UNIVERSITY OF CALIFORNIA, MERCED

FIVE-YEAR PERSPECTIVES REPORT FOR 2005-6 to 2009-10

March 2005 Report—3/7/05

Programs **Approved** for 2005-06

B.S. in Environmental Engineering
B.S. in Computer Science and Engineering
B.S. in Biological Sciences
B.S. in Earth Systems Science
B.A. in Human Biology
B. A. in World Cultures and History
B.A./B.S. in Social, Behavioral and Cognitive Sciences
New track: Public Policy
B.S. in Bioengineering
B.S. in Management
M.A./M.S./Ph.D. in Individual Graduate Program
With emphases in:
Environmental Systems
Computer and Information Systems
Bioengineering
Quantitative Systems Biology
Molecular Science and Engineering
Social, Behavioral and Cognitive Sciences
World Cultures **[name change]**

Program Planned for 2005-06

M.S./Ph.D. in Environmental Systems
M.S./Ph.D. in Molecular Science and Engineering
M.S./Ph.D. in Quantitative Systems Biology
B.A./M.S./Ph.D. in Social and Cognitive Sciences

Programs Planned for 2006-07

B.S. in Mechanical Engineering (description enclosed)
B.S. in Materials Science Engineering (description enclosed)
B.S./M.S./Ph.D. in Chemical Sciences
B.S./M.S./Ph.D. in Mathematical Sciences
B.S./M.S./Ph.D. in Physics
B.A./ B.S. in New Energy
B.A. in Literature and Languages
Emphases: American Studies

Spanish Language and Literature
Comparative Literature
B.A. in Literature and Cultural Studies
B.A. in Public Policy
B.A. in Economics
M.S./Ph.D. in Bioengineering
M.S./Ph.D. in Computer and Information Systems
M.S./Ph.D. in Mechanical Engineering [description enclosed]
M.S./Ph.D. in Materials Science Engineering [description enclosed]
[Eliminate: M.S./Ph.D. in Cognitive Science]
[Eliminate: M.S./Ph.D. in Applied Mathematics and Physics]
M.A./Ph.D. in Public Policy
M.A. Program in Program Evaluation
M.A./Ph.D. in World Cultures
M.A./Ph.D. in Human Biology

Programs Planned for 2007-08

B.S. in Electrical Engineering
M.S./Ph.D. in Electrical Engineering

Programs Planned for 2008-09

B.S. in Engineering Economics and Management
M.S./Ph.D. in Engineering Economics and Management

Programs Planned for 2009-10

B.S. in Chemical Engineering

M.S./Ph.D. in Chemical Engineering

Programs Planned for 2010-2011

B.S. in Civil Engineering
M.S./Ph.D. in Civil Engineering

Programs Planned for 2007-08 through 2009-10

B.S. in Biochemistry
[Eliminate B.S. in Chemistry]
[Eliminate B.S. in Physics and Astronomy]
B.S. in Ecology and Evolutionary Biology **[name change]**
Two-three additions each year, selected from the following:
B.A. in Performance Studies
B.A./Ph.D. in History of Art

B.A./B.S. in Psychology
B.A. in History
B.A./B.S. in Anthropology
B.A. in Political Science
B.A. in Sociology
B.A. in Creative Writing
B.A. in Comparative Ethnic and Cultural Studies
B.A. in Spanish Language and Cultures
M.A./M.S. in Security Studies
M.A./Ph.D. in World Cultures Studies
Ph.D. in Critical Studies
Ph.D. in Economics
[Eliminate M.S./Ph.D. in Neuroscience]

Programs new to the list or revised shown in **bold**.

Campus: **Merced**

Proposed Action: **Establish an undergraduate major, a B.S., and MS/Ph.D. degrees in Mechanical Engineering** to be offered by the School of Engineering. It is anticipated that the MS/Ph.D. degrees will be offered through the appropriate graduate group starting in August 2006. Depending on resources, the B.S. degree will accept students starting in August 2006.

Description and Reasons for Anticipated Action:
Mechanical engineering is that branch of engineering that is concerned most directly with mechanical design, energy conversion, fuel and combustion technologies, heat transfer, materials, noise control and acoustics, manufacturing processes, rail transportation, automatic control, product safety and reliability, solar energy, and technological impacts on society. Practitioners of this branch of engineering study the behavior of materials when forces are applied to them, such as the motion of solids, liquids, and gases, and the heating and cooling of objects and machines. Using these basic building blocks, engineers design space vehicles, computers, power plants, intelligence machines and robots, automobiles, trains, airplanes, furnaces, and air conditioners. Mechanical engineers work on a wide range of devices that improve peoples' lives including jet engine design, submarines, hot air balloons, textiles and new materials, medical and hospital equipment, refrigerators and other home appliances. Anything mechanical or that must interact with mechanical systems—whether living or non-living--falls within the broad scope of modern mechanical engineering.

It is difficult to think of a top engineering program that does not include a mechanical engineering focus, either explicitly, or integrated into a recognizable engineering sub-discipline. Particularly important for UC Merced, a large fraction of Central Valley students interested in engineering careers specify mechanical engineering as the field in which they feel most interested. In order to embrace as large an interest as possible, our current posture is that our program will be more broadly based than as a narrow niche program. Initially, we anticipate at least 3 three focus areas, one or maybe two of which will support our energy initiatives.

Relationship to Existing Campus Programs, Units and Mission:
Mechanical Engineering adds an important dimension to the interdisciplinary framework of our program by interfacing with Environmental Engineering—particularly our air resources engineering focus area, and also fluid mechanics—our Bioengineering program as it develops into areas of biomechanical systems, and our Energy Research Institute as it emerges. We anticipate synergistic interactions with our Materials Science and Engineering program being developed concurrently.

Resources and Funding:
The specific program structure and emphasis will be determined during a workshop that will be held by the faculty during the late spring or early summer of 2005 (several UC colleagues at other campuses and the labs have already agreed to participate in this

workshop. That discussion will be "seeded" by the following ideas that have been put forth as potential focus areas, and thus faculty recruitment areas:

- Energy science & technology: broadly based researcher in mechanical systems
- Air pollution: we are already considering a mechanical engineer working in this area
- Heat & mass transfer: also supporting the UC Merced energy initiative
- Mechanical design: strong design expertise and teaching experience
- Biomechanical: good synergy anticipated with bioengineering
- Fluid mechanics: an essential component of many engineering sub-disciplines
- Controls: important for our efforts in advanced sensor technologies

Students:
Mechanical Engineering is expected to be one of, if not the, most popular Engineering majors at UC Merced. This is supported by the fact that the overwhelming majority of students who visit our campus at Castle, and who complete our information surveys, indicate their preference for this major. We further anticipate that as much as 35-40% of Engineering majors will be in Mechanical Engineering by the end of the year of inauguration for this program.

Employment Implications:
Mechanical Engineering students will find employment in manufacturing, assembly, and production industries, the aerospace industry, the extensive transportation field, and the biomedical/biotechnology fields. This major will provide a solid foundation for graduate studies in many areas of Engineering.

UC Campuses and other California Institutions with Similar Offerings:
UCB
Mechanical Engineering (http://www.me.berkeley.edu/). Focus Areas: Bioengineering, Manufacturing, MEMS and NANO, Computation, Mechatronics, Transportation, Data Storage, Energy and Environment, Ocean Engineering
UCD
Mechanical and Aeronautical Engineering (http://www-mae.engr.ucdavis.edu/). Offers undergraduate and graduate programs
UCSD
Mechanical & Aerospace Engineering (http://maeweb.ucsd.edu/). is a large interdisciplinary engineering department covering Mechanical Engineering, Aerospace Engineering, Chemical Engineering, Engineering Sciences, and Environmental Engineering.
UCLA
Mechanical and Aerospace Engineering Department! (http://www.mae.ucla.edu/). A major in Mechanical Engineering exits on this department with specialization on Power Systems and Thermal Design, Power Systems and Thermal Design
UCR
Department of Mechanical Engineering (http://www.engr.ucr.edu/mechanical/)
UCSB

Mechanical & Environmental Engineering (http://www.me.ucsb.edu/). Accredited program leading to the degrees of Bachelor of Science (B.S.), Master of Science (M.S.), and Doctor of Philosophy (Ph.D).

Anticipated Campus Review and Implementation Dates:
It is anticipated that a proposal will be submitted during Fall 2005 for review by the UC Merced Divisional Senate. Approval is anticipated by Spring 2005, which would allow the course to be advertised on the UC Merced web site for 2006 entry.

Campus Contact Person: Dean Jeff R. Wright:
jeff.wright@eng.ucmerced.edu

Campus: Merced

Proposed Action: **Establish an undergraduate major, a B.S., and MS/Ph.D. degrees in Materials Science Engineering** to be offered by the School of Engineering. It is anticipated that the MS/Ph.D. degrees will be offered through the appropriate graduate group starting in August 2006. Depending on resources, the B.S. degree will accept students starting in August 2006.

Description and Reasons for Anticipated Action:
Civilizations have stumbled or thrived according to the materials that they were able to acquire from nature, or through trade, or by innovation. Wood, stone, bronze, iron, steel, aluminum, cermets, plastics, semiconductors, liquid crystals and quantum dots have successively revolutionized what can be made and what can be done. Nations continue to go to war over access to particular raw materials. The construction of safe dwellings, the conveniences of rapid travel, the efficiency of telecommunications, the calculating and archiving power of computers, the life-prolonging gift of surgical implants, and the dazzling performances of athletes all require dependable materials. Future technological progress will always depend on available materials.

Progress in MSE impacts every other engineering discipline. It is common to find one or more materials research groups in mechanical, electrical, chemical, civil and bioengineering departments, and (as is illustrated by the example of LEDs discussed below) new materials can also have interesting consequences for computer and environmental engineering. At UC Merced, where the often restrictive boundaries between traditional engineering disciplines are absent, it makes particular sense to establish a strong materials presence early on. A well-designed MSE program would support the efficient nucleation of several of our other planned focus areas, and would promote synergy between all our engineering disciplines.

Given the subject's roots in applying principles from physics, chemistry and (increasingly) biology, MSE graduates are especially versatile in the job market. Employers appreciate the ability of MSE graduates to relate to people across a wide spectrum of expertise. With its ready examples of fundamental knowledge being used to widespread practical advantage, MSE also provides a superb platform from which to attract high school students to engineering as a career. In addition, the breadth of fundamental sciences that are encompassed by MSE suggests many opportunities for cross-school collaboration at UC Merced.

A current example of how materials can transform a technology is provided by the move toward LEDs as a replacement for traditional artificial light sources. LED technology – specifically the development of LED materials – has now progressed to where any color of light can be emitted reliably for over 100,000 hours. The power consumption is a small fraction of that used by conventional incandescent bulbs, so even if just the lamps in California's stoplights were replaced by LEDs, it would be possible to save the energy generated by two power stations. In the third world, where centralized power supplies are limited or unreliable, LED technology is finally allowing the average citizen to afford

to become independent of the rising and setting of the sun. It has been estimated that over 300 million batteries are discarded in Nepal each year, leading to significant environmental damage. The number of discards could be reduced to 30 million if white LED flashlights were used, and to a few hundred thousand if these were equipped with wind- or solar-power rechargeable batteries (another materials-limited technology). Light-emitting materials are also central to future-generation computers that will process light rather than electrical signal, leading to additional miniaturization, increases in speeds, and innovations in programming architecture.

The likelihood of this plan surviving intact decreases quickly with each successive year. Given the rapid – indeed accelerating – pace of materials research worldwide, the area of materials research that will be especially exciting in 2010-11 probably hasn't been invented yet. It should be possible to attract versatile colleagues who can contribute to the teaching of upper division courses in other majors. For accreditation purposes, we will need to demonstrate that the traditional aspects of metals, ceramics, and polymers are adequately accounted for.

Relationship to Existing Campus Programs, Units and Mission:
Materials are crucial to virtually all engineering fields. Our MSE program will interface with our program in Bioengineering, Environmental Engineering—particularly advanced sensor research—and our Mechanical Engineering major. This program will also integrate with our colleagues in Chemistry.

Resources and Funding:
We propose the hiring of 4 MSE faculty during AY 2005-06. This will bring our core faculty involvement in this area to a total of 6, which will be sufficient to initiate our upper division course offerings in this area. The *sequence* in which MSE hires are made after these first 3 is independent of the number of hires. The list below tries to interface the MSE hires with what else might be going on, but it is not a unique solution.

- Materials for (optical) computing/communication/data storage: Materials for long-term archiving under ambient conditions. (How long will your data last on CD-R ?)
- Materials for alternative energy devices: These could be materials for active solar energy conversion, or high temperature materials for passive devices, or materials that can resist extreme heat and abrasion.
- Nanomaterials: Properties / processing / environmental consequences.
- Materials modeling: Predicting how materials will behave over long periods of time, under particular in-service conditions, is big business.
- Environmental focus (overlaps EEM and ENVE): How does the production and use of particular materials affect the environment? What are the implications for use of water and power when a particular material is chosen? How do environmental considerations factor into materials selection? When are alternatives viable? What toxic products result from degradation/burning/disposal?
- Degradation/corrosion of materials: What does the environment do to materials? Controlling durability vs degradability.
- High Temperature materials: Materials for high-efficiency engines, flame retardance, spacecraft re-entry, energy conversion.

- Self-assembling materials: Materials produced by transgenic organisms; controlled in vitro self-assembly by mimicking in vivo processes.
- Biomaterials: Implants; tissue-inducing substrates; smart materials that can alter their properties in response to electrical stimulus.

Students:
Materials Science & Engineering is expected to be one of, if not the, most popular Engineering majors at UC Merced. The major will attract about an average number of students at the undergraduate level, and slightly above average numbers at the graduate level. The fraction of MSE students in at both levels will grow as the importance of new and emerging materials to engineering practice increases dramatically over the next few decades.

Employment Implications:
Materials Science & Engineering students will find employment in manufacturing, industries, any industry involved with using high performance materials, the materials production industry, and biotechnology corporations. This major will provide a solid foundation for graduate studies in many areas of Engineering.

UC Campuses and other California Institutions with Similar Offerings:
UCB
Materials Science & Engineering (http://www.mse.berkeley.edu/) awards undergraduate and graduate degrees. programs in the practical and theoretical aspects of materials, their utilization in Biomaterials**,** Chemical and Electrochemical Materials**,** Computational Materials, Electronic, Magnetic & Optical Materials, and Structural Materials**.**
UCD
Mechanical Engineering / Material Science Engineering Major (http://www-mae.engr.ucdavis.edu/programs/undergrads/und_mema.htm) A major within Mechanical and Aeronautical Engineering. Undergraduate and Graduate programs.
UCSD
Materials Science & Engineering (http://matsci.ucsd.edu/). Offers undergraduate and graduate programs. The graduate of the Materials Science and Engineering Program benefits from unique research facilities existing at UCSD. These include the resources in the Department of Mechanical and Aerospace Engineering, Electrical and Computer Engineering, Physics, Chemistry, Bioengineering, Structural Engineering, Scripps Institution of Oceanography, as well as in the Center of Excellent for Advanced Materials and the Center for Magnetic Recording Research.
UCLA
Department of Materials Science and Engineering (*http://www.seas.ucla.edu/ms/*). A joint major field, chemistry/materials science, is offered to students enrolled in the Department of Chemistry and Biochemistry (College of Letters and Science). Several courses in the undergraduate curriculum also play an important role in the manufacturing engineering program. The graduate program allows for specialization in one of the following fields: ceramics and ceramic processing, electronic and optical materials, and structural materials
UCSB

Materials Department (http://www.materials.ucsb.edu/). The Department is organized into four distinct--yet interrelated--groups specializing in:

- electronic materials - compound semiconductors, including wide band-gap and magnetic semiconductors, quantum structures, advanced lasers, solid state lighting MEMS.
- inorganic materials - ferroelectrics, optical materials, and zeolite molecular sieves and catalysts.
- macromolecular and biomolecular materials - self-assembling structures, complex fluids, biopolymers, biomembranes, biosurfaces; conducting and photonic polymers.
- structural materials - advanced thermostructural materials, including alloys, ceramics, high temperature composites and thermal barrier coatings; structural polymers, multifunctional materials.

Anticipated Campus Review and Implementation Dates:
It is anticipated that a proposal will be submitted during Fall 2005 for review by the UC Merced Divisional Senate. Approval is anticipated by Spring 2005, which would allow the course to be advertised on the UC Merced web site for 2006 entry.

Campus Contact Person: Dean Jeff R. Wright: jeff.wright@eng.ucmerced.edu

UC Merced

Proposed Action: To establish a B.S./M.S./Ph.D. in Chemical Sciences.

Brief program description and rationale

Chemistry is often known as "the central science" because of the key position it occupies in modern science and engineering. Most phenomena in the biological and earth sciences can be described in terms of the chemical and physical behavior of atoms and molecules, and chemical principles also underlie much progress in medicine and engineering. In addition, chemical systems are fascinating and often beautiful in their own right. Recent developments in the chemical sciences are increasingly directed toward the study of phenomena at the nanoscale, the size range intermediate between individual molecules and macroscopic matter. The ability to measure, understand, and control the properties of matter on these size scales allows us to draw conceptual and practical connections between the submicroscopic world of atoms and molecules and the macroscopic world with which we interact.

A degree in chemistry opens the door to a wide variety of careers. Many chemistry graduates go on to rewarding careers as researchers in industry in areas such as electronic materials, biotechnology, medicinal chemistry, and petrochemicals. Others enter government service as research chemists in, for example, the US Department of Agriculture, the Food and Drug Administration, and the Environmental Protection Agency, or as forensic chemists in crime laboratories. Still others go into commercial fields such as patent law and scientific writing. Many chemistry majors go on to university graduate programs to prepare for careers in research, teaching, or a combination of the two. The degree in chemistry provides a valuable disciplinary background in preparation for a career in the much-needed area of high school science teaching. A major in chemistry is also an excellent foundation for medical school or other careers in the health sciences.

Essentially all comprehensive research universities offer one or more undergraduate chemistry degrees. Chemistry or chemistry/biochemistry ranks among the top 20 majors at the Berkeley, Davis, Irvine, Santa Cruz, and San Diego campuses. It also tends to attract highly capable students, and our ability to offer a Chemical Sciences major should aid UC Merced in recruiting some of the best and brightest students who would otherwise be lost to other campuses. Like other majors in Natural Sciences, we have structured Chemical Sciences using a "core + emphasis" concept which begins with a common set of fundamental courses and then branches out into multiple emphasis tracks. This allows students to learn the basics of the discipline and then move, if desired, into a specific interdisciplinary area of concentration. We expect that this structure will result in increased student interest, enrollment, and completion of the Chemical Sciences major compared with a traditional chemistry major. Our three emphasis tracks seek to fill several "niches" that will make Merced unique among UC campuses. There currently exist only five American Chemical Society-approved Materials Chemistry programs nationwide, and none of these are in the state of California. No other UC campuses currently have ACS-approved Environmental Chemistry or Biochemistry programs. We plan to offer these three tracks as well as a straight "Chemistry" track. All of our programs are designed to be eligible for ACS approval, and once designated as such, graduates of the program can receive ACS-certified degrees. A certified degree is a valuable personal credential which serves as national-level recognition for successfully completing a rigorous academic chemistry curriculum in an ACS-approved department. The rigor and requirements of the certified degree are valued by potential employers and graduate schools alike.

The lower-division chemistry courses are already being offered as required foundation courses for most of the other majors in the Natural Sciences and Engineering. The upper-division courses for the Biological Chemistry and Environmental Chemistry emphases have been selected and developed to mesh closely with the Biological Sciences and Earth Systems Science majors, respectively, and it is expected that the Materials Chemistry emphasis will have synergy with the Materials major that the School of Engineering is planning to introduce at a later date. Because of the central role of chemistry to so much of science and engineering, we expect that many of the upper-division chemistry courses will be of interest to other science and engineering majors as well as to beginning graduate students in the Molecular Science and Engineering, Environmental Systems, and Quantitative Systems Biology graduate groups.

Program requirements

The curriculum is designed to meet the needs of students who plan to end their formal education with a bachelor's degree as well as those who wish to go on for an advanced degree. The lower-division courses required for junior transfers are standard and are available at almost all community colleges. Our Chemical Sciences program should be readily accessible to transfer students from community colleges or other four-year institutions.

Accreditation

The American Chemical Society's Committee on Professional Training publishes a set of curricular guidelines that programs must meet in order to be eligible for ACS approval. We have designed our programs to meet these guidelines, both for the ordinary chemistry major and the three emphasis tracks. The formal approval process involves a detailed review of the program. A program cannot be approved until it has produced an average of two graduates per year for a total of five years. We plan to seek ACS approval at the earliest possible date.

Resource needs and plan for providing them

UC Merced currently has three faculty whose primary discipline is chemistry. When the Chemical Sciences major is underway at steady state with students at all levels from freshman through senior, a minimum of four more chemistry faculty (roughly one each in the subdisciplines of organic, physical, inorganic, and analytical chemistry) will be needed to provide the required courses.

Chemistry is a laboratory science and a large amount of laboratory work is required for the degree. The curricular guidelines for an ACS approved program require a total of at least 500 contact hours of laboratory work, of which no more than 200 hours can come from independent research. There will also need to be some financial support for use of recharged equipment and materials and supplies consumed by students performing research for credit. Some of the upper-division laboratory courses will require specialized space (which can be shared with other laboratory courses) and one-time purchases of specialized equipment.

Library resources (primarily access to electronic journals) adequate to support the research needs of the current chemistry faculty are already in place. No additional resources should be needed to meet the curricular needs of the Chemical Sciences major. Some of the upper-division courses may require acquisition of some specialized computational software.

Potential for non-majors to participate

Chemistry is a discipline in which one topic builds on another. Therefore most of the upper-division courses will be accessible to non-majors only if they have taken several prerequisite courses.

Timetable for implementation

The CHEM courses that would normally be taken during the student's first two years are all courses that must be offered already to satisfy the requirements of other majors already approved. We therefore propose to begin offering the Chemical Sciences major to freshmen only starting in the 2005-2006 academic year, and to junior transfers as well starting in 2007-2008. In this way no new courses need be taught until the 2007-2008 academic year, by which time we should have adequate faculty in place to offer them.

Enrollments are very difficult to forecast. During the 2002-2003 academic year, the number of chemistry bachelor's degrees awarded at other UC campuses ranged from a high of 180 at UCLA to a low of 18 at Santa Cruz. Scaling these numbers to our assumed entering class size of 1000 results in a prediction of between 4 and 28 degrees awarded per year. For the reasons described above, we believe that our Chemical Sciences program will be quite attractive relative to chemistry programs at other campuses, and we think 20-25 majors per class is a reasonable estimate during the program's first few years. This number would allow comfortable class sizes in our upper-division courses and have only modest resource needs for TAs and laboratory facilities.

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UC Merced

Proposed Program: To establish a B.S./M.S./Ph.D. in Mathematical Sciences

Brief program description and rationale

Mathematics is an essential part of scientific development. By itself, mathematics is a subject of great depth and beauty. However, mathematics is also used extensively in the development of social science, natural science and engineering. This breadth of applicability is also rich with depth and beauty. Hence, our aim for a major in mathematical sciences at UC Merced is twofold. First of all we wish to provide a rich educational experience for students in the fundamentals of mathematics. In addition, we wish to provide students ample opportunities to apply these fundamental tools to develop a deeper understanding of another area. We shall do this by stressing courses that involve the construction, analysis, and evaluation of mathematical models of real-world problems, and those areas of mathematics that are most widely useful in solving them. A student shall acquire a solid background in the three principal areas of applied mathematics: modeling, analysis or solution methods, and numerical analysis and scientific computing. Beyond those topics, the program shall allow for considerable flexibility so that students may develop an application area of expertise. This demanding undergraduate program is inherently interdisciplinary.

A Bachelor of Science degree in Mathematical Sciences prepares its students with fundamental skills needed for modeling, analytical reasoning, problem solving and scientific computing. These skills are widely recognized as essential for solving a broad spectrum of problems across several disciplines. Hence, these skills are marketable to a wide variety of employers. Moreover, mathematical sciences students trained in application areas such as economics, engineering, management, biology, chemistry, physics, computer science, or the environmental sciences are well suited for many specialized positions. Finally, these students have opportunities to continue onto graduate school in mathematical sciences or in their application area of expertise.

The structure of the curriculum has been designed so that students learn the fundamentals of mathematical thought while applying these skills actively to an application area. There are a core set of courses that all mathematical science students take. Beyond those courses, students shall design their own “application theme” consisting of upper division courses in other fields. Finally, all mathematical sciences students take clinic. Clinic students work as a team to solve a real-world problem donated by a client from industry, business or government. The culmination of their work is a formal report and presentation to the client.

All of the lower division mathematics courses are already being offered because most of them are required for all majors in the Schools of Natural Sciences and Engineering. Several of the mathematics courses are needed for majors in the School of Social Science, Humanities and Arts. The upper division courses may also serve undergraduate and graduate students in the physical sciences and engineering programs needing more mathematical training for their education.

Program requirements

UC Merced will offer an undergraduate major which provides the foundations of mathematics and the skills needed to apply mathematics to real-world phenomena in social science, natural science and engineering. The lower-division courses required for junior transfers are standard and are available at almost all community colleges. Our Mathematical Sciences

program should be readily accessible to transfer students from community colleges or other four-year institutions.

Resource needs and plan for providing them

When the Mathematical Sciences major is underway at steady state with students at all levels from freshman through senior, at least eight mathematics faculty will be needed to provide the required courses. That estimate assumes only one instructor is needed for each course to be offered. However, the demands for undergraduate mathematics instruction include approximately 60% of all freshmen students across all three schools. This demand for mathematics instruction increases substantially the need for faculty in mathematical sciences to staff multiple sections of lower division mathematics courses. Hence, the absolute minimum number of fourteen faculty in mathematics is needed to meet these demands.

Library resources (primarily access to electronic journals) adequate to support the research needs of the current mathematical science faculty are already in place. No additional resources should be needed to meet the curricular needs of the Mathematical Sciences major. Some of the upper-division courses may require specialized computational software.

Potential for non-majors to participate

There are several opportunities for non-majors to participate in the mathematical sciences major. For example, the majority of students in lower-division courses are not mathematical sciences majors. The upper-division courses may serve undergraduate and graduate students in other fields such as physics, and computer science among others needing a more rigorous background in mathematics.

Timetable for implementation

The mathematics courses that would normally be taken during the student's first two years are already approved because they are all courses needed to satisfy the requirements of other majors. We therefore propose to begin offering the Mathematical Sciences major to freshmen only starting in the 2006-2007 academic year, and to junior transfers as well starting in 2009-2010. In this way no new courses need be taught until the 2009-2010 academic year at which time we should have adequate faculty in place to offer them.

Campus Contact Person: Dean Maria Pallavicini mailto:mpallavicini@ucmerced.edu

UC Merced

Proposed Action: Establish an undergraduate major, a B.S., and M.S./Ph.D. degrees in Physics: These degrees will be offered by the School of Natural Sciences. It is anticipated that the B.S. program will accept students starting in Fall 2006. Depending on resources, the M.S./Ph.D. degrees will also be offered through the appropriate graduate group starting in Fall 2006.

Description and rationale

Physics is the study of the properties and behavior of nature at its most fundamental. It ranges from the study of the very tiniest pieces of matter and energy, including molecules, atoms, photons, and subatomic particles, to the study of the entire universe. Physics examines problems at their most basic, and it is an integral part of any general science program. Insights in physics have revolutionized our society. It is hard to imagine an area of science or engineering that has not been profoundly affected by fundamental developments in physics. One need only think of the harnessing of electricity, the invention of the transistor, and the discovery of the laser.

The physics major at UC Merced will educate students in basic physical properties and phenomena of the natural world, with an emphasis on quantitative and analytical reasoning. Students will learn a broad range of fundamental skills that will prepare them for a career either in traditional physics (i.e. physics grad school or industry) or in a wide range of other disciplines in which a solid grounding in physics is valuable.

As with the other majors in the School of Natural Sciences, the physics major will consist of a core physics curriculum together with an emphasis in a particular physics track. The track structure will allow students to explore physics within a variety of contexts. This track structure distinguishes the physics program at UC Merced from traditional physics majors, and will enhance the interdisciplinary atmosphere at UC Merced. The initial set of proposed tracks are atomic/molecular/optical (AMO) physics, mathematical physics, biophysics, and geo/planetary physics.

Relationship to existing campus programs and mission

The track structure will provide synergy between the physics program and other majors within Natural Sciences and Engineering, specifically with the biological, mathematical, and earth systems science programs and with the environmental and bioengineering programs. The physics major will also complement the proposed research emphases in Atomic, Molecular, and Optical Science, in Condensed Matter Chemistry and Physics, and in Energy.

Required teaching resources

We will have three FTEs devoted to physics by fall 2005. We will then require five more hires by fall 2009, which is one a year, with two in one of the years. (Current plans include two new physics hires to start in fall 2006.)

Student appeal

It is anticipated that the physics track structure will make the major desirable to a greater

number of UC Merced undergraduate students than might be expected for a traditional physics program. The biophysics track will likely attract those students who want the analytical rigor of a physics degree but are excited by the many revolutionary advances in modern biology. Indeed, many physics departments are currently hiring biophysics faculty, and a student successfully completing this track could pursue graduate education in either biology or physics, in addition to employment in the biotech industry. The geophysics track would appeal to those students interested in earth systems science, but who want a more solid foundation in fundamental physical principles. The AMO and mathematical physics track would likely appeal to those students who otherwise enroll in a traditional physics program. Such students would be well prepared for graduate study in physics or applied math as well as employment in a variety of technical, consulting, and engineering companies.

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