Academic Year 2005-2006
Strategic Plan

School of Engineering
University of California, Merced

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Contents

1. Summary: Strategic Planning Goals and Objectives

The strategic planning process conducted by the faculty of the UC Merced School of Engineering, and described in this document, was guided by the following goals:

1. Develop a strategy for building an Engineering program that is well positioned to conduct, now and in the future, research of the highest quality, while being responsive to the needs of the State, the Nation, and the Central Valley;

2. Craft an educational framework that (1) provides students the knowledge and skills necessary to address increasingly complex technical problems, (2) empowers students to assume leadership positions within their chosen fields of endeavor, and (3) equips them to continue their professional development throughout their careers;

3. Recognize that resources available to build this university are limited, requiring efficient solutions to meet the challenges of establishing a solid foundation for academic excellence; and

4. Establish an academic culture that values diversity, representation, and inclusiveness throughout our community—students, staff, and faculty—and is shaped by the goals of student success.

Complementing these goals, our strategic planning process was guided explicitly by (1) the desire to maximize the degree to which cross-disciplinary research and education can flourish among the Schools at UC Merced, and (2) our need to position our programs to meet the requirements for eventual professional accreditation.

Through the strategic planning process it became clear that rather than beyond simply *conducting* a planning process our goals and objectives could be better met by developing a dynamic framework within which strategic decisions and management operations could be developed and evaluated continuously. This lead to the development of a model that could be used to better understand the implications of our decisions, and that could further be used as an ongoing and evolving mechanism for communication among our current and future faculty, and constituencies. While preliminary at this point, this strategic planning model will be expanded and enhanced as we grow, and will be employed regularly to explore options for continuously improving our academic programs.

The structure of this planning model—as presented schematically in Figure 1—presently consists of 5 separate but related modules plus associated databases:

Strategic planning module: Faculty as individuals or by groups, interact with the model through this module, which allows testing of different estimates and assumptions for student and faculty growth, success and performance.

Faculty growth module: Student growth profiles and strategic opportunities for faculty hiring provide a basis for estimating the need for faculty to meet expected needs and opportunities. This module will eventually be enhanced to capture fluctuations of faculty numbers, including career advancement, sabbaticals and leave assumptions, etc.

Resources module: Allows the testing of different scenarios for allocation of resources throughout our program including students to majors, faculty to programs, facilities to uses, materials to courses, etc. This module will eventually be expanded to include options for infrastructure management and planning.

Student growth module: Inputs of anticipated student interest and demand for Engineering are evaluated with assumptions about student retention, progress toward degree, movement between focus areas, etc. to predict student movement through our program. Future elements will provide the ability to model student retention, performance, and class/course preferences.

Course/curriculum module: A database of course parameters (units, prerequisites, etc.) and program requirements (unit requirements by course/class type, relationship between courses, etc.) is used to develop programmatic options. This will eventually be on-line, allowing students to develop plans of study that can be discussed with, and monitored by, faculty advisors.

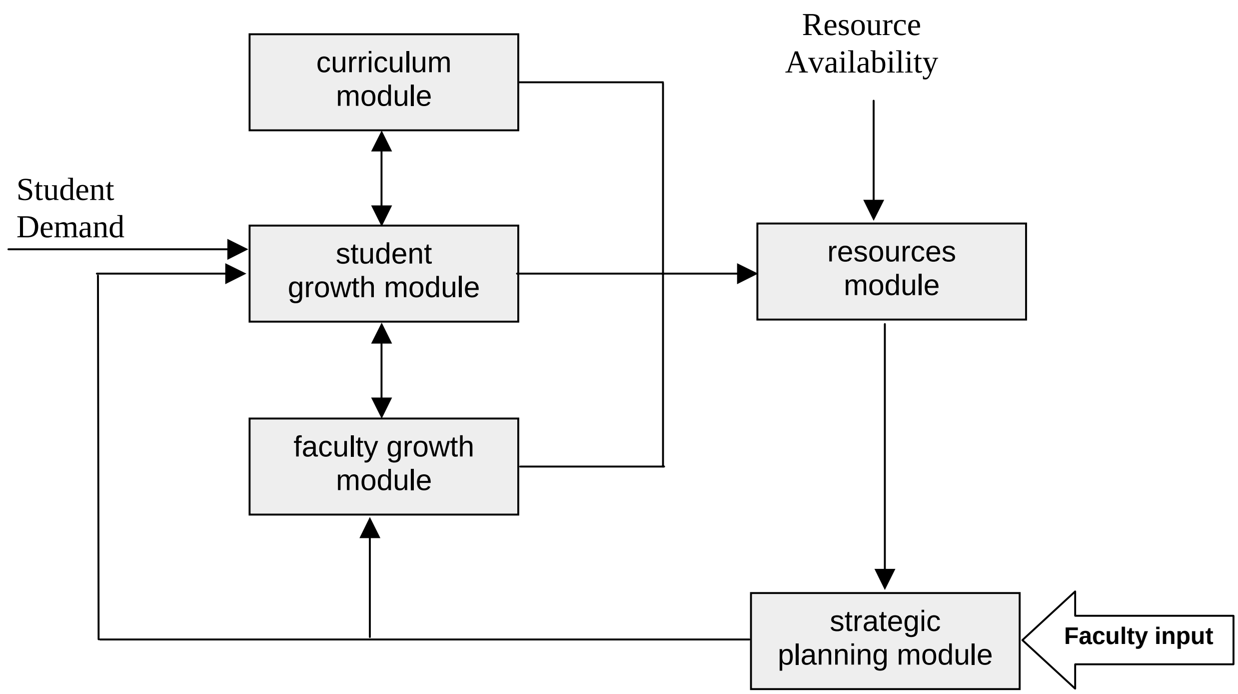

Figure 1 — School of Engineering Strategic Planning Model Structure

While still very much preliminary in nature, the model was used effectively in the development of the strategic plan that is presented in this document. Available data provide a baseline for describing our current academic program: current and anticipated faculty through the first 20 FTE hires; anticipated student numbers; approved and soon-to-be-approved courses and curricula; and existing resource utilization. Our current academic program is described in Section 2, below. Section 3 presents the 1-year plan and request for additional Engineering faculty FTE hiring during the 2005-06 academic year. A 5-year estimate of student growth, programs expansion, and faculty development is described in Section 4.

2. Description of Current Academic Programs

2.1. Inaugural Engineering Academic Majors

The inaugural undergraduate majors to be offered by the School of Engineering (SOE) are Bioengineering (BIOE), Computer Science and Engineering (CSE) and Environmental Engineering (ENVE). Freshman will be admitted directly into these majors, and will experience a common freshman year curriculum[i]; transfer students will be admitted into CSE and ENVE only during the first year.

2.1.1. Environmental Engineering (ENVE)

The undergraduate major in Environmental Engineering prepares students for careers in both industry and government agencies concerned with managing water, energy, public health, and the environment, and provides a solid a good foundation for further study in Earth science, engineering, business, management, law, and public health. The curriculum provides students with a quantitative understanding of the physical, chemical, and biological principles that control air, water and habitat quality and sustainability on Earth, along with expertise in the design, development, implementation, and assessment of engineering solutions to environmental problems.

Environmental engineers are distinguished from other environmental professionals through their focus on problem solving, design, and implementation of technological or management systems. Environmental engineers search for creative and economical ways to use resources efficiently, limit the release of residuals into the environment, develop sensitive techniques to track pollutants once released, and find effective methods to remediate spoiled resources. As such they serve as the vital link between scientific discovery, technological development, and the societal need for protecting human health and ecological integrity. In the coming decades, environmental engineers will increasingly be called upon to address broader issues of environmental sustainability, by minimizing the release of residuals through altered production processes and choice of materials; by capturing the resource value of wastes through recovery, recycling, and reuse; and by managing natural resources to meet competing societal objectives.

UC Merced emphasizes a highly interdisciplinary approach to Environmental Engineering, combining a strong theoretical foundation with field studies, laboratory experiments, and computations. Core courses within the major provide students with a firm foundation in the physical and life sciences and the ways that they apply to energy, hydrology, air, and water quality issues. Emphasis areas allow students the flexibility to study in more depth by following tracks developed in consultation with their academic advisor(s). The main areas of emphasis for environmental engineering at UC Merced are hydrology, water quality, air resources engineering and management, and energy sustainability.

Anticipated Engineering faculty involvement in delivering the EVNE major includes:

- Professor Roger Bales
- Professor Martha Conklin
- Associate Professor Thomas Harmon
- Professor Roland Winston
- Professor Jeff Wright

Supported also by faculty involvement from our sister Schools including:

- Professor Peggy O'Day
- Professor Samuel Traina
- Professor Jessica Green

With anticipated additional faculty hires in the areas of:

- Environmental Microbiology (1.0 FTE)
- Air Pollution Environmental Engineer (1.0 FTE)
- Possible joint air hire with Natural Sciences (0.5 FTE)
- Spatial Analysis Engineering (1.0 FTE)
- Heat Transfer & Energy Systems (1.0 FTE)

2.1.2. Bioengineering (BIOE)

Bioengineering is a highly interdisciplinary field in which (1) the techniques, devices, materials, and resourcefulness of engineers are used to address problems in biology and healthcare, and (2) lessons from biology are used to inspire design and inform progress in engineering. Over the past 40 years, this synergism between biology and engineering has led to a wide range of implantable materials, diagnostic devices, sensors, and molecular characterization techniques, and it has produced tools that greatly expedited the sequencing of the human genome. Alongside these practical innovations there has come a rapidly increasing need for personnel with the necessary hybrid skills to capitalize on them; thus undergraduate bioengineering programs have proliferated alongside the continued growth of bioengineering research.

Most recently, convergence between engineering and biology at the nanoscale level—the level of biological molecules, molecular aggregates and cellular processes—has begun to offer rich new areas of study and commercialization. The undergraduate major in Bioengineering is designed to provide students with both breadth and depth. The Nanobioengineering track reflects the fact that synergism between the "nano" and "bio" themes in engineering and science is here to stay. The name also highlights an initial focus on things molecular, supramolecular, cellular, and material, which will allow the program to draw efficiently on the talents of the biologists, chemists, physicists, and other UC Merced faculty in basic engineering and science programs. It is anticipated that faculty associated with our Bioengineering program will support our campus goals of contributing to innovation in stem cell research at UC Merced.[ii]

The Bioengineering major will admit students only at the freshman level upon opening in 2005; transfer students will be admitted into this major beginning fall, 2006.

Anticipated Engineering faculty involvement in delivering the BIOE major includes:

- Assistant Professor Valerie Leppert
- Professor Christopher Viney

Supported also by faculty involvement from our sister Schools including:

- Professor Michael Colvin
- Professor Henry Forman

With additional Engineering faculty hires in Bioengineering with a nano and molecular-scale focus in the following areas:

- Biosensors (1.0 FTE)
- Biomembranes (1.0 FTE)
- Organic or Inorganic Interfaces (1.0 FTE)

2.1.3. Computer Science and Engineering (CSE)

The undergraduate major in Computer Science and Engineering is designed to provide students with both breadth and depth in the exciting and rapidly expanding fields of

- **Computer Science:** the study of computation, including algorithms and data structures
- **Computer Engineering:** including hardware, software, and network architecture

A degree in Computer Science and Engineering from UC Merced will prepare students to assume leadership roles in designing, building, and implementing a vast array of powerful new technologies that will continue to advance humankind. As the foundation for innovation in areas ranging from robotics and automation, to informatics and personal computation, careers in computer science and engineering are among the most satisfying and rewarding of any technical discipline.

Computer science and engineering constitutes one of the strongest industrial sectors in the region and the nation, offering a broad spectrum of career opportunities. Education at UC Merced will provide the opportunity to participate in innovative classroom learning experiences, to become involved in laboratory research, to participate with fellow students in team activities and projects, and to interact directly with our remarkable faculty. From introductory programming courses, through architecture design experiences, to research and team project activities, our students will gain insights that will allow them to excel throughout their chosen career path.

Anticipated Engineering faculty involvement in delivering the CSE major includes faculty hires in the following areas:

- Data Management (1.0 FTE)
- Networking (1.0 FTE)
- Graphics/Visualization (1.0 FTE)
- Software Engineering (1.0 FTE)
- Computer Hardware/architecture (1.0 FTE)
- Autonomous computing/Robotics/MEMS (1.0 FTE)
- Computational Science and Engineering (1.0 FTE)

Supported also by possible faculty involvement from our sister Schools including:

- Professor Michael Colvin
- Assistant Professor Arnold Kim

2.2. Involvement in Graduate Groups

Engineering faculty participate in planning and development, and research activities of UC Merced existing and planned graduate groups.

2.2.1. Environmental Systems

The graduate emphasis in Environmental Systems is organized to establish and administer a program of instruction and research leading to the M.S. and Ph.D. under the auspices of the Interim Individual Graduate Program (IIGP) and in conformance with the regulations of the Graduate Council and the Office of Graduate Studies at the University of California, Merced. The Graduate Group is responsible for establishing standards and requirements for the M.S. and Ph.D. degrees and certifying satisfactory completion by candidates.

The Group function is to provide a focus for graduate training in Environmental Systems by facilitating the research interactions among and between graduate students and faculty. By its very nature the study of environmental systems is multifaceted and draws on the expertise of the Natural Sciences, and Engineering disciplines, as well as those within the Social and Behavioral Sciences, and Management. The principal focal areas of the Group include, but are not limited to Atmospheric Sciences, Earth Systems Science, Ecology, Environmental Geochemistry, Hydrology and Water Resources Management, and Environmental Engineering; this is not intended to preclude the growth into other areas. As the breadth of faculty expertise grows in the coming years there is expected to be broad faculty representation in this group from across the University.

2.2.2. Molecular Science and Engineering

The Molecular Science and Engineering graduate group was established to coordinate research across a variety of interdisciplinary areas, including materials science and engineering, and chemical, biological, and materials processes and products. A key feature is joining molecularly based modeling with the other computational methodologies that are used in the chemical engineering sciences for research, development, operations, and education. This group is intended to foster research synergy among the combined community of engineers and scientists interested in applying molecularly based theories to systems modeling, and simulation. Strong synergy between this group and the computational systems and systems biology group is anticipated.

2.2.3. Quantitative and System Biology

The life sciences are undergoing a vast and fundamental metamorphosis from a discipline based on qualitative observation and description, into a quantitative science based on comprehensive datasets and predictive models. The Quantitative and Systems Biology Graduate Group at UC Merced offers individualized, research-based courses of study leading to the M.S. and Ph.D. degrees. Research projects are available on topics ranging from intercellular signaling to computational molecular biology. Coursework will provide a background in the tools of modern biology, including computational biology, genomics, and advanced instrumentation. The Graduate Group will offer opportunities for students interested in multidisciplinary projects at the interface of biology, computer science, and bioengineering.

2.2.4. World Cultures and History

A Graduate Group in World Cultures has been formed to offer individualized, research-based courses of study leading to the M.A. and Ph.D. degrees. The program will explore cultures in both their local manifestations (by focusing on the rich cultural and historical heritage of California, the San Joaquin Valley, and the Sierra Nevada), and in a global context. The Group will pay particular attention to world cultures in their historical, political, and cultural manifestations, and to the effects of immigration and migration on society and cultural change. Students will understand and use the methods by which historians, literary scholars, artists, philosophers, and other humanists and social scientists examine societies and cultures. Initially, the program will offer concentrations in History, Literatures and Cultures of the Spanish-speaking World, and Literatures and Cultures of the English-speaking world. Concentrations will include multidisciplinary courses, and they are conceived as mutually complementary. Since proximity to the Sierra and the other splendid natural features of

California has significantly influenced the cultural and historical development of the state, students will also benefit from the intersections of interests between the World Cultures Institute (WCI) and the Sierra Nevada Research Institute (SNRI), particularly in the area of the cultural understanding of wilderness and the environment. Since the construction of the faculty for the World Cultures graduate group is currently ongoing, please consult the graduate division web page

2.2.5. Computer & Information Systems

The graduate group in Computer and Information Systems has not yet been developed. It is anticipated that the inaugural Computer Science and Engineering faculty will constitute the core of this graduate group, working closely with faculty in areas of applied mathematics, and quantitative biology, and possibly faculty in the more quantitative areas of the School of Social Sciences, Humanities and Arts.

2.2.6. Social, Behavioral and Cognitive Sciences

Planning is currently in progress to create a Graduate Group in Social, Behavioral and Cognitive Sciences beginning in the fall of 2005. SBCS graduate training is likely to focus initially on the areas represented by current faculty—economics and, experimental psychology, behavioral research methodology, and cognitive science. In subsequent years, additional faculty and graduate emphases in sociology, political science, public policy, or anthropology may be added. This site will be updated periodically with more specific information about the graduate programs in SBCS.

2.3. Involvement with UC Merced Research Institutes and Centers

2.3.1. Sierra Nevada Research Institute (SNRI)

The SNRI is creating new knowledge on questions of national and international scope through the prism of the natural laboratory that is UC Merced's home–the San Joaquin Valley and the Sierra Nevada region, and is carrying out research on the critical issues that affect humankind's ability to live in an environmentally sustainable way.

These issues are especially vital to sustaining the unparalleled agricultural resources and magnificent natural landscapes of the San Joaquin Valley and Sierra Nevada. The Sierra Nevada Research Institute will draw in the natural sciences, engineering and policy sciences.

2.3.2. World Cultures Institute

As a natural laboratory for research of international import, California's San Joaquin Valley is defined by the mobility and migration, and sometimes forced diasporas, of peoples affected by historical events. The history of these events will be complemented by studies of the impact of such human and social changes on established peoples and resources. The World Cultures Institute will weave together humanities, arts and social sciences.

As the World Cultures Institute grows, these themes will be part of it:

- Migration and displacement
- Histories and cultures of California and particularly the San Joaquin Valley
- Local, regional and national identities, boundaries, and their crossings
- Economics, religion, the arts and ethnic identity in the formation of the individual and society

- Nature and culture: the relation of wilderness to the manmade landscape, with the role of technological invention in affecting both
- Agriculture and society
- Evolving and competing images (artistic, literary, cinematic, architectural) of California

Undergraduates are invited to participate in research with historians, anthropologists, artists, political scientists and policy specialists, economists, scholars of literature and languages, and others—even scientists. Internships with a cultural resources emphasis are anticipated with museums, arts centers, historical societies, community groups, libraries, public education organizations, and National Parks.

2.3.3. Energy Research Institute

Renewed State, national, and world-wide attention on energy, the impending need for a comprehensive US energy policy bolstered by sound scientific principles, and our commitment to improved and sustainable environmental quality in the Central Valley, make a compelling case for the development of a strong research focus on renewable energy systems at UCM. By establishing at the outset a strong, yet narrowly focused program in Solar Energy, UC Merced will plant a seed that will grow quickly into a highly visible pillar upon which we will build a preeminent energy research infrastructure, that will support a focused research and educational agenda in the area of New Energy Systems. The relationship between new energy sources, and water supply planning an management with its extreme reliance on energy, will be an initial cross-disciplinary thrust between the Energy Institute and the SNRI.

The initial technical focus of the Center will be solar technology focusing on solar concentration; solar thermal technologies and concentrating photovoltaic. This work will build upon the foundation established in the area of non-imaging optics, and will expand into a comprehensive solar energy research program through collaboration with LLNL scientists, involvement with other UC faculty and new UC Merced faulty hires, researchers at other academic institutions globally as appropriate. Extensions into other technical research areas of renewable energy such as wind, geothermal, hydroelectric, and hydrogen-based technologies will occur, and with additional faculty hires focusing in areas of energy economics and public policy, evolution into a *New Energy Research Institute* is envisioned. As this comprehensive program in renewable and sustainable energy research and policy evolves, it will attract substantial federal and industrial funding support that will enable expansion across the UC system in the form of a multi-university research unit (MRU).

2.3.4. Systems Biology Institute

The long-term goal of the Systems Biology Institute will be to help enable a biology that drives, and is driven by, the latest developments in the mathematical and computational sciences. The key steps in advancing this goal are to:

- Produce outstanding research results at the interface between the computational and life sciences;
- Create computational and life scientists with strong cross-disciplinary knowledge; and
- Build post-doctoral, graduate, and undergraduate biology programs that attract quantitatively-oriented students.

It is anticipated that Engineering faculty from the BIOE area will become affiliated with this institute as it evolves.

2.4. Involvement with UC Systemwide Research Centers and Institutes

Engineering faculty are involved directly with two system-wide UC multi-campus research entities: the Center for Information Technology Research in the Interest of Society (CITRIS) based at UC Berkeley, and the Bioengineering Institute of California (BID) based at UC San Diego. Involvement with each at this point is modest, with faculty primarily involved with administration and organizational activities of the Institutes. But our involvement will grow quickly as the university expands its faculty, students and academic programs.

2.4.1. Center for Information Technology Research in the Interest of Society

In 2000 the Governor and Legislature established the California Institutes for Science and Innovation (CISI). The Center for Information Technology Research in the Interest of Society (CITRIS)—launched by this initiative as a partnership among a consortium of four University of California campuses: UC Berkeley, UC Davis, UC Merced, and UC Santa Cruz—was established to sponsor collaborative information technology research that will ultimately provide solutions to grand-challenge social and commercial problems affecting the quality of life of all Californians. The set of applications include energy efficiency, transportation, environmental monitoring, seismic safety, education, cultural research and health care.

UC Merced's involvement is a significant component of CITRIS's education initiative, and as additional faculty are hired—particularly in the area of Computer Science and Engineering—our involvement will grow substantially.

2.4.2. Bioengineering Multicampus Research Institute

UC Merced is part of a the new Bioengineering MRU that has recently been established across all 10 campuses to promote:

- Inter-campus organization for research and training;
- Research collaborations through symposia and workshops and inter-campus exchange of faculty and students;
- Collaboration in pursuing extramural funding;
- Enhancement of training activities and opportunities;
- Cooperation and collaborations with industry;
- Outreach to the public; and
- Advancement of biomedical engineering to enhance the health and well-being of humankind.

Professor Christopher Viney serves as the UC Merced Site Director of the Bioengineering MRU and Professor Valerie Leppert as Assistant UCM Site Director. Additional cross-Schools faculty participation is anticipated as we grow.

2.5. General Education for Engineering Students

2.5.1. Engineering Perspective on Guiding Principles for General Education

All UC Merced graduates will reflect the following principles, which provide the foundation for their education. UC Merced students will be prepared in areas of:

- Scientific literacy:
- Decision-making:
- Communication:
- Self and Society:

- Ethics and Responsibility:
- Leadership and Teamwork:
- Aesthetic Understanding and Creativity:
- Development of Personal Potential:

Engineering faces the additional challenge in the development or academic programs to insure that establish a framework for teaching and learning that adheres to the requirements for ABET 2000 accreditation.

> *"…Accreditation…requires an educational institution or program to meet certain, defined standards or criteria. Accreditation is sometimes confused with certification. In general, institutions and programs are accredited, and individuals are certified. …*
>
> ***Accreditation serves to notify:*** *Parents and prospective students that a program has met minimum standards; Faculty, deans and administrators of a program's strengths and weaknesses and of ways to improve the program; Employers that graduates are prepared to begin professional practice; Taxpayers that their funds are spent well; and The public that graduates are aware of public health and safety considerations."*
>
> — from ABET 2000 website: http://www.abet.org/

The guidelines for accreditation under the ABET 2000 policies and procedures are reflected in 11 requirements—known widely as the ABET 2000 A-K requirements—that have been articulated by ABET. A mapping of the Guiding Principles for General Education at UC Merced to the ABET 2000 A-K requirements is shown in Table 1.

2.5.2. Engineering Service Learning (EPICS)

Under the advisement of a faculty mentor, students will have the opportunity to form teams that will work with and for an approved community not-for-profit organization — or client — to solve practical engineering problems. For example, a team composed of both lower- and upper-division students might work together to design, develop, implement, and test an information system to serve the needs of a local United Way-type organization. Clients could include food banks, housing assistance programs and shelters, women's assistance programs, animal shelters and rescue organizations, after school programs, etc. Students will create (1) an organizational structure within the team, (2) a communications structure with their client organization, and (3) a strategic plan, mission statement, and work plan to guide the activities of the team. Interacting closely and continuously with the client, students will learn about the needs of the organization, delineate project objectives, formulate work plans, conduct design activities, implement resulting solutions, and monitor and assess program effectiveness. Students' performance and contribution to the team effort will be formally assessed through regular written reports and panel interviews. In addition to obtaining practical experience that complements their formal coursework, students will gain experience in working in teams, organizing and writing reports and proposals, interacting with clients, performing and evaluating basic engineering designs, and formally evaluating outcomes. Because teams and team activities will extend across multiple semesters and years, clients will be assured of continuity of technical support and ongoing attention to their needs. Students electing to enroll in the UC Merced Service Learning Initiative may earn up to two credits per semester for participation, depending on their leadership position within the team for that semester.

Table 1— Relating UCM Guiding Principles to ABET 2000 Guidelines

Guiding Principles	ABET A-K requirements
Scientific literacy:	(a) an ability to apply knowledge of mathematics, science, and engineering (b) an ability to design and conduct experiments, as well as to analyze and interpret data (e) an ability to identify, formulate, and solve engineering problems
Decision-making:	(j) a knowledge of contemporary issues (e) an ability to identify, formulate, and solve engineering problems
Communication:	(g) an ability to communicate effectively
Self and Society:	(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability (h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
Ethics and Responsibility:	(f) an understanding of professional and ethical responsibility (i) a recognition of the need for, and an ability to engage in life-long learning
Leadership and Teamwork:	(d) an ability to function on multi-disciplinary teams
Aesthetic Understanding and Creativity:	(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability (d) an ability to function on multi-disciplinary teams (e) an ability to identify, formulate, and solve engineering problems
Development of Personal Potential:	(d) an ability to function on multi-disciplinary teams (g) an ability to communicate effectively (j) a knowledge of contemporary issues

Freshman and Professional Seminars in Engineering

The School of Engineering will encourage—for most Engineering majors, require—students to enroll in a variety of 1-unit seminar courses. In particular, each major will offer Freshmen seminars each semester, and upper division, (professional) seminars for seniors and advanced students having junior standing.

2.5.3. The Writing/Communications Requirements for Engineering Students

Writing and communications experiences and expertise for Engineering students are a top priority of our academic planning. Writing and communications will be a major component of the 4-unit foundational general education course that all Engineering students will take during the freshman year (Core 1); completion of the Subject A writing course will be required for entry into this course. All Engineering students will the take a 4-unit sophomore-level reading and comprehension course (WRI 1). Beyond that foundation, the Engineering faculty are actively discussing ways of explicitly integrating substantive writing requirements into all professional courses, and to develop mechanisms by which student performance—particularly improvement—can be monitored, assessed, and evaluated to the extent that the writing and communication skills of our graduates become a signature of our program.[iii]

2.5.4. General Education Requirements for Engineering Students

The General Education requirement for the School of Engineering has been developed in such a way as to reflect explicitly the 8 Guiding Principles for general education at UC Merced (page 44 of the Inaugural Catalog). It is expected that all UC Merced graduates will reflect these principles, which provide the foundation for their education. The School of Engineering requires that its students meet a 45-unit general education requirement through a combination of required and elective courses as presented in Table 2.

Table 2—School of Engineering General Education Requirements

Lower Division General Education Requirements:	
Integrated Calculus and Physics (ICP 1)	8 units
Contemporary Biology (BIS 1)	4 units
Introduction to Computing I and II (CSE 20 and CSE 21)	4 units
The World at Home (CORE 1)	4 units
College Reading and Composition (WRI 1)	4 units
Probability and Statistics (Math 10)	3 units
Freshman seminar	0-1 units
Additional General Education Requirements:	
The World at Home (CORE 2)	4 units
Not more than 6 Service Learning units (ENGR 97 or ENGR 197)	0-6 units
Electives (selected from a list of acceptable courses)	8-14 units

The general education elective courses will be selected from a list of approved courses based on our need to embrace all Guiding Principles. Of the 8 Guiding Principles, the first—Scientific Literacy—is well served by the bulk of our engineering curriculum, including our science and engineering core, our engineering fundamental courses, our upper division major courses, and our technical electives. A second principle—Communication—is served in part by writing experiences during the Core 1 foundational general education course, the college reading and composition course (WRI 1), and in part by writing assignments that are integral to our Service Learning program, as well as by writing requirements within other Engineering courses.

Proposals have been invited from our sister schools—Natural Sciences, and Social Sciences and Arts—for courses from those Schools that meet additional Guiding Principles grouped into two areas:

Area I

- Aesthetic Understanding and Creativity
- Communication

Area II

- Decision-making
- Self and Society
- Ethics and Responsibility
- Leadership and Teamwork
- Development of Personal Potential

Engineering students who participate in our Service Learning program (ENGR 97 & 197) will receive considerable—if not sufficient—exposure to the Guiding Principles listed in Area 2. But until such time as Service Learning becomes a requirement throughout Engineering, some will need non-engineering courses for such exposure—furthermore, some students may elect to participate in Service Learning, but not up to the full complement of 6 units, thus will need further exposure to these Principles.

2.6. Anticipated Student Enrollment in Engineering for AY 2005-06

Preliminary estimates for enrollments at UC Merced for our inaugural year are presented in Table 1. Student preferences for admission to academic Schools—Engineering, Natural Science, and Social Science, Humanities, and Arts—an by inaugural major are broken presented as both absolute numbers and percentages. For example, total applications received for admission to UC Merced is estimated at 7,993, with 16.8% (or 1,496) indicating a preference for Engineering, 26.17% (or 1,987) preferring Natural Sciences, and 34.76% (or 2,651) opting for Social Sciences and Arts. A total of 1,983 students had no preference for school, and a total of 305 students who preferred Engineering expressed no preference for a specific program within Engineering.

Based on past experience with respect to enrollment as a fraction of application and preference for academic programs across the University of California, an estimated 15% of students applying for a specific Engineering major at a specific UC campus will actually enroll at in that program. It is therefore assumed that total enrollment in Engineering at UC Merced upon opening will be 151 students, with a student cohort of 39 enrolling in our Bioengineering major, 69 students in Computer Science and Engineering, 11 in Environmental Engineering, and 32 not yet sure of their preferred major. Numbers by class

Table 3 -- Estimates of Student Enrollment for AY 2005-06.

	Fr.	So.	Jr.	Sr.	Total	%	Fr.	So.	Jr.	Total
Engineering	1,372	14	110	0	1,496	16.80%	139	1	11	151
BIOE	390	0	0	0	390	4.38%	39	0	0	39
CSE	583	10	86	0	679	7.62%	59	1	9	69
ENVE	94	0	13	0	107	1.20%	10	0	1	11
Und	305	4	11	0	320	3.59%	31	0	1	32
Science	1,987	29	314	0	2,330	26.17%	201	3	32	235
BIOS	1,214	24	14	0	1,252	14.06%	123	2	1	127
ESS	72	0	42	0	114	1.28%	7	0	4	12
HBIO	454	1	11	0	466	5.23%	46	0	1	47
Und	247	4	247	0	498	5.59%	25	0	25	50
SSHA	2,651	41	403	0	3,095	34.76%	268	4	41	313
MGMT	1,086	0	0	0	1,086	12.20%	110	0	0	110
SBS	784	24	272	0	1,080	12.13%	79	2	27	109
USHA	445	13	39	0	497	5.58%	45	1	4	50
WCH	336	4	92	0	432	4.85%	34	0	9	44
Undeclared	1,983	0	1	0	1,984	22.28%	200	0	0	201
TOTAL	7,993	84	828	0	8,905	100.00%	808	8	84	900
%	89.76%	0.94%	9.30%	0.00%						

—freshman, sophomore, junior, and senior—are also shown. Interestingly, only about 10% of total admits are expected to be transfer students; curiously, about 1% of will be sophomores.

2.7. Inaugural Course Offerings

Assuming the number of students expected to enroll in the School of Engineering based on the number presented in Table 1, and given the approved curricula for the three inaugural Engineering majors, the minimum number of courses that will need to be offered at UC Merced can be determined. This list for our inaugural year is presented in Table 4. This list includes the general education Core 1 and Core 2 courses because these courses will be offered with generally equal support from the three Schools. All other courses listed in Table 4 will be the primary responsibility of one or more Engineering faculty. In contrast, some Engineering faculty will have major responsibilities for teaching courses the delivery of which is the major responsibility of a sister School—ICP administered through Natural Sciences, for example.

Additional courses—technical electives, engineering fundamentals, general education, etc.—will also be offered by Engineering; the specific designation of which to be determined after actual admission numbers, and areas of expertise of future faculty hires, become available.

Table 4 -- Minimum Engineering Course Obligations During AY 2005-06

Fall 2005	
CORE 1	**THE WORLD AT HOME**
CSE 20	**INTRODUCTION TO COMPUTING 1**
ENGR 130	**THERMODYNAMICS**
ENGR 120	**FLUID MECHANICS**
ENGR 52	**COMPUTER MODELING & ANALYSIS**
ENGR 180	**SPATIAL ANALYSIS AND MODELING**
ENGR 130	**THERMODYNAMICS**
ENGR 135	**HEAT TRANSFER**
ENGR 97G	**SERVICE LEARNING: ENGINEERING PROJECTS IN COMMUNITY SERVICE**
ENVE 10	**ENVIRONMENT IN CRISIS**

Spring 2006	
CORE 2	**THE WORLD AT HOME**
CSE 120	**SOFTWARE ENGINEERING**
CSE 140	**COMPUTER ARCHITECTURE**
CSE 21	**INTRODUCTION TO COMPUTING 2**
ENGR 155	**ENGINEERING ECONOMICS ANALYSIS**
ENGR 90X	**ENGINEERING FRESHMAN SEMINAR**
ENGR 97G	**SERVICE LEARNING: ENGINEERING PROJECTS IN COMMUNITY SERVICE**
ENVE 100	**ENVIROMENTAL CHEMISTRY**

2.7.1. Engineering Faculty Teaching Load and Responsibilities

The teaching load for faculty in the School of Engineering is 3 *course equivalents* per academic year. The faculty are currently engaged in discussions about the specific definition of course equivalent as it relates to courses having formats other than the traditional podium-style lecture course typical of professional engineering education—upper division core courses for a particular major, technical electives, engineering science courses, graduate courses having 12 or more students, etc. These non-traditional courses most prevalent in our current curriculum across our majors include:

- Engineering service learning team mentoring
- Freshman seminars
- Involvement in the general education foundational courses—Core 1 and Core 2
- Involvement in team taught courses including ICP 1[iv]
- Professional seminars
- General education courses for sister Schools
- Large lecture/lab courses such as CSE 20

These discussions will continue as we expand our faculty. At the present time, Engineering is not considering teaching assignment contingencies such as (1) different course load factors based on typical loads in different engineering sub-disciplines, (2) options for faculty to receive “adjusted” teaching loads based on research commitments and obligations, or (3) reduced or zero teaching loads based on academic rank.[v]

3. Strategic Plan for AY 2005-06

The growth of the Engineering faculty and our academic programs is guided by our strategic objectives as presented in Section 1 of this report and has resulted in the establishment of a solid foundation for further growth. As we continue to hire our initial allotment of inaugural faculty, our primary considerations are to attract and recruit faculty who:

1. have demonstrated scholarly excellence, and the potential to develop an academic program worthy of a UC campus;
2. are committed to developing a university that is at once a leader in Engineering research and education, and at the same time provides opportunities to the region and creates an atmosphere that enables the educationally underserved population of the Central Valley to take advantage of those opportunities;
3. embrace the goals and objectives of cross-disciplinary scholarship, which remains a signature of UC Merced's academic culture; and
4. are sufficient in number, and have sufficient resources, to deliver our programs—both undergraduate and graduate—to the level of quality that is expected of the University of California.

We present, in this section of our strategic academic planning report, our request for additional faculty positions to be filled during the 2005-06 academic year[vi]. The request is based on our assumptions about student enrollment, strategic opportunity for initiating new academic programs (majors), the need for fiscal efficiencies, and a realistic expectation for faculty workload and adherence to the resourcing policies and norms of the University of California.

3.1. Anticipated Student Enrollment in Engineering for AY 2006-07

A major consideration in the development of the programs of the School of Engineering at UC Merced is the need to bring new opportunities to the population of the Central Valley through UC-class education. The fields of Engineering offer particularly attractive opportunities because of the continued demand for a strong technical workforce in the state and the nation, and continued high salaries available to Engineering graduates. It is our responsibility to develop quickly a program that offers a spectrum of opportunities to a population that is largely unfamiliar with 4-year college education in general and UC education in particular, as well as uninformed about engineering disciplines.

Upon opening, the student population at UC Merced is anticipated to include 900 undergraduates as presented in Table 3, above. Approximately 150 (~17%) of these students are expected to enroll in Engineering during our inaugural academic year. Two additional assumptions have been made about student preferences for Engineering in order to make realistic estimates about our undergraduate student population initially, and over our first few years of operation:

1. It is assumed that students who have not indicated a preference for an academic School are less likely—indeed unlikely—to decide to pursue Engineering as a career path as they are to select a SSHA or Natural Science discipline; and

2. It is assumed that students who have indicated a preference for Engineering, but have not chosen an area (major) to pursue, will indicate a preference for their major in the same proportion of those students who initially selected their major.[vii]

It is the goal of the faculty of the School of Engineering that our current fraction of UC Merced undergraduate students increase from its initial level of 16.8% as reflected in Table 3, to 20% over the first 5 years of operation, and remain stable at that level. This will require (1) developing a program that is relatively (though modestly) more attractive to students[viii], and (2) improving the awareness of students about Engineering career opportunities.

Our specific targets for increasing slightly the fraction of UC Merced students who choose Engineering for the 2006-07 academic year are shown in Table 5. Recruiting efforts will be launched with an goal if increasing Engineering applications to 18% of the university total. It is further anticipated that undecided applicants will ultimate make preferences for majors in proportion to those who indicate majors preferences upon application, as shown in Table 5Two new undergraduate majors will be proposed as described below. New majors are expected to have a combined initial cohort starting that year of approximately 80 students.

Table 5 -- Estimates of Student Enrollment for AY 2006-07[ix].

	Fr.	So.	Jr.	Sr.	Total	%	Fr.	So.	Jr.	Sr.	Total
Engineering	2,779	28	223	0	3,030	18.0%	139	115	42	10	306
BIOE	790	0	0	0	790	4.7%	34	38	5	0	77
CSE	1,181	20	174	0	1,375	8.2%	31	67	12	9	119
ENVE	190	0	26	0	217	1.3%	17	10	5	1	34
Und	618	8	22	0	648	3.8%					
New Majors							57	0	20	0	77

3.2. <u>Engineering Academic Majors to be Proposed During AY 2005-06</u>

The School of Engineering will propose two additional undergraduate majors and associated graduate groups during the 2005-06 academic year: Mechanical Engineering and Materials Science and Engineering.

3.2.1. Mechanical Engineering

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. 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

3.2.2. Materials Science and Engineering

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 synergism 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.

We propose the hiring of X MSE faculty during AY 2005-06. This will bring our core faculty involvement in this area to a total of 5, including Professors Leppert and Viney, 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.

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.

3.3. Proposed Faculty Hiring Activity During AY 2005-06

The initial distribution of inaugural (20) faculty across initial Engineering academic majors—Environmental Engineering (ENVE), Computer Science and Engineering (CSE), and Bioengineering (BIOE)—are shown in Table 6 (shaded light blue). Total FTE count anticipated for upon completion of inaugural hiring is 20 FTE: 5 FTE for ENVE; 6 FTE for CSE, 6 FTE for BIOE; and 3 FTE in the areas of our next majors (shown as ME). An additional 12 FTEs are requested to be hired during AY 2005-06 to (1) augment disciplinary distribution of faculty in our ENVE and CSE majors, (2) initiate two additional Engineering majors; Mechanical Engineering (ME) and Materials Science and Engineering (MSE) as described above, and (3) to initiate planning for a our 6th academic Engineering major—Electrical Engineering (EE) —scheduled to enroll students during starting in AY 2007-08. The specific anticipated distribution of these faculty positions is shown as the yellow-shaded cells in Table 6.

Table 6 -- Requested Additional Engineering Faculty to be Hired During AY 2005-06

Academic Year	Engineering Majors by the end of AY 2005-06												Cumulative Total FTEs
	ENVE		CSE		BIOE		ME		MSE		EE		
	Name	FTE	Name	FTE	Name	FTE	Name	FTE	Name	FTE	Name	FTE	
	Bales	1.0	CSE 1	1.0	Leppert	1.0	ME 1	1.0	MSE 1	1.0	EE 1	1.0	
	Conklin	1.0	CSE 2	1.0	Viney	1.0	ME 2	1.0	MSE 2	1.0	EE 2	1.0	
	Harmon	1.0	CSE 3	1.0	BioE 3	1.0	ME 3	1.0	MSE 3	1.0			
	Winston	0.5	CSE 4	1.0	BioE 4	1.0	ME 4	1.0	MSE 4	1.0			
	ENV 5	1.5	CSE 5	1.0	BioE 5	1.0	ME 5	1.0					
	ENV 6	1.0	CSE 6	1.0	BioE 6	1.0	ME 6	1.0					
			CSE 7	1.0			ME 7	1.0					
AY 05-06	5		6		6		3		0		0		20
AY 06-07	6		7		6		7		4		2		32

Additional faculty hires in ENVE and CSE are expected to be mid-career scholars that will complement the distribution of disciplinary expertise among the existing faculty or who will integrate with colleagues in our sister Schools (see joint hire strategy, below). Two of the ME hires are expected to be senior colleagues, with the other two being junior faculty. Two of the four MSE hires are anticipated to be senior, with the remaining being junior of mid-career. Both EE faculty hires are expected to be senior faculty.

As a result this strategy the size of the regular Engineering faculty at UC Merced at the beginning of the 2006-07 academic year will be 32 ladder-rank faculty. In addition, our program will receive support from additional faculty anticipated to be hired across academic Schools, as well as from a number of carefully identified adjunct faculty.

3.4. Multidisciplinary Faculty Hiring Opportunities During AY 2005-06

The School of Engineering encourages joint appointments between and among our sister Schools as a means of fostering multi-disciplinary research and education. This includes joint ladder-rank appointments as well as adjunct appointments that further the research, education, and professional service commitments of the university. Joint or adjunct faculty appointments that improve diversity and inclusiveness among our faculty, staff, and students, are particularly welcomed.

3.4.1. Strategic Hiring of Joint Appointments

The Deans for the three schools have shared the emerging strategic plans from their respective schools, and have identified some areas where on-going discussions are warranted for possible joint or coordinated appointments across schools. These areas include:

- Human biology, health and environment, including management and policy
- Mathematical sciences, applied mathematics, and applied statistics
- Atmospheric sciences, air resources
- Environmental/energy sustainability including policy
- Energy; including optics, material sciences, and energy policy
- Management and decision sciences
- Cognitive and computational sciences
- Geography and spatial analysis

While a full and open discussion about cross-institutional synergy within or across these areas among the faculties of the three Schools has not yet been conducted, it is anticipated that these are very fertile areas for future joint faculty hires. Prior to the development and approval of the initial version of this document, it was anticipated that several faculty FTEs might be “held in reserve” by the Provost, and possibly earmarked for potential joint hires.

Following a more detailed discussion among the faculty of the School of Engineering regarding these potential areas of general synergy, and possible joint faculty hires, among the three Schools, a framework was developed that relates these areas to those of the current, planned, and proposed faculty hires in Engineering. The results of that discussion are presented in Table 7. The main objective of this table is to relate the faculty hiring plan of the Schools of Engineering for both current and future (requested) positions more explicitly to (1) our strategic intra-School research areas, and (2) these strategic cross-schools research areas listed above. Because of the importance of Engineering’s goal of developing *accreditable* engineering degrees, the academic undergraduate majors are also included as an important dimension of this framework.

The rows of the matrix are the strategic research areas that have guided the School of Engineering’s strategic planning process. The first areas listed are those that were agreed upon by the Schools as areas of particular interest for possible joint hires as listed above—STRATEGIC CROSS-SCHOOLS RESEARCH AREAS. The remaining rows—those below the double line—are those that are more likely to be of interest between engineering subdisciplines—ENGINEERING STRATEGIC RESEARCH AREAS. The columns of the matrix list research focus areas within Engineering, grouped by what would be *departments* at most universities—*majors* at UC Merced—and areas of particular interest for recruiting Engineering faculty. We have great flexibility in specifying these focus areas or research emphases, into which one or more faculty could be hired, to best support multidisciplinary research across Schools, or among engineering subdisciplines.

> **NOTE**: Changes to the original labels for these multidisciplinary research areas that were suggested by the faculty of the School of Engineering are

shown in **bold type**. Note further that one new area will be proposed for inclusion as a cross-School strategic research area: **Stem Cell Research**[x].

The entries in the matrix describe our current faculty hiring profile and plan more specifically than, thought consistent with, the 1-year hiring plan that was presented in Table 6. Cells shaded green are those faculty hired, or anticipated to be hired as our first 20 Engineering faculty, showing their relation ship to their area of specialty within the engineering major of their principle teaching responsibilities and their likely principle multidisciplinary strategic research contribution. Cells representing faculty who have already been hired, or for which offers are pending are marked with an **X**. Cells shaded blue denote those positions being requested within the 1-year hiring plan for the School of Engineering (Section 3.3 and Table 6). Entries in the matrix that have **bold borders** are those that are joint hires (in the case of cells indicating faculty who are already hired), or priorities for future joint hires. Specifically, the 12 Engineering FTE positions being requested within the ME, MSE, ENVE, CSE, and CSE majors are shown as blue-shaded cells with normal borders, and our top priorities for joint FTEs are shown as blue-shaded cells having bold borders (air pollution, and management and decision sciences).

To the extent that the columns and rows adequately represent the disciplinary and cross disciplinary research areas that are the highest priorities within Engineering subdisciplines and across Schools, respectively, the table itself represents a "snapshot" of how Engineering's 5-year hiring plan contributes to the overall cross-disciplinary research goals of UC Merced. Specifically, the 8 multidisciplinary research areas originally agreed upon by the Schools could be supported by the current proposal for future (12) Engineering faculty hires as follows:

- Human biology, health and environment, including management and policy
    - ENVE: Water quality
    - MSE: Nanomaterials
- Mathematical sciences, applied mathematics, and applied statistics
    - ME: Mechanics & mass Transfer
- Atmospheric sciences, air resources
    - ENVE: Air pollution
- Environmental/energy sustainability including policy
    - ME: Mechanical design/energy systems
    - ME: Environmental fluid mechanics
- Energy; including optics, material sciences, and energy policy
    - ME: Energy science and technology
    - MSE: Composite materials
    - MSE: Energy materials
    - EE: Optics and photonics
- Management and decision sciences
    - ENVE: Management and decision sciences
- Cognitive and computational sciences
- Geography and spatial analysis

The faculty feel that such a framework, or some variation thereof, can be adapted to reflect the contributions of our sister Schools as well, and would thus provide a framework for communication that will support future strategic planning activities. In particular, this profile would facilitate the identification of targets of particular opportunity for joint faculty hires.

3.4.2. Strategic Hiring of Adjunct Faculty

The faculty of the School of Engineering, while very support of both adjunct faculty and adjunct researchers, is judicious in its consideration of candidates for these positions. For the position of Adjunct Faculty, regular teaching responsibilities that contribute to the curricula of our majors are required. Adjunct Faculty appointments may also be an opportunity to bring special expertise to our faculty; individuals who will develop professional associations, provide unique research linkages, or otherwise increase the academic stature of our School.

The Adjunct Researcher appointment in the School of Engineering at UC Merced requires scholarly achievement in ones field such that he or she is qualified to assume Co-PI status on research grants with UC ladder-rank faculty, and will thus will work closely with faculty, graduate students, and post-doctoral researchers. While they may be involved in teaching, outreach, and professional activities on behalf of the University, their primary involvement in scholarly activities will be through research activities. Consequently, these individuals must have a stellar track record of research accomplishment as documented by scholarly publication and accomplishment in their fields. Use of this title is not governed by the APM and does not require CAP approval. In other respects, the qualifications and procedures for review and appointment are like that for Research Engineer or Research Scientist. The SOE will offer this title to persons whose primary involvement is research. It is expected that this title will be appropriate for research scientists or engineers from national laboratories and from government agencies who work with UCM faculty, students and postdocs on one or more research projects. It is also expected that the individual will want to affiliate with one or more UCM graduate groups and institutes. A person appointed in this series can be a Co-PI on a grant with a ladder-rank faculty member. The individual can also be given Principal Investigator responsibility, in accord with University of California Policies and Guidelines Pertaining to Research (section 1-500 of CGM), and subject to approval of the VCR.

The procedure for appointment as Adjunct Researcher within the SOE involves four steps. First, the candidate should submit a request to the SOE Dean for an appointment, including evidence of qualifications comparable to that for appointment in the Professor series (APM310-10). The package should include, at a minimum, a complete CV, copies of 5 publications, a statement of research and the names of 3 scholars who can provide letters of recommendation. Second, the Dean will solicit letters, including one or more letters from individuals not recommended by the candidate, and will appoint a 3-person ad hoc committee of faculty to evaluate the package. Third, the ad hoc committee will make a recommendation to the SOE faculty. The full SOE faculty must then approve the appointment by majority vote. The Dean will then make the appointment, subject to approval of the Chancellor. Subsequent to this appointment the package will be forwarded to the Vice President for Research for evaluation for PI status, if requested by the candidate. Recognizing that the candidate may also want to join a graduate group, the package will be provided to that graduate group, at the request of the candidate.

At present, the School of Engineering pursuing Adjunct Faculty appointments for two candidates, and the appointment of an adjunct researcher for one.

Table 7 Hiring profile relating first 20 faculty hires and proposed new FTEs to UCM multidisciplinary strategic research areas.

- ■ (green) Engieering faculty (first 20)
- ☒ Engieering faculty already hired or offers pending (first 20)
- □ (heavy border) Joint (cross-school) faculty hires or joint hires requested
- ■ (blue) Enginerring faculty positions requested for academic year 2005 - 2006

		ENVE					CSE				
		Hydrology	Water Quality	Air Pollution	Energy Sustainabilty	Energy water & resource management	Networking	Architecture	Data Base Mining/Informatics	Software	Computational Science & Eng
STRATEGIC CROSS SCHOOLS RESEARCH AREAS	Human biology, health and environment, including management and policy		blue								
	Mathematical sciences, applied mathematics, and applied statistics						green ☒				green ☒
	Atmospheric & **climate** sciences, air resources		green ☒	joint blue							
	Energy, **Water** & Environmental sustainability, including policy	green ☒	green ☒	green				green ☒			
	Energy; including optics, material sciences~~, & energy policy~~				joint green ☒						
	Management and decision sciences					joint blue					
	Cognitive and computational sciences									green ☒	
	Geography and spatial analysis					green			green ☒		
New ?	Stem cell research										
ENGINEERING STRATEGIC RESEARCH AREAS	MSE mechanical properties										
	Hardware systems							blue			
	Electrical & electronics systems										
	Computer science									green	
	Computer enginering										

		BIOE					ME				
		NanoBio/Bioelectronics	Biomaterials Eng	Cellular Bioengineering	Tissue Bioengineering	Bioprocess Eng	Energy Science & Technology	Mechanics & Mass transfer	Mechanical Design/energy systems	MicroElectroMechanical Systems	Environmental Fluids Mechanics
STRATEGIC CROSS SCHOOLS RESEARCH AREAS	Human biology, health and environment, including management and policy		green								
	Mathematical sciences, applied mathematics, and applied statistics							blue			green ☒
	Atmospheric & **climate** sciences, air resources	green ☒					green				
	Energy, **Water** & Environmental sustainability, including policy								blue		blue
	Energy; including optics, material sciences~~, & energy policy~~	green ☒					blue	green ☒			
	Management and decision sciences										
	Cognitive and computational sciences										
	Geography and spatial analysis										
New ?	Stem cell research	green		green	green						
ENGINEERING STRATEGIC RESEARCH AREAS	MSE mechanical properties										
	Hardware systems										
	Electrical & electronics systems										
	Computer science										
	Computer enginering										

		MSE					EE							
		Nanomaterials	Composite materials	Energy Materials	Materials characterization	Environmental Aspects Materials	Microelectronics and Nano Technology	Communications Network	Bioelectronics	Optics and Photonics	MicroElectroMechanical Systems	Signal Processing	Circuits	Embedded Systems
STRATEGIC CROSS SCHOOLS RESEARCH AREAS	Human biology, health and environment, including management and policy	blue												
	Mathematical sciences, applied mathematics, and applied statistics													
	Atmospheric & **climate** sciences, air resources													
	Energy, **Water** & Environmental sustainability, including policy													
	Energy; including optics, material sciences~~, & energy policy~~		blue	blue						blue				
	Management and decision sciences													
	Cognitive and computational sciences													
	Geography and spatial analysis													
New ?	Stem cell research													
ENGINEERING STRATEGIC RESEARCH AREAS	MSE mechanical properties				blue									
	Hardware systems													
	Electrical & electronics systems						blue							
	Computer science													
	Computer enginering													

Bold : Indicates changes from original Strategic Plan (Section 3.4.1)

4. Strategic Plan for the Period 2005-2010

4.1. Anticipated Student Enrollment in Engineering

Our faculty hiring plan beyond AY 2005-06 is oriented towards finding a balance between rapid expansion of our excellence in research and education for purposes of providing increasing opportunities for students—both graduate and undergraduate, and reaching an acceptable and cost effective workload level reflected by overall student/faculty ratio and other benchmarks. The first condition is served by continuing to hire the best available faculty according to a strategic plan for programs development that is based on sound logic and that effectively leverages existing resources. The second condition will require a modest level of increased student enrollments into Engineering as a fraction of total UC Merced enrollments. Figure 2 presents our target for undergraduate enrollments into Engineering over a 5-year planning horizon. This growth results from increasing our second-year total Engineering to 18%--slightly more than 1% increase of over the inaugural level—followed by 19% the following year, stabilizing at 20% of total UC Merced students after that.

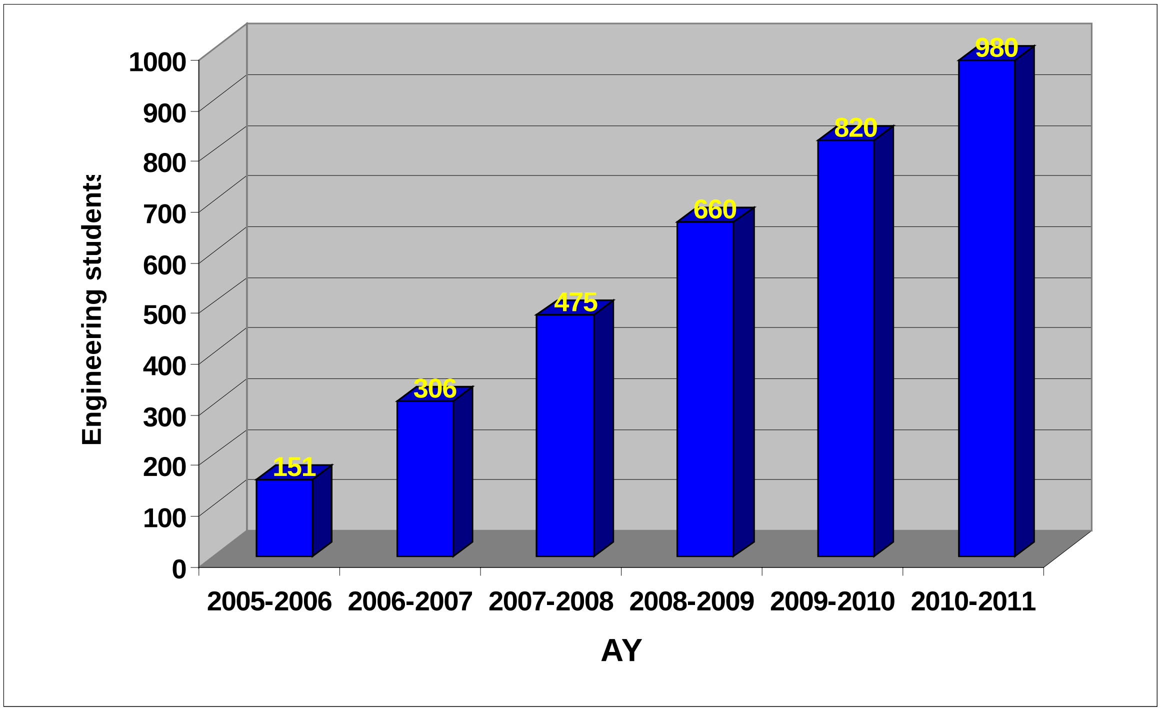

Figure 2 – Targets for total Engineering student enrollment over the planning horizon.

This increasing number of students will be accomplished by (1) an active recruiting program that has been instituted during the current year, (2) the thoughtful expansion of our academic programs so that a richer set of programs is available to our students.

4.2. Engineering Academic Majors to be Proposed 2006-2011

The progression of academic programs within the School of Engineering at UC Merced is reflected in Table 7. An Electrical Engineering (EE) major will be initiated during the 2007-08 academic year, followed by a major called Engineering Economics and Management

(EEM), then Chemical Engineering (CHE), followed by Civil Engineering. It is important to note that the School of Engineering faculty will revisit this anticipated progression each year, and commitments beyond 2007-08 are subject to revision in both discipline and sequence.

Table 8—Anticipated progression of Engineering undergraduate majors 2005-2011.

Academic Year	Engineering Undergraduate Programs Available
2005-06	**BIOE, CSE, ENVE**
2006-07	BIOE, CSE, ENVE, **ME, MSE**
2007-08	BIOE, CSE, ENVE, ME, MSE, **EE**
2008-09	BIOE, CSE, ENVE, ME, MSE, EE, **EEM**
2009-10	BIOE, CSE, ENVE, ME, MSE, EE, EEM, **CHE**
2010-11	BIOE, CSE, ENVE, ME, MSE, EE, EEM, CHE, **CE**
BOLD entries indicate new majors added that academic year	

4.3. Anticipated Engineering Growth Over 5-year Planning Period

Assuming successful increase in the fraction of students recruited into Engineering, with the resulting numbers as presented in Figure 2, and the progression of new academic Engineering majors targeted in Table 7, the anticipated annual distribution of student enrollments during the planning horizon by major preference is presented in Figure 3. In order to support this rate of growth of majors, while continuing to support and expand prior majors, and in addition looking over the horizon to future majors, the progression of specific Engineering faculty hiring has been developed, and is presented in Table 8.

The faculty hiring profile and programs growth strategy is based on best available data on student numbers, and a realistic estimate of what is feasible over the planning period. A key driver in behind this plan is to develop a thoughtful approach to maintaining an aggressive level of growth, while maintaining a cost efficient program-building. A key consideration in this analysis has been the consideration of our student/faculty ration, both in aggregate across our programs, and within sub-disciplinary areas. The overall profile of student/faculty ratios by year, by sub-discipline, and for the Engineering program as a whole is presented in Figure 4. As can be seen in this profile, our growth strategy is such that the student/faculty ration for each major grows steadily from a low initial number upon initiation, to an acceptable level over a 3-4 year period. The overall Engineering student/faculty ration grows from an initial level of less than 8:1, to a respectable level of 14:1 at the end of the planning horizon.

It is important to realize that these numbers, and this analysis considers only undergraduate programs growth. Considering that an average sized graduate group for individual Engineering faculty is estimated to include 8-10 (or more) graduate students. By keeping the undergraduate ratio at a manageable level, particularly in times of rapid programs growth, we can also nurture our graduate student/faculty ratio, thereby honoring UC system standards for excellence while (1) raising the quality of undergrad/faculty interactions, (2) establishing a culture of strong graduate programs building—especially cross disciplinary synergy across our Schools, and (3) positioning ourselves to rise to join the Top 25 Engineering Programs within 15 years.

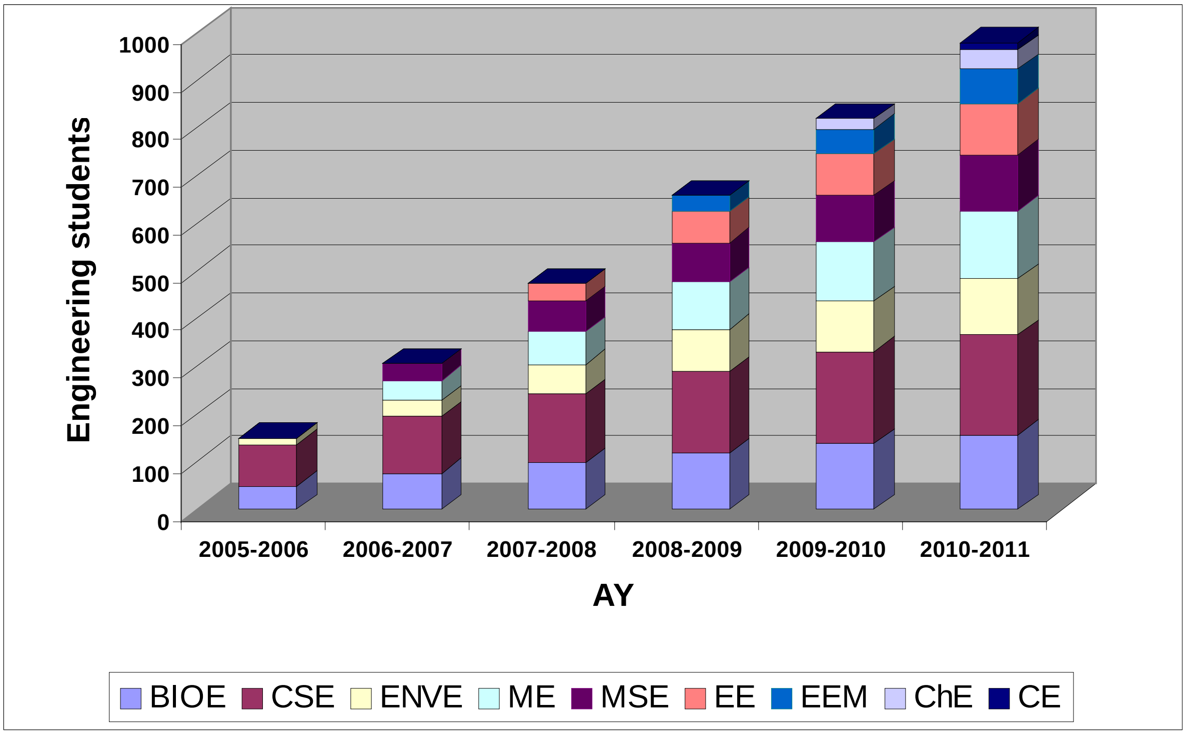

Figure 3—Distributed of expected enrollments by undergraduate major for the period 2005-2011.

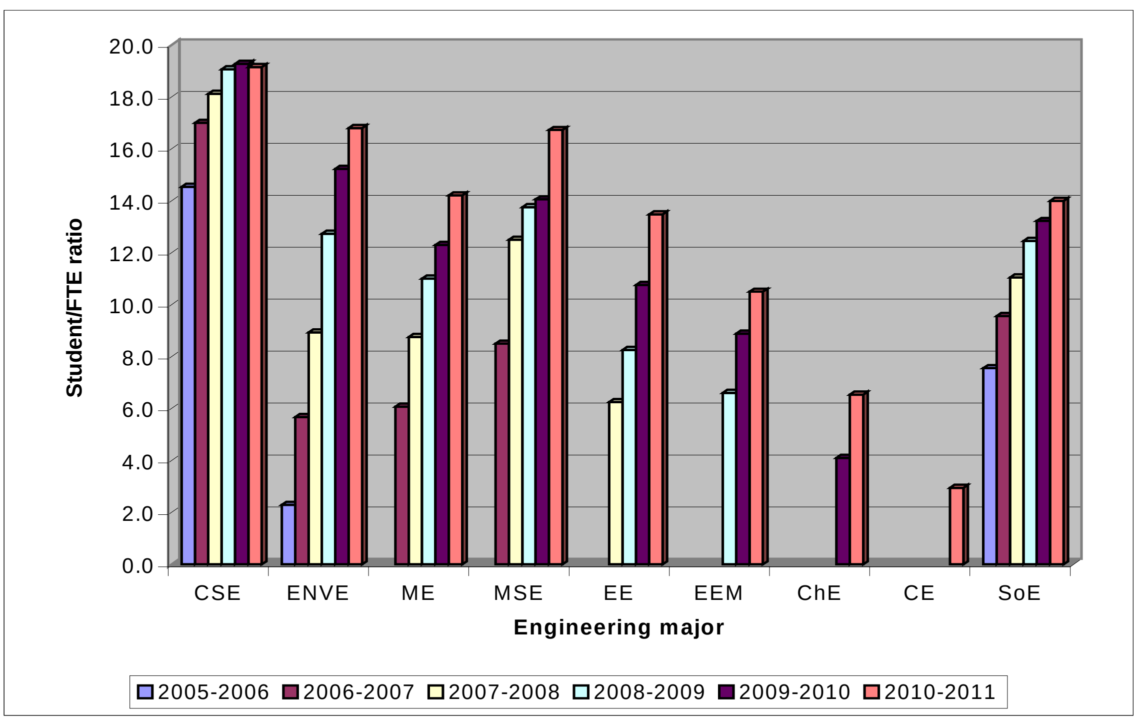

Figure 4—Trends in student/faculty ratio by Engineering major over the period 2005-2011.

Table 9—Projection of School of Engineering faculty hiring sequence by expected undergraduate major over the planning horizon: 2005-2011.

Academic Year	Engineering 5-year Hiring and New Majors Plan																		Cumulative Total FTEs
	ENVE		CSE		BIOE		ME		MSE		EE		EEM		ChE		CE		
	Name	FTE	Name	FTE	Name	FTE	Name	FTE	Name	FTE	Name	FTE	Name	FTE	Name	FTE	Name	FTE	
	Bales	1.0	CSE 1	1.0	Leppert	1.0	ME 1	1.0	MSE 1	1.0	EE 1	1.0	EEM 1	1.0	ChE 1	1.0	CE 1	1.0	
	Conklin	1.0	CSE 2	1.0	Viney	1.0	ME 2	1.0	MSE 2	1.0	EE 2	1.0	EEM 2	1.0	ChE 2	1.0	CE 2	1.0	
	Harmon	1.0	CSE 3	1.0	BIOE 3	1.0	ME 3	1.0	MSE 3	1.0	EE 3	1.0	EEM 3	1.0	ChE 3	1.0	CE 3	1.0	
	Winston	0.5	CSE 4	1.0	BIOE 4	1.0	ME 4	1.0	MSE 4	1.0	EE 4	1.0	EEM 4	1.0	ChE 4	1.0	CE 4	1.0	
	ENVE 5	1.5	CSE 5	1.0	BIOE 5	1.0	ME 5	1.0	MSE 5	1.0	EE 5	1.0	EEM 5	1.0	ChE 5	1.0	CE 5	1.0	
	ENVE 6	1.0	CSE 6	1.0	BIOE 6	1.0	ME 6	1.0	MSE 6	1.0	EE 6	1.0	EEM 6	1.0	ChE 6	1.0			
	ENVE 7	1.0	CSE 7	1.0	BIOE 7	1.0	ME 7	1.0	MSE 7	1.0	EE 7	1.0	EEM 7	1.0					
	ENVE 8	1.0	CSE 8	1.0			ME 8	1.0			EE 8	1.0							
	ENVE 9	1.0	CSE 9	1.0			ME 9	1.0											
			CSE 10	1.0			ME10	1.0											
			CSE 11	1.0															
AY 05-06	5		6		6		3		0		0		0		0		0		20
AY 06-07	6		7		6		7		4		2		0		0		0		32
AY 07-08	7		8		7		8		5		6		2		0		0		43
AY 08-09	7		9		7		9		6		8		5		2		0		53
AY 09-10	8		10		7		10		7		8		6		5		1		62
AY 10-11	9		11		7		10		7		8		7		6		5		70

Endnotes

[i] The initial intent was to deliver a common freshman year for all students interested in science, technology, engineering, and math (STEM-Science, Technology, Engineering, Math), such that these students would not declare a major until the end of the freshman year. The goal was to improve student retention by facilitating a better match between student interests and preferences, and available technical majors. It was subsequently determined that applications across the University would be made not only to individual Schools, but to academic majors as well. While the common freshman year across Schools has been abandoned, Engineering will still require a common freshman year for all Engineering academic majors.

[ii] There are excellent opportunities for Bioengineering to benefit from and contribute to a stem cell research effort at UC Merced. The field of regenerative medicine is looking for ways to use undifferentiated cells to “grow replacement body parts,” preferably in situ, with the benefit that the regenerated materials (tissues, even organs someday) will not trigger rejection by the patient's immune system. In the initial stages of regeneration, it is often necessary to already have in place a "scaffolding" that can physically support the population of cells that will regenerate the desired component. Bioengineers (and especially nanobioengineers) can be expected to be at the forefront of developing these sorts of scaffoldings; elements of self-assembly on a small and intricate scale, mimicking the body's own way of building structures, will be of interest, as will the nature of the cell-scaffolding interactions that are appropriate to hold the cells in place. There may even be ways to functionalise the surface of an inert implant by decorating it with adhered stem cells and then encouraging those cells to develop a durable interface with normal tissue. Clearly our colleagues in Natural Sciences are interested in capitalizing on Prop.71, and encouraging to see that SSHA are interested in collaborating (committing one or more FTEs to researching ethical considerations and consequences). The university would like to explore ways to use Prop.71 at least for space and equipment upgrades, and possibly for building new space. To contribute explicitly to this effort we anticipate one or more of the later BioE appointments (i.e. not those in the current searches) being in the area of tissue engineering.

[iii] The faculty of the school of Engineering is considering the possible future allocation of resources to retaining a writing and communications professional whose primary duties will include monitoring the improvement of each individual engineering student through their program of study.

[iv] Design and development of the UC Merced Integrated Calculus/Physics course was motivated by the desire to improve the teaching of both subjects by teaching them together. A team of faculty from the Schools of Engineering and Natural Sciences is presently building this course, with overall leadership in this effort provided by Professor Kevin Mitchell of the School of Natural Science, and major involvement from Professor Christopher Viney of Engineering. It is anticipated that most of the students enrolled in that class will be Engineering students.

[v] The Engineering faculty place great value on the quality of our educational programs, both collectively as well as the contributions of each individual. Junior faculty will be provided special support in the form of guidance and mentorship by senior faculty; particularly those whose teaching accomplishments have been widely recognized, more carefully weighted choices of available course assignments such as possible preferences for smaller courses more directly in the area of expertise of the junior faculty member, and additional consideration of course resources support such as TA support. It is our firm belief that great teachers are made through the process of teaching, not by being excused from teaching. Quality teaching is an essential component in the consideration of academic advancement within the School of Engineering at UC Merced.

[vi] The positions being requested are in addition to the first 20 positions independent of our ability to recruit the remaining 20 during this academic year. It is assumed that the resources for hiring the inaugural faculty are committed, and do not depend on the time at which those faculty are hired.

[vii] It is of course possible to assign undeclared Engineering students to majors based on the desire to distribute faculty workload evenly, but our preference is to instill a culture among our faculty, both current and future, that is committed to helping students make informed choices about their major at the end of their first year

rather than forcing them to make premature decisions or making those decisions on their behalf. The motivation for the common freshman year in Engineering is to help improve retention and enhance the chances of student success.

[viii] Our goal is explicitly **not** to maximize the number of students enrolling in Engineering, but to maximize the number of students who *graduate* from Engineering. We feel that a target of 20% Engineering students is reasonable and achievable within a 5-year planning horizon.

[ix] It is essential to note that the student numbers reflected in this table, and through the remainder of this report, represent net numbers of students. The academic planning model does not yet include a realistic student retention/attrition component. Population the assumption is made that UC Merced will experience a net increase of 800 undergraduate students in the second year of operation, though in reality (1) a significant number of students will likely not return to continue their studies, (2) some students will enter the sophomore or years after having completed their freshman or junior year elsewhere, (3) some students may transfer in to Engineering from other Schools, etc.

[x] Since the original submission of the Schools' strategic plans, a cross-Schools planning committee has been meeting to discuss opportunities leveraging our multidisciplinary research capabilities in this area. This should be included explicitly in any future strategic planning framework for UC Merced.