC, PO, PZ and SC
May 6-7	Thurs-Fri	Finals for seniors; reading days for other students
May 10	Mon	Senior grades due to registrar by 9:00a.m.; other final examinations begin
May 14	Fri	Final examinations end
May 16	Sun	Commencement at 1:30p.m.; last meal - brunch
May 17	Mon	Residence halls close 8:00a.m.
May 20	Thurs	All other grades due to registrar by noon
May 25	Tues	Spring grades viewable on the portal



# INDEX

- 3-2 Program in Economics and Engineering. . . . .19–20, 97
- 3-2 Program in Engineering. . . . .19–20, 97–98
- 3-2 Programs . . . . .19–20, 97–98
- 4+1 B.S. and M.B.A. Program . . . . .98
- 4+1 B.S. and M.S.I.S. Program . . . . .98
- Academic Program . . . . .24–32
- Academic Regulations . . .100–108
- Academic Standing. . . .104–105
- Accreditation . . . . .2
- Chemistry . . . . .40–44
  - Engineering . . . . .2
- ACT exam . . . . .16–17
- Activities . . . . .15
- Adding a Course. . . . .101–102
- Administration. . . . .124
- Admission . . . . .16–22
- Advanced Placement . . . . .20, 105–106
- Africana Studies . . . . .11, 72
- Aerospace Studies/AFROTC . . . . .15, 98–99
- Alumni. . . . .5
- American Studies . . .62–63, 66, 72
- Anthropology. . . . .63
- Application Form Options . . .16
- Applications
- Admission . . . . .16
  - Financial Aid . . . . .22
  - Graduation . . . . .100
- Applied Physics . . . . .87
- Art . . . . .63
- Asian-American Studies . . . .72
- Astronomy . . . . .91–92
- Astrophysics . . . . .87
- Athletic Eligibility . . . . .105
- Athletics. . . . .14
- Attendance, Class. . . . .108
- Automobiles. . . . .109
- Awards . . . . .104
- Beckman Hall . . . . .7
- Bernard Biological Field Station . . . . .10
- Biological Chemistry . . . . .40
- Biology. . . . .24, 33–39
- Biophysics . . . . .87
- Black Studies (see Africana Studies). . .11, 72
- Bookstore, Huntley . . . . .11
- Bridges Auditorium . . . . .10
- Campus Center, Joseph B. Platt. . . . .6
- Campus Visits . . . . .20
- Career Services . . . . .13
- Cars . . . . .109
- Changing Courses . . . .101–102
- Chemical Biology. . . . .34
- Chemical Engineering . . . . .40
- Chemical Physics . . . . .41, 87
- Chemistry . . . . .25, 40–44
- Chicano Studies . . . . .11, 72–73
- Chinese . . . . .64
- Claremont . . . . .8
- Claremont Colleges, The . . . .8–9
- Claremont Colleges Map . . . . . inside back cover
- College Board Tests . . . . .17
- Claremont Graduate University (CGU) . . . . .8–9
- Claremont McKenna College (CMC) . . . . .9
- Class Attendance . . . . .108
- Clinic Program. . . .4, 53, 55–56
- College Calendar . . . . .125
- College Expenses . . . . .20–21
- Common Core. . . . .24–30
- Completion of Required Course Work. . . . .102
- Computational Chemistry . . .41
- Computational Mathematics . .76
- Computer Engineering. . . . .47
- Computer Science . . .25, 45–52
- Computer Science Clinic . .46, 52
- Computing and Information Services (CIS) . . . . .7–8
- Conduct, Standards of. . . . .12
- Consortium, The Claremont Colleges. . . . .8–11
- Costs . . . . .20–21, 108
- Counseling. . . . .11
- Course Approvals . . . . .106
- Course Changes . . . .101–102
- Course Deficiencies . . . . .102
- Course Elections. . . .106–108
- Credit
- by Examination . . . . .106
  - Transfer . . . . .106
- Curriculum . . . . .5
- Deadlines
- Admission . . . . .18
- Dean's List . . . . .104
- Deferred Entrance . . . . .18
- Delinquent Accounts . . . . .111
- Deposits. . . . .109
- Dining. . . . .12
- Diploma. . . . .100
- Directed Reading Courses . .107
- Disenrollment, Involuntary from a Course. . . . .108
- Discipline. . . . .12
- Diversity, Office of Institutional . . . . .14
- Domestic Exchange Program . . . . .31–32
- Dropping a Course. . . .101–102
- Dual Degree Programs . . .97–98
- Dues and Fees . . . . .21
- Early Decision, Freshman. . . .18
- Economics . . . . .64–65
- Education. . . . .87
- Emeriti. . . . .123
- Employment, Student . . . . .111
- Engineering . . . . .25, 53–60
- Engineering Building, Parsons . .6
- Engineering Clinic. . . . .53
- Enrollment Deposit . . . . .21
- Entrance Requirements . . .18–21
- Environmental Biology. . . . .34
- Environmental Chemistry . . .41
- Environmental Studies . . . . .73
- Examinations, HMC Placement. . . . .106
- Expectations, Curricular for Applicants . . . . .17–18
- Expenses. . . . .20–21
- Extracurricular Activities . . . .15
- Facilities . . . . .6
- Faculty . . . . .5, 113–123
- Federal Work-Study . . . . .111
- Fees . . . . .108
- FERPA. . . . .102–104
- Financial Aid . . . . .110–111
- First-Year Admission. . . . .16
- First-Year Courses. . . . .27
- Foreign Languages . . . . .64, 108
- F.W. Olin Science Center . . . . .6
- Galileo Hall . . . . .7
- Geochemistry. . . . .41
- Geophysics. . . . .88
- Grade Point Averages (GPA). .102
- Grade Reports . . . . .102
- Grading Regulations. . .100–102
- Graduate Study in Chemistry. .41
- Graduation Requirements . . . . .100
- Graduation with Distinction and High Distinction. . . .104
- Graduation with Honors . . .104
- Harvey S. Mudd. . . . .11
- Health Professions . . . . .35
- Health Service . . . . .10, 13

- High School Students
- AP Examinations .20, 105–106
  - Courses . . . . .20
- History, HSA . . . . .65–66
- History of HMC . . . . .4–5
- Hixon Court . . . . .7
- Hoch-Shanahan Dining Commons . . . . .12
- Honnold Library . . . . .9–10
- Honor System . . . . .12
- Housing Facilities . . . . .12
- Housing Deposit, New and Returning Students . . . . .109
- Humanities, Social Sciences, and the Arts. . . . .25, 28, 61–75
- Huntley Bookstore . . . . .11
- Incomplete Grade . . . . .101
- Individual Program of Studies (IPS) . . . . .96
- Ineligible to Re-register (ITR) . . . . .105
- Institutional Diversity, Office of . . . . .14
- Insurance . . . . .110
- Integrative Experience (IE) . . . . .28–29, 66
- Interdisciplinary Programs .92–96
- Chemistry and Biology .92–93
  - Computer Science and Mathematics . . . . .93–94
  - Mathematical Biology .94–96
- International Students . . . . .19
- Interview, Admission . . . . .17
- Involuntary Disenrollment . .102
- Jacobs Science Center . . . . .7
- Job Placement . . . . .13, 111
- Joint Major in
- Chemistry and Biology .92–93
  - Computer Science and Mathematics . . . . .93–94
  - Mathematical Biology .94–96
- Keck Graduate Institute of Applied Life Sciences (KGI) . .9
- Keck Laboratories, W.M. . . . .7
- Leave of Absence . . . . .108
- Letters of Commendation . .104
- Libraries . . . . .9–10
- Linde Activities Center . . . . .7
- Literature . . . . .66–67
- Loan Programs . . . . .22
- Majors . . . . .30
- Biology . . . . .30, 33–39
  - Chemistry . . . . .30, 40–44
  - Computer Science .30, 45–52
  - Engineering . . . . .30, 53–60
  - Joint Chemistry and Biology . . . . .30, 92–93
  - Joint Computer Science and Mathematics . . . . .30, 93–94
  - Mathematical Biology . . . . .30, 94–96
  - Mathematics . . . . .30, 76–86
  - Off-Campus Major . . . . .96
  - Physics . . . . .30, 87–92
- Materials Chemistry . . . . .41
- Mathematical Biology . . .35, 76
- Mathematical Competition in Modeling (MCM) . . . . .78
- Mathematical Physics . . . . .88
- Mathematics Clinic . . . . .77, 79
- McAlister Center for Religious Activities . . . . .11
- Meals . . . . .12
- Media Studies . . . . .67–68, 73
- Medical Requirements . . . . .110
- Medical School . . . . .41
- Mid-Term Warnings . . . . .105
- Minors . . . . .97
- Mission Statement . . . . .4
- Molecular Biology . . . . .34
- Monsour Counseling and Psychological Services . . . . .10
- Motorcycles . . . . .109
- Mudd, Harvey S. . . . .11
- Music . . . . .68–69, 73
- NCAA Division III . . . . .14
- Need-Based Financial Aid. . . .22
- New Student Orientation . . . .12
- Nondiscrimination, Statement on . . . . .2
- Notification of Student Rights . . . . .102–104
- Off-campus Major . . . . .96–97
- Off-campus Registration . . .107
- Olin Science Center, F.W. . . . .6
- Orientation, New Student . . .12
- Overloads . . . . .106–107
- Parsons Engineering Building. .6
- Pass/Fail Courses . . . . .102
- Philosophy . . . . .69–70
- Physical Education . . . . .30, 86
- Physics and Computers . . . . .88
- Physics Clinic . . . . .87
- Physics . . . . .26, 87–92
- Pitzer College . . . . .9
- Placement Examinations, HMC . . . . .106
- Platt Campus Center . . . . .6
- Political Studies . . . . .70, 73
- Pomona College . . . . .8
- Premedical Program . . . . .35
- Privacy (FERPA) . . . . .102–104
- Probation . . . . .104–105
- Program of Transfer Studies (PTS) . . . . .108
- Psychology . . . . .70
- Putnam (William Lowell) Examination . . . . .78
- Recreation . . . . .14
- References, Personal . . . . .17
- Refunds . . . . .108–109
- Registrar . . . . .13
- Registration, Off-campus . .107
- Regulations
- Academic . . . . .100–108
  - General . . . . .108–111
- Religious Activities . . . . .11
- Religious Studies . . . . .70–71, 73
- Requirements
- Admission . . . . .16–21
  - Graduation . . . . .100
- Research (see specific major in Departmental Programs, 33–99)
- Residence Halls . . . . .6
- Retention . . . . .20
- Room and Board . . . . .21
- ROTC . . . . .14
- Schedule . . . . .12
- Scholarly Standing Committee (SSC) . . . . .107
- Scholastic Aptitude Test (SAT) . . . . .16, 17
- SCIAC . . . . .14
- Science, Technology and Society (STS) . . . . .71, 74
- Scripps College . . . . .9
- Social Life . . . . .13
- Social Sciences . . . . .61, 71–72
- Solomon Amendment . .103–104
- Sophomore Courses . . . . .27
- Sports . . . . .14
- Sprague Memorial Building . . .6
- Standards of Conduct . . . . .12
- Student Counseling . . . . .13
- Student Exchange . . . . .32
- Student Association (ASHMC) . . . . .15
- Student Government . . . . .15
- Student Health Service . . . . .10, 13, 109–110
- Student Life . . . . .12–15
- Student Rights . . . . .102–104
- Students . . . . .6
- Student Services Center, The Claremont Colleges . . . . .10
- Study Abroad . . . . .31–32
- Summer School Credit . . . . .107



Table Mountain  
 Observatory . . . . .11

Teaching Credential  
 (CGU) . . . . .98

Theater. . . . .74

Transcripts . . . . .108

Transfers. . . . .19

Transfer Studies . . . . .108

Tuition . . . . .20

Vacations  
 (College Calendar) . . . . .125

Verifications, enrollment  
 and degree . . . . .13

Veterans . . . . .20, 105

Visits, Campus . . . . .20

W.M. Keck Laboratories. . . . .7

Warning, Academic . . . . .104

Withdrawal  
 • From College . . . . .108  
 • From Courses . .101–102, 108

Women's Studies. . . . .74

Writing Center. . . . .14





