The University of New Mexico

Faculty Senate
Meeting Agenda
November 23, 2010
3:00 P.M.
Scholes Hall
Roberts Room

AGENDA TOPICS		TYPE OF ITEMS/ PRESENTER(S)
3:00	1. Approval of Agenda	**Action**
	2. Acceptance of the October 26, 2010 Summarized Minutes	**Action**
3:05	3. Posthumous Degree Request for Yi Huang	**Action** Yolanda Sanchez
3:10	4. Provost's Report	**Information** Richard Holder
3:20	5. Faculty Senate President's Report	**Information** Richard Wood
3:30	6. Honorary Degree Nominations	**Action** Stephen Bishop
3:35	7. Faculty Handbook Policy Parental Leave C215	**Action** Jackie Hood and Jane Slaughter
3:40	8. Budget	**Discussion** Richard Wood
CONSENT AGENDA TOPICS		
4:00	9. Forms C from the Curricula Committee Deletion of Major in BS of PA Studies, School of Medicine New Marketing Minor in BBA, Anderson School of Management Revision of BS in Dental Hygiene, Dental Hygiene Revision of Marketing Concentration in BBA, Anderson School of Management Revision of Major in BA of Psychology, College of Arts and Sciences Revision of Major in BS of Civil Engineering, School of Engineering New Concentration in PhD of Biomedical Engineering, School of Engineering	**Action** Amy Neel
	10. Fall 2010 Degree Candidates	**Action** Tim Ross
AGENDA TOPICS		
4:05	11. Faculty Disciplinary Policy C07 Proposal	**Discussion** Victor Strasburger
4:15	12. eScholar Innovation	**Information** Martha Beddard
4:25	13. ERB Proposal and Faculty response	**Discussion** Beulah Woodfin and Nissane Capps
4:40	14. Form D from the Curricula Committee New Graduate Degree - Master's of Science in Biomedical Engineering, School of Engineering	**Action** Steven Graves
4:45	15. Governmental Relations	**Information** Marc Saavedra and Antoinette Sedillo

		Lopez
4:55	16. 2010 United Way Campaign	**Information** Marla Wood
	17. New Business and Open Discussion	
5:00	18. Adjournment	

NOTES:

1. All faculty are invited to attend Faculty Senate meetings.
2. Full agenda packets are available at http://www.unm.edu/~facsen/
3. All information pertaining to the Faculty Senate can be found at http://www.unm.edu/~facsen/
4. Questions should be directed to the Office of the Secretary, Scholes 103, 277-4664
5. Information found in agenda packets is in draft form only and may not be used for quotes or dissemination of information until approved by the Faculty Senate.

FACULTY SENATE SUMMARIZED MINUTES

2010-2011 Faculty Senate
October 26, 2010
(DRAFT-AWAITING APPROVAL AT THE November 23, 2010 FACULTY SENATE MEETING)

The Faculty Senate meeting for October 26 was called to order at 3:05 p.m. in the Lobo Room of the Student Union Building. Senate President Richard Wood presided.

1. ATTENDANCE

Guests Present: Director PC System and Support Mike Campbell, President Lazaro Cardenas (Associated Students of the University of New Mexico), President Elect Mary Clark (Staff Council), Assistant Professor Kevin Comerford (University Libraries), Chelsea Erven (Daily Lobo), Deputy CIO Moira Gerety (Information Technologies), Deputy Provost Richard Holder, Editor Sari Krosinsky (University Communication and Marketing), Editor Patrick Lohmann (UNM Daily Lobo), Jaymie Roybal (Associated Students of the University of New Mexico), and Alexandra Swanberg (Student Publications).

2. APPROVAL OF THE AGENDA
The agenda was approved as written.

3. APPROVAL OF SUMMARIZED MINUTES FOR SEPTEMBER 28, 2010 MEETING
The minutes were approved as written.

4. PROVOST'S REPORT
Deputy Provost Richard Holder reported the following:

- The School of Engineering Dean search has a very strong candidate pool. Interviews will be held in December.
- Amigo Scholarships pay the difference between in-state and out-of-state tuition. The scholarships had been limited to three percent of student FTE, about 120. The percentage of Amigo Scholarships has been increased to six percent. More than 1,000 out of state and international students will be helped.
- There have been 21 white paper preliminary proposals submitted. Good ideas were submitted, but there were not many cost containment ideas. Proposals will be posted on the Academic Affairs web page. Five full proposals have been requested from the authors and are due November 12. Deans' instructional efficiency plans are due October 29. More than 40 units are being evaluated in Academic Affairs. Self-Studies from those units are due November 3. Comprehensive reviews are due December 22. The review panel is comprised of 10 members from faculty, staff, retirees, Parents Association, and alumni. The chair is Dean Emeritus Leo Romero (Law).
- Two task forces are being formed. One is to consider moving the Honors Program to a resident Honors College. The other is a task force to develop recognition of faculty achievements and awards.

5. FACULTY SENATE PRESIDENT'S REPORT
Faculty Senate President Richard Wood reported the following:

- The Operations Committee is continuing to address the budget through various venues. The Operations Committee is involved in the development of the 2011-2012 budget. Work is being done by the Faculty Senate Budget Committee, the hard analytic work. Two members of the

Budget Committee, President Richard Wood, and President Elect Tim Ross sit on the Dean's Council as full members.

- A person from the AAUP did an analysis of UNM's budget situation. The Operations Committee and the Budget Committee are reviewing the accuracy of the report.
- The Forum on Higher Education was a success with seven legislators participating and more than 300 people in attendance. The coverage in the Daily Lobo was good while the coverage in the Albuquerque Journal was poor. President Wood thanked Antoinette Sedillo Lopez and the Governmental Relations Committee.
- Governor Richardson has asked for a draft of the proposed Regent Vetting Executive Order.
- Academic Prioritization proposals will come through the Faculty Senate. It is the Provost's project.
- There are number of faculty working on the core curriculum.
- Excellence and diversity at UNM will be a future agenda item.
- President Wood asked for assistance in getting a Google Doc posted so deans can add their actual faculty counts to the report from Academic Affairs.

6. ACADEMIC COUNCIL PILOT

Operations Committee member Amy Neel (Speech and Hearing Sciences) presented the revised Academic Council Pilot proposal below. The Academic Council Pilot is part of the Faculty Senate restructuring proposal from Senator Douglas Fields (Physics). There are minor changes from the version presented in September. The ultimate goal is to increase faculty participation and communication in the Faculty Senate committees, especially those that handle academic issues. All decisions of the Academic Council will come before the Faculty Senate. The senate voted 20-3 in favor of the Academic Council Pilot. The approved text is below. Additionally, the senate voted 20-3 to require all decisions of the council to be voted upon by the senate.

Proposal for Faculty Senate Academic Council 10/19/10

We ask the Faculty Senate to establish the Academic Council as an ad hoc committee of the Faculty Senate effective immediately.

1. Purpose

The purpose of the Academic Council is to address academic issues facing the Faculty Senate that cannot easily or fully be handled by single existing Faculty Senate Committees. Examples of such issues include the Academic Program Prioritization process instituted by the Provost for program consolidation and elimination, the multi-term scheduling and registration proposal put forward by the Vice President for Enrollment Management, the future of University College, and changes to the core curriculum of the University.

2. Voting Members

Chairs (or their delegates) of the following Faculty Senate Committees will constitute the voting membership of the Academic Council: Undergraduate, Professional and Graduate, Curricula, Admissions and Registration, Research Policy, and Teaching Enhancement.

3. Authority

The Academic Council will have decision-making authority in academic matters that cannot easily or fully be handled by single existing Faculty Senate committees. Academic Council decisions are subject to ratification by the Faculty Senate.

4. Relationship of the Academic Council to the Faculty Senate

The Academic Council will not replace any existing Faculty Senate committees. However, the representatives of those committees who serve as members of the Academic Council will have the authority to act on the behalf of these committees. This authority will continue for 12 months of the year.

5. Leadership
Academic Council members will elect a chair from among the membership of the committee.

6. Meetings
The Academic Council will schedule meetings as needed. Meetings will be open to the public. Notification of meetings, agendas, and minutes will be posted on the Faculty Senate website.

7. EMAIL/MESSAGING/CALENDRING TASK FORCE FINDINGS
Deputy CIO Moira Gerety requested endorsement by the Faculty Senate on the recommendations below. The recommendations are from the task force studying the Email/Messaging/Calendaring system at UNM. The proposal was reviewed by the Faculty Senate Computer Use Committee. The FS CUC recommended an opt-out guarantee based on departmental research needs.

Senator Howard Snell (Biology) expressed privacy concerns. Deputy Garety replied that there is a strict policy on privacy requiring an EVP signature for investigation. The senate would like the addition of the notification of the Faculty Senate President when it involves a faculty member. Moira Gerety supports the notification of the Faculty Senate President but it would require changes to other polices. She will work with the necessary entities and the Faculty Senate to make the changes.

The Faculty Senate voted unanimously to endorse the FS CUC recommendation of support for the proposal with the incorporation of the two suggestions. The next phase is the formal selection process and will include faculty. No vendor has yet been selected.

Recommended Direction

1. Move to a single, robust solution for all UNM units,

- Address all integration, training, security issues
- Provide distributed branding, client independence
- Pick an industry leader : Google or Microsoft
- Enable integration other UNM systems
- Evaluate cloud options
- Platform must sync with "all" mobile devices
- Platform must be reliable: BC/DR

Recommended Direction, Cont'd

2. Refine and segment UNM solutions by USER group

- (Student/Faculty /Staff/Public etc.) NOT organizational circumstance
- Integration is essential

Table: # of people at UNM by category

Population	Main	Branches	HSC	Hospital	Med Grp	Foundation	Total
Student	19,129	7,370	482	0	0	0	26,981
Grads	2,032	0	817	0	0	0	2,849
Faculty	2,111	565	1,031	0	0	0	3,707
Staff	9,944	1,135	4,650	5,951	91	65/5	21,836

Recommended Direction, Cont'd

3. **Build an infrastructure that enables distributed flexibility, control and added value**
   - Look at email/messaging as a means to strategic ends
   - Create common core infrastructure – common directory needs to be a part of this
   - Design in flexibility and control for academic departments: ease up on "controls"
   - Design to enable Departmental identity
   - Allow client options, with parameters
   - There needs to be an avenue for email/calendar as the object of teaching or research
   - Govern the one solution formally

Recommended Direction, Cont'd

4. **Continue the collaborative process to:**

– Investigate the tool set options to 'fix' UNM communication
– Develop a campus-wide implementation approach
– Develop a time table

UNM

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IT UNM

8. ON-LINE SALARY BOOK
UNM Daily Lobo Editor Pat Lohmann presented a request for the Faculty Senate to endorse the placement of the UNM Salary Book online. He requests that the salary book be placed online in a simple spreadsheet format. Currently, the salary book is only available in hard-copy for two hour periods in Zimmerman Library. The Operations Committee unanimously supports an online salary book.

A senator suggested the salary figures in the book should reflect all compensation. Quality of the data needs to be ensured before access is granted. Once the data is truthful it should be placed online.

The Faculty Senate voted 4 -19 against the requested endorsement.

9. FACULTY HANDBOOK POLICY PARENTAL LEAVE C215
The Faculty Senate voted unanimously to table Policy C215 until the November meeting when someone from the Policy Committee or the Faculty Staff Benefits Committee could attend to address questions.

10. FACULTY HANDBOOK POLICY FACULTY WORKLOAD C100
Operations Committee member Melissa Bokovoy (History) presented the information below on the revision of Faculty Handbook Policy C100 Faculty Workload. The Operations Committee has been working on the policy this semester and this is an update for the senate.

There is concern among senators about junior faculty not being able to achieve nine load units of teaching. Senators also expressed concern that credit for all members serving on a dissertation committee should be included. Presently, only the chair is credited with the service. In addition, there needs to be a calculation for writing-intensive courses.

Dr. Bokovoy asks senators to review the proposals and to take them to their constituents and departments. Please send feedback to Dr. Bokovoy or President Elect Tim Ross. The Operations Committee workgroup is revising the policy and will send it to the FS Policy Committee for further review before it comes back to the senate for action.

C100: Current Work Load Policy

ACADEMIC LOAD

- The term "academic load" describes, the sum total of all officially recognized University duties carried out by an individual member of the faculty at any given time. Teaching in regularly scheduled classes is basic, of course, but overall load may also include research or creative work, sponsored research, committee assignments, student advisement, direction of theses and dissertations, and administrative or supervisory duties. The normal teaching load each semester is nine adjusted credit hours and the normal academic load, as defined by the formula available in the Office of the Provost/Vice President for Academic Affairs, is twelve units per semester. (See also "Teaching Assignments" C110, *Faculty Handbook*.)

Provost Presentation to Regents about Work Loads, August 2010

- http://www.unm.edu/regents/meetings/documents/bor-e-book-2010-08-10.pdf
- Pdf p. 218

Provost Presentation to Regents about Work Loads, August 2010

Faculty Workload Update

A "Translation" of Policy C110 (Teaching Assignments)

- Full-time faculty must teach at least 9 "load units" each semester
- A "load unit" is defined and calculated according to the current load formula document issued by the Provost.
- If the teaching assignment is less than 9 but at least 6 load units the Dean must approve in advance.
- Any reduction below 6 load units requires the advance approval of the Provost
- At the end of each semester Deans must report the names of all faculty members who taught less than 9 load units and the justification for each.
- The Provost will review the Deans' decisions to assure the justifications were adequate
- Policy C110 suggests some possible justifications, but there may be others
- A faculty member will not regularly be released from the obligation of carrying 9 teaching load units. This includes instances of class cancellations due to low enrollment, which departments need to manage to minimize.

Formula for Computing Faculty Loads

1. Teaching

A. Multiply classroom teaching hours by an appropriate weighting factor:
   - I. Lectures and seminars: 1
   - II. Second section of the same class: 0.6
   - III. Personal supervision of lab, applied music, etc: 0.6 to 1.0

B. Directing individual students in problems: sch times 0.2

C. Membership of committees for graduate students:
   - I. Chair of doctoral dissertation: 1 unit per semester for every semester the student is working on the dissertation.
   - II. Chair of master's thesis: 1 unit for one semester, typically the last semester of the student's work.
   - III. Member of a dissertation committee: 0.5 units for the semester in which the dissertation is completed.

2. Special Assignments

A. Developing new courses, new curricula advising, directing performances, courses with unusual preparation requirements, experimental demonstrations, etc.: units as proposed by the department Chair and approved by the college Dean.

3. Other Responsibilities

THE UNIVERSITY of NEW MEXICO

UNM

Faculty Workload AY09-10

College	Fall 2009 Formula Teaching Load	Fall 2009 Formula Workload	Spring 2010 Formula Teaching Load	Spring 2010 Formula Workload
A&P	8.6		8.5	13.9
A&S	9.4	19.8	9.1	19.2
ASM	7.6	15.3	7.3	15.0
COE	11.1	23.0	12.7	21.6
CFA	11.5		10.0	13.9
LAW	6.2	18.4	6.4	19.7
SOE	10.0	11.0	10.8	11.8
SPA	7.0		5.9	
UC	8.1		9.1	
Policy	9.0	12.0	9.0	12.0

SOE data are being checked and recalculated

http://www.unm.edu/regents/meetings/documents/bor-e-book-2010-08-10.pdf
Pdf p. 223

Formula for Computing Faculty Workloads Section on Research

V. Research

Units will be assigned by the department chairman for contract research according to the nature of the contract. Units will be assigned for non-sponsored research and creative work on the basis of reasonably accurate information regarding the scope of the project and the time devoted to it. Points assigned should be proportionate, on the basis of time spent, to those assigned for classroom teaching.

Last sentence is key.

Formula is 9 load units for teaching, 5 load units for research, and 1 load unit for service. Teaching is only category in the formula where you can exceed the norm. Must bring c100 to reflect what is already *de facto* policy.

How to rework C100 to reflect what our workloads actually are?

Proposal 1: C100

ACADEMIC LOAD

- The term "academic load" describes the sum total of all officially recognized University duties carried out by an individual member of the faculty at any given time. Teaching in regularly scheduled classes is basic, of course, but overall load may also include research or creative work, sponsored research, committee assignments, student advisement, direction of theses and dissertations, and administrative or supervisory duties. It should be recognized that the University has become a major research institution, such that teaching, in the normal sense, should be extended to include those activities that involving graduate supervision and efforts with graduate students in a research laboratory, or some other creative environment. The normal teaching load each semester is nine adjusted credit hours and the normal academic load, as defined by the formula available in the Office of the Provost/Vice President for Academic Affairs, is twelve units per semester. The adjusted credit hours may involve a mix of classroom teaching, individual instruction to students, laboratory efforts associated with research, field instructions associated with research, and other environments where faculty are directly engaged with students in a creative environment. (See also "Teaching Assignments" C110, *Faculty Handbook*.)

- This proposal inserts language about change in the nature of university as a Research I institution.

- Inserts language making it clear what teaching is and reiterates what is in C110 and Section B 1.2.1-1.2.3 of *Faculty Handbook*.

Proposal 2: C100

ACADEMIC LOAD

- The term "academic load" describes, the sum total of teaching, scholarly work, and service which are the officially recognized University duties to be carried out by an individual member of the faculty at any given time. (See Section B 1.2.1-1.2.3 of *Faculty Handbook* for definition of each category of the academic load.) Teaching and scholarly work constitute equal shares of the academic load; service constitutes a lesser share. The normal teaching load each semester is nine adjusted credit hours. (See also "Teaching Assignments" C110, *Faculty Handbook*.) The normal research load, as defined by the formula available in the Office of the Provost/Vice President for Academic Affairs, equals that of teaching. The service load, as defined by the formula available in the Office of Provost/Vice President for Academic Affairs, is a quarter of research and teaching loads combined.

- Assumes a change in formula giving same number of load units to research as there is to teaching(9 load units teaching/9 load units research and then 4.5 load units service.

- Increases the normal academic load from 12 load units to 22.5 load units.

- Both proposals will necessitate a comparable research policy to C110 and a research load formula caliberated to take into account all forms of scholarly work as defined in *Faculty Handbook*

Proposal 2: C100

ACADEMIC LOAD

- The term "academic load" describes, the sum total of teaching, scholarly work, and service which are the officially recognized University duties to be carried out by an individual member of the faculty at any given time. (See Section B 1.2.1-1.2.3 of *Faculty Handbook* for definition of each category of the academic load.) Teaching and scholarly work constitute equal shares of the academic load; service constitutes a lesser share. The normal teaching load each semester is nine adjusted credit hours. (See also "Teaching Assignments" C110, *Faculty Handbook*.) The normal research load, as defined by the formula available in the Office of the Provost/Vice President for Academic Affairs, equals that of teaching. The service load, as defined by the formula available in the Office of Provost/Vice President for Academic Affairs, is a quarter of research and teaching loads combined.

- Assumes a change in formula giving same number of load units to research as there is to teaching(9 load units teaching/9 load units research and then 4.5 load units service.

- Increases the normal academic load from 12 load units to 22.5 load units.

- Both proposals will necessitate a comparable research policy to C110 and a research load formula caliberated to take into account all forms of scholarly work as defined in *Faculty Handbook*

Current Policy on Work Loads

C100
Policy

ACADEMIC LOAD

The term "academic load" describes the sum total of all officially recognized University duties carried out by an individual member of the faculty at any given time. Teaching in regularly scheduled classes is basic, of course, but overall load may also include research or creative work, sponsored research, committee assignments, student advisement, direction of theses and dissertations, and administrative or supervisory duties. The normal teaching load each semester is nine adjusted credit hours and the normal academic load, as defined by the formula available in the Office of the Provost/Vice President for Academic Affairs, is twelve units per semester. (See also "Teaching Assignments" C110, *Faculty Handbook*.)

We will be considering the following:

Proposal 1:

C100
Policy

ACADEMIC LOAD

The term "academic load" describes the sum total of all officially recognized University duties carried out by an individual member of the faculty at any given time. Teaching in regularly scheduled classes is basic, of course, but overall load may also include research or creative work, sponsored research, committee assignments, student advisement, direction of theses and dissertations, and administrative or supervisory duties. It should be recognized that the University has become a major research institution, such that teaching, in the normal sense, should be extended to include those activities that involving graduate supervision and efforts with graduate students in a research laboratory, or some other creative environment. The normal teaching load each semester is nine adjusted credit hours and the normal academic load, as defined by the formula available in the Office of the Provost/Vice President for Academic Affairs, is twelve units per semester. The adjusted credit hours may involve a mix of classroom teaching, individual instruction to students, laboratory efforts associated with research, field instructions associated with research, and other environments where faculty are directly engaged with students in a creative environment. (See also "Teaching Assignments" C110, *Faculty Handbook*.)

Proposal 2:

C100
Policy

ACADEMIC LOAD

The term "academic load" describes, the sum total of teaching, scholarly work, and service which are the officially recognized University duties to be carried out by an individual member of the faculty at any given time. (See Section B 1.2.1-1.2.3 of *Faculty Handbook* for definition of each category of the academic load.) Teaching and scholarly work constitute equal shares of the academic load; service constitutes a lesser share. The normal teaching load each semester is nine adjusted credit hours. (See also "Teaching Assignments" C110, *Faculty Handbook*.) The normal research load, as defined by the formula available in the Office of the Provost/Vice President for Academic Affairs, equals that of teaching. The service load, as defined by the formula available in the Office of Provost/Vice President for Academic Affairs, is a quarter of research and teaching loads combined.

FYI:

C110
Policy

TEACHING ASSIGNMENTS

(Approved by Faculty Senate 12/6/77; by the Regents l/24/78)

1. This policy has been developed pursuant to the resolution of the Regents at their meeting 13 June 1977.

2. Faculty "teaching" assignments are measured in "load units" as defined and calculated in accordance with the University's load formula. The term "load unit" as used in this policy is defined by that formula as currently revised (now the Ninth Revision, 8 September 1975).

3. "Instructional faculty FTE" measures the percentage of time charged to an instructional budget. A portion of the time of faculty-administrators and of faculty engaged in contract research or projects is charged to other budgets. The guidelines in paragraph 5 relate to the teaching assignments of full time faculty members (1.00 FTE), i.e., those whose salaries are charged entirely to instructional budgets. The teaching assignments of faculty members charged in part to instructional budgets (less than 1.00 FTE) would be modified proportionately.

4. The guidelines established in paragraph 5 do not apply to the School of Medicine or to library faculty members. Separate policies will be developed for these groups.

5. The following guidelines are established with respect to minimum* teaching assignments (Section I of the load formula):

5.1 A full-time faculty member normally shall be assigned a minimum teaching load of nine load units each semester.

5.2 In all cases in which it is proposed that a full-time faculty member be assigned a semester teaching load of less than nine load units (but at least six load units), advance approval by the dean of the faculty member's college shall be required. For the 1978-79 school year, advance approval of Office of the Provost/Vice President for Academic Affairs shall also be required. (On 1/19/79 the Regents extended this requirement to include the 1979-80 school year.

5.3 Any reduction in teaching load below six load units shall be granted only with the advance approval of the Office of the Provost/Vice President for Academic Affairs.

5.4 It is recognized that in rare cases, a teaching load of nine or more load units may be planned for a faculty member, but that the required minimal teaching load of nine load units may in fact not materialize because of a shortfall in student enrollment. This should be the only circumstance in which the teaching load of a full-time faculty member will be less than nine load units, except with the advance approval of the appropriate dean's office. Departments, schools and colleges should be prepared to explain load reductions of this kind and present plans to minimize their repetition.

5.5 At the end of each semester each dean shall report to the Provost/Vice President for Academic Affairs a list of the names of all persons to whom reduced teaching loads have been assigned with the justification for each.

5.6 Justification for reduced teaching loads may include (but not be limited to) the following:

5.61 exceptional current productivity in scholarship, research, and/or creative work;

5.62 released time for development of contract research proposals;

5.63 released time for course or curriculum development;

5.64 special administrative assignments or exceptionally heavy committee assignments; and/or

5.65 load reduction in compensation for a teaching overload in an alternate semester.

5.7 The Office of the Provost/Vice President for Academic Affairs shall review all decisions by deans to allow reduced teaching loads to assure that the justifications used were adequate and that approval of such assignments in the future will not have the effect of creating or continuing unjustifiable inequities in faculty teaching loads among the departments, schools, and colleges. It is an expected result of this policy and the required review that a faculty member will not regularly be released from the obligation of carrying nine teaching load units.

Section B 1.2.1-1.2.3 of *Faculty Handbook*

B1.2.1 Teaching

(a) Due to the variety of subject matter and student populations at the University, teaching occurs in various settings and via a diversity of forms of instruction, such as didactic lecturing, small group seminars, problem-based learning, and clinical practicums. The term *teaching* as used here includes, but is not restricted to, regularly scheduled undergraduate, graduate, post-graduate, and professional instruction, and the advising, direction and supervision of individual undergraduate, graduate, post-doctoral, and professional students. Library faculty, in the discharge of their professional duties, shall be regarded as engaged in teaching. Teaching also includes the direction or supervision of students in reading, research, internships, residencies, or fellowships. Faculty supervision or guidance of students in recognized academic pursuits that confer no University credit should also be considered as teaching.

B1.2.2 Scholarly Work

(a) The term *Scholarly Work,* as used in this Policy, comprises scholarship, research, or creative work. *Scholarship* embodies the critical and accurate synthesis and dissemination of knowledge. The term *research* is understood to mean systematic, original investigation directed toward the generation, development, and validation of new knowledge or the solution of contemporary problems. *Creative work* is understood to mean original or imaginative accomplishment in literature, the arts, or the professions.

B1.2.3 Service

(a) There are two broad categories of faculty service: professional and public.

(1) Professional service consists of those activities performed within the academic community that are directly related to the faculty member's discipline or profession. Within the University, it includes both the extraordinary and the routine service necessary for the regular operation of departments and colleges and the University as a whole, including, for example, facilitating the day-to-day operations of academic life, mentoring students and colleagues, and, in the Health Sciences Center, providing patient care. Universities, and their component colleges and departments, rely to a great extent for their operation and advancement on the active participation of faculty members in their administration and governance. Although service is not weighted as heavily as teaching and research or creative works, "service" is an essential element of faculty performance and duties. Faculty members, particularly senior faculty members, have a responsibility to contribute to the government of the University through timely participation on committees and other advisory groups at the department, college, and University levels. Beyond the University, professional service includes service to professional organizations and other groups that engage in or support educational and research activities.

(2) Public service consists of activities that arise from a faculty member’s role in the University. These activities normally involve the sharing and application of faculty expertise to issues and needs of the civic community in which the University is located.

11. REVISED FACULTY WORKLOAD RESOLUTION
Senator John Tabor presented the following Faculty Workload resolution. The resolution was officially withdrawn at the request of the submitter. The requestor withdrew the resolution after becoming aware of the Operations Committee working on the revisions of Faculty Handbook Policies C100 and C110. Also, the perception of the resolution outside the university could be misinterpreted. No action was taken by the senate.

FS resolution regarding teaching II

Whereas, the University of New Mexico is the flagship university of the State of New Mexico;

Whereas an increase in the actual amount of classroom teaching done by full-time faculty above its present level would significantly reduce the total amount of research done by faculty across the University;

Whereas the average teaching workload and total faculty workload in some colleges already exceed the minimum;

Whereas an increase in the actual amount of teaching for individual faculty due to an inflexible implementation of the official 3-3 teaching load would encourage many of the leading researchers of the University to seek positions elsewhere, and would make it difficult for the University to recruit quality scholars, scientists, and artists as new faculty;

Whereas an increase in teaching would affect the quality of attention faculty are able to devote to both undergraduates and graduate students,

Whereas the idea of a research university is that *all* faculty are teacher-scholars,

Whereas other public research universities, even in these difficult economic times, have not increased official teaching loads or the actual amount of teaching required of their faculty,

And whereas administrators (Deans and Provosts) of the recent past have observed a flexible and enlightened implementation of the Faculty Handbook teaching load policy so as to maximize the research of all faculty in all departments, the Faculty Senate of the University of New Mexico urges the Provost, the President, and the Regents of UNM not to take any steps, for any reasons, that would have the effect of increasing the amount of teaching done by full-time faculty above its present level.

12. ASUNM PRINTING RESOLUTION
President Lazaro Cardenas (Associated Students of the University of New Mexico) presented the following revised printing resolution for endorsement by the Faculty Senate. ASUNM worked with Faculty Senator Judith White (Communication and Journalism) to revise the original resolution that was previously presented at the August 2010 Faculty Senate meeting. The point of the resolution is to encourage faculty to lower printing requirements of their students. The Faculty Senate voted 13 – 9 in favor of endorsement.

WHEREAS the Associated Students of the University of New Mexico is the representative body of the undergraduate students; and

WHEREAS the University of New Mexico is moving towards a more sustainable approach for the environment; and

WHEREAS printing a vast amount of documents may not be the best practice for promoting campus sustainability; and

WHEREAS printing costs are burdensome on students as well as faculty and academic departments; and

WHEREAS students are affected by the printing restriction enforced during the Spring semester of 2010 and now are unable to print unlimited documents; and

WHEREAS some classes require students to print large numbers of documents at their own expense; and

WHEREAS students want the option to print or not print syllabi for their respective courses; and

WHEREAS instructor may opt to present their syllabi to classes and engage in discussions which outline course goals and expectations without requiring students to have a printed copy of the syllabus; and

WHEREAS students may not be required to print non-essential documents, but instead have them made available in electronic form, such as through e-mail, WebCT, E-reserves and/or an instructor's course website; and

WHEREAS faculty members will then require students to print only papers and assignments produced for a class; and

WHEREAS the instructor of each course will make students aware of the documents that should be printed; and

WHEREAS faculty members will make a good faith effort to limit the number of documents they require students to print; and

THERFORE BE IT RESOLVED faculty will engage in discussions to develop a plan to reduce the amount of documents they require students to print each semester, and faculty will encourage one another to reduce the amount of printing they require from their students; and

NOW THEREFORE BE IT FURTHER RESOLVED that this resolution will be presented to Board of Regents President Raymond Sanchez, UNM President Dr. David Schmidly, Provost Dr. Suzanne Ortega, Vice-President for Student Affairs Dr. Eliseo "Cheo" Torres, Chief Information Officer Dr. Gil Gonzales, Faculty Senate President Dr. Richard Wood and GPSA President Lissa Knudsen.

CONSENT AGENDA

13. FORMS C FROM THE CURRICULA COMMITTEE
The following Forms C were approved by unanimous vote of the Faculty Senate.

New Dual Degree PharmD/MBA, College of Pharmacy
Revision of MS and PhD of Nanoscience and Microsystems, College of Arts and Sciences
Revision of All PhD Concentrations in Psychology, College of Arts and Sciences

AGENDA TOPICS

14. NEW BUSINESS AND OPEN DISCUSSION
One item was raised:

> Senator Howard Snell (Biology) asked for an update on the faculty requested special procedures audit.
>
> The Faculty Senate Budget Committee is reviewing the audit and has sent a preliminary report to the Board of Regents Audit Committee. The audit will be posted on the Faculty Senate website.

15. ADJOURNMENT
The meeting was adjourned at 5:03 p.m.

Respectfully submitted,

Rick Holmes
Office of the Secretary

The University of New Mexico

SENATE GRADUATE &
PROFESSIONAL COMMITTEE
Claudia B. Isaac, Chair
cisaac@unm.edu

DATE: October 21, 2010

TO: Operations Committee of the Faculty Senate

FROM: Claudia B. Isaac, Ph.D., Chair
Senate Graduate & Professional Committee

RE: Posthumous Degree

At its October 21, 2010 meeting the Senate Graduate & Professional Committee voted to approve a request to grant a posthumous degree to Yi Huang (101337974). Please see the attached memo from Rafiqul A. Tarefder, Assistant Professor, Civil Engineering, detailing this request for Ms. Huang.

The Senate Graduate & Professional Committee's approval is based primarily on the two conditions specified in the faculty handbook relative to the granting of posthumous degrees. Ms. Huang had completed the coursework required for the degree and her academic record is in good standing. Therefore, we request that the Faculty Senate support the awarding of a posthumous Master of Science in Civil Engineering to Yi Huang. We also request that this item be put on the Senate's agenda at the earliest convenience. The Department of Civil Engineering is concerned on behalf of Ms. Huang's family that this situation be resolved quickly.

Thank you.

Attachment

THE UNIVERSITY of NEW MEXICO | SCHOOL of ENGINEERING

Department of Civil Engineering

OCT 1 9 2010

OFFICE OF SECRETARY

DATE: October 7, 2010

TO: Dean, Office of Graduate Studies

FROM: Rafiqul A. Tarefder, Assistant Professor
Department of Civil Engineering

Rafi Tarefder

SUBJECT: REQUEST TO AWARD POSTHUMOUS DEGREE

I am requesting that the degree of Master of Science in Civil Engineering be awarded posthumously to Yi Huang. Yi started her M.S. study in Fall 2008, and completed most of her degree prior to her death in June 2010.

Yi was a student in good standing and on the verge of completing all of her requirements including a thesis for the M.S. when she passed away on June 7, 2010. She had turned in draft of all chapters of her thesis to me and was planning to defend during the last week of June 2010. At the time of her death, Yi had completed all of her course requirements and was taking only thesis hours.

I hope that you will agree that this is an appropriate action to take. Thank you for your assistance in this matter. If there is any additional information needed, please contact Dr. Rafi Tarefder at 277-6083 or tarefder@unm.edu.

By signing below, I am strongly endorsing this request:

JStormont
....
John Stormont
Chair, Department of Civil Engineering

10/13/10

....
Arup Maji
Interim Dean, School of Engineering

C215
Policy

PARENTAL LEAVE *(Draft ~~7/17~~9/12/07)~~/07)~~*

SECTION 1: GENERAL PRINCIPLES

The University of New Mexico supports faculty in balancing their academic and personal lives. The University strives to help faculty coordinate the~~The~~ needs and timing of an academic career and balancing the sometimes competing priorities of their academic and personal lives.~~may conflict with those of parenting, and the~~ The University is committed to creating an environment that supports faculty when the responsibilities of family life are particularly demanding by allowing faculty to take time away from work ***for caring for*** ~~***for***~~ ~~care-giving~~ and bonding with children.~~with an increased need to take time away from work for care-giving.~~ This policy provides ~~up to~~ one semester of ~~partial~~ parental leave ~~relief~~ with full pay for a primary or coequal care-giving faculty parent as defined within this policy.

1.1 Role of Academic Leadership

Academic leaders and supervisors will ***attempt to*** foster an environment in which every eligible faculty member will be encouraged to consider freely the parental leave ***opportunity~~ties~~*** offered through this policy. Deans, ~~and~~ department chairs, and program directors should make every effort to promote use of this policy. Individuals participating in reappointment, tenure, and promotion reviews shall not allow use of parental leave or family-related tenure-clock extensions to have a negative influence in the evaluation of any candidate.

1.2 Ethical Use

This ***policy shall*** ~~should~~ be promulgated, used, and applied within the intent and principles of the policy and with the high ethical standards expected in all areas of academic endeavors and leadership.

The parent/s taking leave must also realize this is a revocable benefit under certain circumstances. The leave may not be used for outside work, whether part-time or full-time, for pay. The parent taking leave must also agree that he or she will return to work at The University of New Mexico after leave has been taken for a minimum of time equal to leave time taken.

1.3. Relationship to Medical Leave

Parental leave is not intended to take the place of medical leave for a birth mother, but is granted in addition to any medically required leave.

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SECTION 2: ELIGIBILITY, REQUIREMENTS, AND LIMITATIONS

2.1 Eligibility

All regular contract faculty at .50 FTE or higher who have been employed at UNM at least one semester are eligible for parental leave. ~~To qualify for parental leave the faculty member must have significant responsibility for the care of a child who has recently joined the household.~~ In taking parental leave, the expectation is that the faculty member will spend this time caring for *and bonding with a child who has recently joined the household. If both parents are faculty members, each is eligible for parental leave. ~~.~~ If both faculty members are in the same department, the faculty members and the chair will discuss how best to meet the needs of the department and the family including whether to take the leave concurrently or consecutively (preferable). If only one parent takes leave, that parent will be reimbursed at full pay during the leave. If both parents wish to take leave, whether consecutively or concurrently, they will each be reimbursed at one-half of their usual salary. Mothers giving birth, spouses or domestic partners of mothers giving birth, parents adopting, and parents accepting a long-term foster placement or fostering toward adoption, are all eligible for equal amounts of parental leave under this policy.

2.2 Eligible Events

Parental leave ~~of up to one semester~~ should normally begin within one calendar year after a child is born or an adopted or foster child joins the household. Exceptions to the one-year time frame will be reviewed on a case-by-case basis in accordance with Section 3.1. herein.

2.3. Relief

This policy provides ~~partial~~ full relief ~~primarily~~ from ~~the demands of~~ teaching duties and similar ~~and program~~ responsibilities. When research and advising are part of the duties, it is normally expected that these activities will continue during parental leave, but not during any period of medically required leave. ~~Due t~~Given ~~o~~ the varied nature of academic responsibilities across the University~~,~~ it is the prerogative of each dean to establish guidelines for relief under this policy. Due to the unique nature of faculty responsibilities that include providing patient care, the Health Sciences Center will define the extent of relief provided to HSC faculty requesting parental leave.

The faculty member should discuss the need for parental leave with the dean or department chair well in advance of the leave and when possible, in time for any alternative teaching, patient care, and other academic arrangements to be made. The faculty member and the dean or department chair will work together to develop a plan for ~~partial relief~~ parental leave that meets both the needs of the faculty member and the needs of the University. ***They shall***~~should~~ work together to minimize the impact of leave on students, grantors, patients, and other beneficiaries of the academic program.

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2.4 Family and Medical Leave (FMLA)

~~Relief under this policy counts as part of the federal FMLA entitlement. To the extent that any of the twelve (12) week FMLA entitlement remains, it is possible~~ Faculty members may also ~~to~~ take unpaid FMLA to arrange additional relief. ~~Use of all twelve weeks of FMLA entitlement does not affect eligibility to take parental leave.~~ For more information on FMLA refer to Policy 3440 "Family and Medical Leave," UBP, which can be viewed at http://www.unm.edu/~ubppm/ubppmanual/3440.htm.

2.5 Tenure Clock

~~In accordance with the policy on Academic Freedom and Tenure, a faculty member on parental leave may request that~~ The running of the probationary period will be suspended, ~~for the duration of the leave,~~ unless otherwise requested in writing, when a faculty member is on parental leave. ~~and s~~ Subsequent mid-probationary and tenure reviews will be one full year later. Deans, department chairs, and program directors should help faculty members to make informed decisions about suspending the probationary period.

2.6 Sabbatical

Parental leave time will count towards time worked to earn a sabbatical.

SECTION 3: EXTRAORDINARY CIRCUMSTANCES AND APPEALS

3.1 Extraordinary Circumstances

Extraordinary circumstances such as multiple births/adoptions or events involving special-needs children may necessitate additional parental ~~flexibility and/or~~ leave and/or flexibility, ***and shall***~~should~~ be referred to the appropriate ~~Executive~~ executive ~~Vice~~ vice ~~President~~ president for a determination. These situations will be reviewed on a case-by-case basis to determine how best to meet the additional needs of the faculty member and the University. ~~, however~~ These decisions will be applied consistently across the University to ensure equitable treatment.

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3.2 Appeals

If a faculty member and the dean or department chair cannot reach agreement on a parental leave plan for ~~partial~~ relief, the faculty member may appeal the dean's decision to the applicable executive vice president for a final decision.

SECTION 4: PROGRAM REVIEW AND EVALUATION

The Provost's Office will review this parental leave program biennially to ensure that it is applied equitably and consistently across the University within the intent of the policy. This review will also analyze the program's impact on the University's mission and faculty recruitment, retention, and satisfaction in relation to associated costs.

What about an unfunded mandate? Should it be tied into a similar situation as in funding of sabbaticals?

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FORM C - DEGREE/PROGRAM CHANGE

Date: April 6, 2010

MVH

CIP CODE

APR 08 2010

Assigned by Associate Provost for Academic Affairs

ROUTING (All Four Collated Sets)
1. Department Chairperson
2. College Curriculum Committee
3. College or School Faculty (if necessary)
4. College or School Dean/Dean of Instruction
5. Office of the Registrar—Catalog
6. Director of relevant Library
7. FS Graduate Committee (graduate courses)
8. FS Undergraduate Committee (undergraduate courses)
9. FS Curriculum Committee
10. Assoc. Provost for Academic Affairs
11. Faculty Senate
12. Board of Regents (new degree only)

RECEIVED

REC'D

Nikki Katalanos
(Name of individual initiating curricular change form)

PhD, PA-C, Director 272-9830
(Title, position, telephone number)

nkatalanos@salud.unm.edu
(Email address)

Family & Community Medicine
(Department/Division/Program/Branch)

*** Plan for curricular process to take at least 12 months.**

Mark Appropriate Program:

Undergraduate Degree Program ☒

Graduate Degree Program ☐
(For existing degree only)

This form is for BS in PA Studies
Name of New or Existing Program

This program is or would be located in current undergraduate/graduate catalog on page(s).

Mark appropriate category:	NEW	REVISION OF	DELETION	NAME CHANGE
Degree BS (Type)	☐ Undergraduate degree only	☐	☒	☐
Major	☐	☐	☒	☐
Minor	☐	☐	☐	☐
Concentration	☐	☐	☐	☐
Certificate	☐	☐	☐	☐
Emphasis	☐	☐	☐	☐
Department	☐	NA	☐	☐
Subject Code	☐	☐	☐	☐

Give exact title and requirements as they should appear in the catalog. See current catalog for format within the respective college (attach additional sheets if necessary). Identify in bracket form what is being changed.

Reason(s) for Request (attach additional sheets if necessary).

MS degree will replace the BS in PA Studies. The last PA class to receive a BS will gradute in August 2011. BS courses will remain on the schedule through Fall of 2012, as needed, to allow remediation or delay for any member of that class.

Attach statements to address Budgetary and Faculty Load Implications and Long-range planning.

Does this change affect in a significant way, any other departmental programs/branch campuses? Yes ____ No X

If yes, have you resolved these issues with department/branch involved? ____________(attach statement)

Proposed Effective Term: Fall (Term) 2012 (Year)

Required Signatures:

Department Chair	M McGrew	Date	4/1/10
College Curriculum Committee	n/a	Date	
College or School Faculty (if necessary)	n/a	Date	
College or School Dean/Dean of Instruction	[signature]	Date	4.5.10
Office of the Registrar—Catalog	Elizabeth A. Barton	Date	05/28/10
Director of relevent Library		Date	
FS Graduate Committee (graduate courses)		Date	
FS Undergraduate Committee (undergraduate courses)	Amy Shell	Date	10/28/10
FS Curriculum Committee	[signature]	Date	11-8-10
Assoc. Provost for Academic Affairs		Date	
Faculty Senate		Date	
Board of Regents		Date	

For Registrar's Office ONLY:

Entered Banner JUL 1 6 2010

Entered Catalog

Copies Mailed

Graduate Office
University of New Mexico

THE UNIVERSITY OF NEW MEXICO OFFICE OF THE REGISTRAR (Revised 06/2006)

FORM C - DEGREE/PROGRAM CHANGE

Date: April 6, 2010

Nikki Katalanos
(Name of individual initiating curricular change form)

PhD, PA-C, Director 272-9830
(Title, position, telephone number)

nkatalanos@salud.unm.edu
(Email address)

Family & Community Medicine
(Department/Division/Program/Branch)

CIP CODE

Assigned by Associate Provost for Academic Affairs

ROUTING (All Four Collated Sets)

1. Department Chairperson
2. College Curriculum Committee
3. College or School Faculty (if necessary)
4. College or School Dean/Dean of Instruction
5. Office of the Registrar—Catalog
6. Director of relevant Library
7. FS Graduate Committee (graduate courses)
8. FS Undergraduate Committee (undergraduate courses)
9. FS Curriculum Committee
10. Assoc. Provost for Academic Affairs
11. Faculty Senate
12. Board of Regents (new degree only)

*** Plan for curricular process to take at least 12 months.**

Mark Appropriate Program:

- Undergraduate Degree Program ☒
- Graduate Degree Program (For existing degree only) ☐

This form is for BS in PA Studies
Name of New or Existing Program

This program is or would be located in current undergraduate/graduate catalog on page(s).

Mark appropriate category:

	NEW	REVISION OF	DELETION	NAME CHANGE
Degree BS (Type)	☐ Undergraduate degree only	☐	☒	☐
Major	☐	☐	☒	☐
Minor	☐	☐	☐	☐
Concentration	☐	☐	☐	☐
Certificate	☐	☐	☐	☐
Emphasis	☐	☐	☐	☐
Department	☐	NA	☐	☐
Subject Code	☐	☐	☐	☐

Give exact title and requirements as they should appear in the catalog. See current catalog for format within the respective college (attach additional sheets if necessary). Identify in bracket form what is being changed.

Reason(s) for Request (attach additional sheets if necessary).

MS degree will replace the BS in PA Studies. The last PA class to receive a BS will gradute in August 2011. BS courses will remain on the schedule through Fall of 2012, as needed, to allow remediation or delay for any member of that class.

Attach statements to address Budgetary and Faculty Load Implications and Long-range planning.

Does this change affect in a significant way, any other departmental programs/branch campuses? Yes ____ No X

If yes, have you resolved these issues with department/branch involved? ____________(attach statement)

Proposed Effective Term: Fall (Term), 2012 (Year)

Required Signatures:

Department Chair	M McGrew	Date 4/1/10
College Curriculum Committee	n/a	Date
College or School Faculty (if necessary)	n/a	Date
College or School Dean/Dean of Instruction	[signature]	Date 4.5.10
Office of the Registrar—Catalog	Elizabeth A. Barton	Date 05/28/10
Director of relevent Library		Date
FS Graduate Committee (graduate courses)		Date
FS Undergraduate Committee (undergraduate courses)	[signature]	Date 10/28/10
FS Curriculum Committee	K. Kord	Date 11-8-10
Assoc. Provost for Academic Affairs		Date
Faculty Senate		Date
Board of Regents		Date

For Registrar's Office ONLY: Entered Banner ____ Entered Catalog ____ Copies Mailed ____

FORM C - DEGREE/PROGRAM CHANGE

Date: April 6, 2010

Nikki Katalanos
(Name of individual initiating curricular change form)

PhD, PA-C, Director 272-9830
(Title, position, telephone number)

nkatalanos@salud.unm.edu
(Email address)

Family & Community Medicine
(Department/Division/Program/Branch)

CIP CODE

- **Assigned by Associate Provost for Academic Affairs**

ROUTING (All Four Collated Sets)

1. Department Chairperson
2. College Curriculum Committee
3. College or School Faculty (if necessary)
4. College or School Dean/Dean of Instruction
5. Office of the Registrar—Catalog
6. Director of relevant Library
7. FS Graduate Committee (graduate courses)
8. FS Undergraduate Committee (undergraduate courses)
9. FS Curriculum Committee
10. Assoc. Provost for Academic Affairs
11. Faculty Senate
12. Board of Regents (new degree only)

*** Plan for curricular process to take at least 12 months.**

For Registrar's Office ONLY: Entered Banner ____ Entered Catalog ____ Copies Mailed ____

Mark Appropriate Program:

Undergraduate Degree Program ☒

Graduate Degree Program (For existing degree only) ☐

This form is for BS in PA Studies
Name of New or Existing Program

This program is or would be located in current undergraduate/graduate catalog on page(s).

Mark appropriate category:

	NEW	REVISION OF	DELETION	NAME CHANGE
Degree BS (Type)	☐ Undergraduate degree only	☐	☒	☐
Major	☐	☐	☒	☐
Minor	☐	☐	☐	☐
Concentration	☐	☐	☐	☐
Certificate	☐	☐	☐	☐
Emphasis	☐	☐	☐	☐
Department	☐	NA	☐	☐
Subject Code	☐	☐	☐	☐

Give exact title and requirements as they should appear in the catalog. See current catalog for format within the respective college (attach additional sheets if necessary). Identify in bracket form what is being changed.

Reason(s) for Request (attach additional sheets if necessary).

MS degree will replace the BS in PA Studies. The last PA class to receive a BS will gradute in August 2011. BS courses will remain on the schedule through Fall of 2012, as needed, to allow remediation or delay for any member of that class.

Attach statements to address Budgetary and Faculty Load Implications and Long-range planning.

Does this change affect in a significant way, any other departmental programs/branch campuses? Yes ____ No X

If yes, have you resolved these issues with department/branch involved? ____________(attach statement)

Proposed Effective Term: Fall (Term), 2012 (Year)

Required Signatures:

Department Chair	M McGrew	Date 4/1/10
College Curriculum Committee	n/A	Date
College or School Faculty (if necessary)	n/A	Date
College or School Dean/Dean of Instruction	[signature]	Date 4.5.10
Office of the Registrar—Catalog	Elizabeth A. Baxton	Date 05/28/10
Director of relevent Library		Date
FS Graduate Committee (graduate courses)		Date
FS Undergraduate Committee (undergraduate courses)	Amy Neel	Date 10/28/10
FS Curriculum Committee	K Beal	Date 11-8-10
Assoc. Provost for Academic Affairs		Date
Faculty Senate		Date
Board of Regents		Date

DEGREE/PROGRAM CHANGE
FORM C

Fields marked with * are required

Name of Initiator: Jerome Hall **Email:*** jerome@unm.edu **Date:*** 06-14-10

Phone Number:* 505 277-1418 Initiator's Rank / Title* Professor: Civil Engineering

Faculty Contact* Jerome Hall Administrative Contact* Josie Gibson

Department* Civil Engineering

Division **Program**

Branch

Proposed effective term:

Semester Fall Year 2011

Course Information

Select Appropriate Program Undergraduate Degree Program CIP Code

Name of New or Existing Program * BS degree in Civil Engineering

Catalog Page Number 425 Select Category Major Degree Type BS

Select Action Revision

Exact Title and Requirements as they should appear in the catalog.

See current catalog for format within the respective college (enter text below or upload a doc/pdf file)

In the listing of courses, First Year, Second Semester: Delete Chem 122 General Chemistry (3) Delete Chem 124 General Chemistry Lab (1) Add Phyc 167 Problems in General Physics (1) Add Biol 110 Biology Non-Majors (3) or EPS 101 How the Earth Works (3)

☐ **This Change affects other departmental program/branch campuses**

Reason(s) for Request * (enter text below or upload a doc/pdf file)

The Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology, which accredits UNM's BSCE degree, has changed its requirements to read in part: "The program must demonstrate that graduates can apply knowledge of mathematics through differential equations, calculus-based physics, chemistry, and at least one additional area of science, consistent with the program educational objectives." The proposed change requiring an introductory course in either biology or earth and planetary sciences will satisfy the new "one additional area of science" requirement. The addition of Phyc 167 will help our students with their problem-solving skills. The total number of hours required for the BSCE degree will remain unchanged. The program will continue to satisfy the core curriculum requirements with Chem 121/123, Phyc 160 and 161, and either Biol 110 or EPS 101.

Statements to address budgetary and Faculty Load Implications and Long-range planning * (enter text below or upload a doc/pdf file)

Between 10 and 15 students per semester will be removed from Chem 122 and Chem 124, and a similar number will be split between Biol 110 and EPS 101, as well as Phyc 167. There will be less demand for chemistry lab facilities. There will be no net effect on faculty load.

DEGREE/PROGRAM CHANGE
FORM C

Fields marked with * are required
Name of Initiator: Tonya Lashun Bryant **Email:*** tbryant@unm.edu **Date:*** 12-01-09
Phone Number:* 505 277-5009 Initiator's Rank / Title* Coord,Program Advisement: Psychology Department

Faculty Contact* Jane Ellen Smith Administrative Contact* Tonya Bryant
Department* Psychology
Division Arts & Sciences **Program** Undergraduate
Branch Main Campus

Proposed effective term:
Semester Fall Year 2009

Course Information

Select Appropriate Program Undergraduate Degree Program CIP Code
Name of New or Existing Program * Bachelor of Arts in Psychology
Catalog Page Number 276 Select Category Major Degree Type BA
Select Action Revision

Exact Title and Requirements as they should appear in the catalog.
See current catalog for format within the respective college (enter text below or upload a doc/pdf file)
3. Four courses (12 credits) selected from our six 200-level core courses: PSY 220, 240, 260, 265, 271 and 280

☐ **This Change affects other departmental program/branch campuses**

Reason(s) for Request * (enter text below or upload a doc/pdf file)
This is an error in the catalog. It currently states selected from our five 200-level core courses. It shout state six, as their are six core courses to choose from.

Statements to address budgetary and Faculty Load Implications and Long-range planning * (enter text below or upload a doc/pdf file)
None.

DEGREE/PROGRAM CHANGE
FORM C

Fields marked with * are required

Name of Initiator: Stephen Burd **Email:*** burd@unm.edu **Date:*** 11-02-09

Phone Number:* 505 277-6418 Initiator's Rank / Title* Associate Professor: ASM Mrkting Info Decision Sci

Faculty Contact* Stephen Burd Administrative Contact* Roberta Murray

Department* ASM Marketing, Information, and Decision Sciences

Division **Program** BBA

Branch

Proposed effective term:

Semester Fall Year 2010

Course Information

Select Appropriate Program Undergraduate Degree Program CIP Code

Name of New or Existing Program * Bachelors in Business Administration - Marketing Concentration

Catalog Page Number 88 Select Category Concentration Degree Type BBA

Select Action Revision

Exact Title and Requirements as they should appear in the catalog.

See current catalog for format within the respective college (enter text below or upload a doc/pdf file)

MGMT 481 and 435 plus three additional marketing electives from 433, 480, 483, 484, 485, 486, 487, 488, and 489. Other courses may be substituted with prior consent of the Marketing concentration faculty advisor.

☐ **This Change affects other departmental program/branch campuses**

Reason(s) for Request * (enter text below or upload a doc/pdf file)

The faculty wants to add Marketing Strategy (MGMT 435) as a required course so that students have a broader perspective of how all the pieces of marketing "fit together". MGMT 480 will no longer be a required course, which keeps the concentration at 15 hours. MGMT 482 will be added to the list of concentration electives.

Statements to address budgetary and Faculty Load Implications and Long-range planning * (enter text below or upload a doc/pdf file)

No net change in number of undergraduate marketing concentration courses offered per academic year. Offerings of other courses will be reduced to compensate for the addition of MGMT 435.

FORM C - DEGREE/PROGRAM CHANGE

Date: 8/11/10

Demetra Logothetis
(Name of individual initiating curricular change form)

Director, 2-6687
(Title, position, telephone number)

dlogothetis@salud.unm.edu
(Email address)

Dental Hygiene
(Department/Division/Program/Branch)

CIP CODE

Assigned by Associate Provost for Academic Affairs

ROUTING (All Four Collated Sets)
1. Department Chairperson
2. College Curriculum Committee
3. College or School Faculty (if necessary)
4. College or School Dean/Dean of Instruction
5. Office of the Registrar—Catalog
6. Director of relevant Library
7. FS Graduate Committee (graduate courses)
8. FS Undergraduate Committee (undergraduate courses)
9. FS Curriculum Committee
10. Assoc. Provost for Academic Affairs
11. Faculty Senate
12. Board of Regents (new degree only)

*** Plan for curricular process to take at least 12 months.**

Mark Appropriate Program:
Undergraduate Degree Program ☒
Graduate Degree Program ☐
(For existing degree only)

This form is for Dental Hygiene
Name of New or Existing Program

This program is or would be located in current undergraduate/graduate catalog on page(s) 552

Mark appropriate category:

	NEW	REVISION OF	DELETION	NAME CHANGE
Degree BS (Type)	☐ Undergraduate degree only	☒	☐	☐
Major	☐	☐	☐	☐
Minor	☐	☐	☐	☐
Concentration	☐	☐	☐	☐
Certificate	☐	☐	☐	☐
Emphasis	☐	☐	☐	☐
Department	☐	NA	☐	☐
Subject Code	☐	☐	☐	☐

Give exact title and requirements as they should appear in the catalog. See current catalog for format within the respective college (attach additional sheets if necessary). Identify in bracket form what is being changed.

Delete DEHY 475

Reason(s) for Request (attach additional sheets if necessary).

Deleting course requirement, as content has been integrated into other courses via case studies to align with accreditation standards and national board format.

Attach statements to address Budgetary and Faculty Load Implications and Long-range planning.
Does this change affect in a significant way, any other departmental programs/branch campuses? Yes ____ No ✓
If yes, have you resolved these issues with department/branch involved? ________(attach statement)
Proposed Effective Term: Spring (Term), 2011 (Year)

Required Signatures:

		Date
Department Chair	[signature]	8-16-10
College Curriculum Committee		
College or School Faculty (if necessary)		
College or School Dean/Dean of Instruction		
Office of the Registrar—Catalog	Elizabeth A. Baston	09/10/10
Director of relevent Library		
FS Graduate Committee (graduate courses)		
FS Undergraduate Committee (undergraduate courses)	[signature]	10/28/10
FS Curriculum Committee	[signature]	11-8-10
Assoc. Provost for Academic Affairs		
Faculty Senate		
Board of Regents		

For Registrar's Office ONLY: Entered Banner ____ Entered Catalog ____ Copies Mailed ____

Deletion of DEHY 475 as a program requirement does not negatively affect budgetary, faculty load implications or long range planning initiatives.

Exhibit 2-A

Division of Dental Hygiene
Bachelor of Science Degree in Dental Hygiene Curriculum

FALL SEMESTERS | **SPRING SEMESTERS**

Freshman

Semester 1				Semester 2	
Eng. 101	Comp. I: Exposition	3	Eng. 102	Comp II: Arg.	3
Biol. 123/L	Biology for Health Sci.	4	Biol. 237	Human Anat & Phys I	3
Chem. 111/L	Elem. of Gen. Chem	4	Biol. 247/L	Anat./Phys Lab	1
Psych 105	Gen. Psych I	3	Chem 212/L	Intro Org & Bio Chem	4
Elective	(Fine Arts Core Curr.)	3	C & J 221	Interp. Comm (Core Curriculum)	3
		17			**14**

Sophomore

Semester 3				Semester 4	
Soc. 101	Intro to Soc.	3	DEHY 205	Intro to Den. Hygiene	2
Biol. 239/L	Microbiology	4	DEHY 210	Head & Neck Anat.	3
Nutr 244	Human Nutrition	3	DEHY 211	Dental Anatomy	2
Stat 145	Intro to Prob.	3	DEHY 250	Gen./Oral Hist & Embry	2
Biol. 238	Human Anat & Phys II	3	2 Electives	(Humanities, Core Curr.)	6
Biol. 248/L	Anatomy & Phys Lab	1			**15**
		17			

Junior

Semester 5				Semester 6	
DEHY 301	Clinical DH Lec I	3	DEHY 303	Clinical DH Lec II	2
DEHY 302	Clinical DH I	2	DEHY 304	Clinical DH II	3
DEHY 330	Dental Health Ed I	2	DEHY 320	Dental Bio Mtls	2
DEHY 340	Gen. & Oral Path	3	DEHY 470	Periodontology I	3
DEHY 312	Dental Radiology/L	3	Nursing 238	Pharmacology	3
DEHY 335	Dental Off Emg.	2	DEHY 370	Spec Pat Care in DH	2
		15			**15**

Summer Semester			
	DEHY 440	Extramural Exp.	3
		Elective/ Language(Core Curr.)	3
			6

Senior

Semester 7				Semester 8	
DEHY 401	Clinical DH Lec III	2	DEHY 403	Clinical DH Lec. IV	2
DEHY 402	Clinical DH III	3	DEHY 404	Clinical DH IV	4
DEHY 475	Periodontology II	2	DEHY 442	Principles of Practice	2
DEHY 422	Dental Pub Health I	3	DEHY 400	Current Issues	3
DEHY 410	DH Research	3	DEHY 423	Dental Pub Health II	1
DEHY 480	Loc. Anes & Pain Control	3	DEHY 440	Extramural Exp.	3
		16			**15**

TOTAL CREDITS 130

DEGREE/PROGRAM CHANGE
FORM C

Fields marked with * are required

Name of Initiator: Stephen Burd **Email:*** burd@unm.edu **Date:*** 10-13-09

Phone Number:* 505 277-6418 Initiator's Rank / Title* Associate Professor: ASM Mrkting Info Decision Sci

Faculty Contact* Stephen Burd Administrative Contact* Robert Murray

Department* Anderson School of Management - MIDS

Division **Program** Bachelor of Business Administration

Branch

Proposed effective term:

Semester Fall Year 2010

Course Information

Select Appropriate Program Undergraduate Degree Program CIP Code

Name of New or Existing Program * Bachelor of Business Administration - Marketing Minor

Catalog Page Number 88 Select Category Minor Degree Type Bachelor

Select Action New

Exact Title and Requirements as they should appear in the catalog.

See current catalog for format within the respective college (enter text below or upload a doc/pdf file)

Insert New section under major heading Minor Study as follows: Minor in Marketing Management The Marketing minor requires a total of 18 credit hours. All Marketing minor students must take ENGL 102, ECON 106, and MGMT 322. Each student should consult with the Marketing faculty advisor to choose an additional nine (9) credits of Marketing courses. Marketing courses include MGMT 480, 481, 483, 484, 485, 486, 487, 488, 489, 433, 435, and some MGMT 490 special topics offerings. All pre- or co-requisites must be satisfied. Students must receive grades of C or better in all courses applied to the minor.

☐ **This Change affects other departmental program/branch campuses**

Reason(s) for Request * (enter text below or upload a doc/pdf file)

There is some demand (estimated at 10 students per year or less) for marketing courses outside ASM, particularly from students in Communication & Journalism. The Marketing Minor will enable such students to have a transcripted minor that specifically uses the word Marketing as compared to the more general Management minor

Statements to address budgetary and Faculty Load Implications and Long-range planning * (enter text below or upload a doc/pdf file)

Minor students are currently prevented from registering for ASM classes until after students enrolled in the BBA program have registered. This policy will extend to the Marketing minor. Current enrollment in courses included in the minor ranges from the low 20s to near 60. Thus, there is some slack to include minor students. However, no additional sections will be scheduled to accommodate demand from students in the minor. Thus, additional budget and faculty lines will not be required by this proposal.

FORM C - DEGREE/PROGRAM CHANGE

Date: 5/6/10

Steven W. Graves
(Name of individual initiating curricular change form)

Associate Professor, 505-277-6395
(Title, position, telephone number)

graves@unm.edu
(Email address)

X152 (Interdisciplinary: Engineering)
(Department/Division/Program/Branch)

CIP CODE

Assigned by Associate Provost for Academic Affairs

ROUTING (All Four Collated Sets)

1. Department Chairperson
2. College Curriculum Committee
3. College or School Faculty (if necessary)
4. College or School Dean/Dean of Instruction
5. Office of the Registrar—Catalog
6. Director of relevant Library
7. FS Graduate Committee (graduate courses)
8. FS Undergraduate Committee (undergraduate courses)
9. FS Curriculum Committee
10. Assoc. Provost for Academic Affairs
11. Faculty Senate
12. Board of Regents (new degree only)

Entered Banner ___ Entered Catalog ___ Copies Mailed ___ For Registrar's Office ONLY:

*** Plan for curricular process to take at least 12 months.**

Mark Appropriate Program:

Undergraduate Degree Program ☐

Graduate Degree Program (For existing degree only) ☒

This form is for Ph.D. in Engineering
(Name of New or Existing Program)

This program is or would be located in current undergraduate/graduate catalog on page(s) p 394. catalog of 2009-2010

Mark appropriate category:

	NEW	REVISION OF	DELETION	NAME CHANGE
Degree ______ Type	☐ Undergraduate degree only	☐	☐	☐
Major	☐	☐	☐	☐
Minor	☐	☐	☐	☐
Concentration	☒	☐	☐	☐
Certificate	☐	☐	☐	☐
Emphasis	☐	☐	☐	☐
Department	☐	NA	☐	☐
Subject Code	☐	☐	☐	☐

Give exact title and requirements as they should appear in the catalog. See current catalog for format within the respective college (attach additional sheets if necessary). Identify in bracket form what is being changed.

Biomedical Engineering Concentration

See Appendix A.

Reason(s) for Request (attach additional sheets if necessary).

See Appendix B.

Attach statements to address Budgetary and Faculty Load Implications and Long-range planning.

Does this change affect in a significant way, any other departmental programs/branch campuses? Yes ____ No ✔

If yes, have you resolved these issues with department/branch involved? ____________(attach statement)

Proposed Effective Term: Spring (Term), 2011 (Year)

Required Signatures:

Department Chair	[signature]	Date 7/6/2010
College Curriculum Committee	[signature]	Date 6 July 2010
College or School Faculty (if necessary)	[signature]	Date 6 July 2010
College or School Dean/Dean of Instruction	[signature]	Date 6 July 2010
Office of the Registrar—Catalog	Elizabeth A. Barton	Date 07/15/10
Director of relevent Library	[signature]	Date 7/28/10
FS Graduate Committee (graduate courses)	[signature]	Date 10·21·10
FS Undergraduate Committee (undergraduate courses)		Date
FS Curriculum Committee	[signature]	Date 11-9-10
Assoc. Provost for Academic Affairs	[signature]	Date 11/18/10
Faculty Senate		Date
Board of Regents		Date

Appendix A
Exact title and requirements as they should appear in the catalog

BIOMEDICAL ENGINEERING GRADUATE PROGRAM

Steven W. Graves, Director

Center for Biomedical Engineering

Biomedical Engineering Concentration for the Ph.D. in Engineering

Ph.D. Admission Requirements

Prospective candidates can apply directly for admission to the Ph.D. program. The Admissions Committee will make admission decisions on a case-by-case basis.

Ph.D. Degree Completion Requirements

The general requirements for this degree are identical to those specified in the Graduate Program section of this catalog. (Please see the Graduate Program section for detailed requirements and procedures common to all UNM graduate programs.) In addition to the general requirement specified in the Graduate Program, graduates must complete the core and elective BME curriculum specified below. BME 567 (Biomedical Engineering Seminar) should be taken every semester, but a student can only apply a maximum of 8 credit hours of this seminar toward their course degree requirements.

Students must pass the Qualifying Examination before applying for Candidacy or proceeding to the Comprehensive Exam. Upon successfully passing the Doctoral Comprehensive Exam and following approval of their application for Candidacy by the program faculty and the Dean of Graduate Studies, the students are admitted to Candidacy for the doctoral degree.

For successful completion of the program requirements, all candidates must pass a Final examination (Defense of Dissertation).

Curriculum for Students Pursuing the BME Concentration for the Ph.D. in Engineering

Focus area: Molecular and Cellular Systems

The following core courses are required of all students pursuing the BME Concentration for the Ph.D. in Engineering. These courses will be taught once per academic year.

BME 517 Applied Biology for Biomedical Engineers
BME 544 Mechanics and Thermodynamics of Molecular Components in Cells
BME 547 Biomedical Engineering Research Practices
BME 556 Protein and Nucleic Acid Engineering
BME 558 Methods of Analysis in Bioengineering

BME 544. Mechanics and Thermodynamics of Molecular Components in Cells. (3)
Chemical thermodynamics and physics are used to establish a material science perspective of the molecular components – chemical kinetics – and structural properties needed for both understanding cell behavior and advancing biotechnology. Restriction: Permission of the instructor. {Fall}

BME 547. Biomedical Engineering Research Practices. (3)
Students will develop research, presentation, and scientific writing skills for theses, proposals, invention disclosures and journal articles. The course includes oral presentations, case studies of research ethics, technology transfer and manuscript preparation. Restriction: Permission of the instructor. {Fall}

BME 556. Protein and Nucleic Acid Engineering. (3)
Students will learn the scientific principles and methods for engineering and manufacturing custom proteins, peptides, nucleic acids, and carbohydrates. The course will explicitly discuss methods and tools used in the production of engineered biomacromolecules. Restriction: Permission of the instructor. {Spring}

BME 558. Methods of Analysis in Bioengineering. (3)
Presents applied analytical and numerical mathematical methods in the context of biomedical engineering problems. Introduces statistical methods for the design of experiments and analysis of experimental data in research and development activities. Restriction: Permission of the instructor. {Spring}

BME 567. Biomedical Engineering Seminar. (1)
Students will gain insight into scientific presentations and current biomedical engineering research by presenting their research and actively participating in an external research seminar which will feature outstanding external and internal researchers as speakers. Restriction: Permission of the instructor. {Fall, Spring}

BME 570. Physical Bioanalytical Methods. (3)
Introduction to the physics and chemistry of classical physical methods of analyzing biological and biologically-related samples. Topics include fluorescence microscopy, chemiluminescence, chromatography, electrophoresis, mass spectrometry, electrochemistry, ultracentrifugation, SPR, SEM, TEM, AFM, XPS, radiochemistry and flow cytometry. Restriction: Permission of the instructor. {Fall}

BME 572. Biomaterials Engineering. (3)
Introduction to biomaterials currently in use, including commercial and research applications. Includes an understanding of a material's properties, biological responses to the materials, clinical context of their use, manufacturing processes, and regulatory issues. Restriction: Permission of the instructor. {Fall}

BME 579. Tissue Engineering. (3)
A review of the current strategies involved in the design of engineered tissues and organs. The principles underlying the implementation of selected cells, biomaterial scaffolds, soluble regulators, and culture conditions will be addressed. Restriction: Permission of the instructor. {Spring}

BME 598. Special Topics. (1-3, no limit) Δ
{Offered upon demand}

Equivalent graduate-level courses taken at other institutions may be used to satisfy these requirements. The BMEGP Graduate Advisor or the BMEGP Curriculum Committee must approve such substitutions.

For completion of the Ph.D. degree, the student must complete a minimum of 18 credit hours of elective courses from the list below. At least 9 of these must be from courses offered in the School of Engineering.

For the BME Concentration for the Ph.D. in Engineering, the student may substitute electives other than those listed below as approved by the BMEGP Graduate Advisor or the BMEGP Curriculum Committee.

Biomedical Engineering (BME) Electives

BIOL ** 351 General Microbiology
BIOL 547 Advanced Techniques in Light Microscopy
BIOM507/BIOL 581 Advanced Molecular Biology
BIOM508/BIOL 582 Advanced Cell Biology
BIOM 509 Principles of Neurobiology
BIOM 510 Physiology
BIOM 514 Immunobiology
BIOM 515 Cancer Biology
BIOM 516 Molecular Genetics and Genomics
CHNE/NSMS 522L. Fundamentals of Nanofluidics
CHNE/NSMS 530 Surface and Interfacial Phenomena
CHNE/NSMS 538/438. Biosensors Fundamentals and Applications
CHNE 504 Nanomaterials
CHNE 521 Advanced Transport Phenomena I
CS 529 Introduction to Machine Learning
CS 530 Geometric and Probabilistic Methods in CS
CS 561 Algorithms and Data Structures
CS 590 Topics: Complex Adaptive Systems
ECE 510 Medical Imaging
ECE 500 Theory of Linear Systems
ECE 533 Digital Image Processing
ECE 537 Foundations of Computing
ECE 539 Digital Signal Processing I
ME 501 Advanced Mechanics of Materials
ME 504 Computational Mechanics
ME 512 Intro to Continuum Mechanics
ME 530 Theoretical Fluid Mechanics I
ME 571 Advanced Materials Science

Biomedical Engineering (BME) Courses

BME 517. Applied Biology for Biomedical Engineers. (3)
Emphasis on engineering principles and analysis of: (i) the cell as a complete system including cellular subsystems, structures and functions; and (ii) select higher order systems of human physiology. Restriction: Permission of the instructor. {Fall}

BME 599. Master's Thesis. (1-6, no limit) Δ
See Graduate Programs section for total credit requirements.

BME 699. Dissertation. (3-12, no limit) Δ
See Graduate Programs section for total credit requirements.

Appendix B
Reasons for Request

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1. Executive Summary

Enterprises engaged in biomedical technology development and implementation, from start-up companies to large scale medical and research laboratories, represent a huge economic activity in New Mexico, both in the private and public sector. There is thus a critical need for workforce development in biomedical technology in NM. Perhaps the best way to address this need is to establish sustainable education and workforce development programs in biomedical engineering (BME) at UNM, starting with a new PhD concentration in BME within the School of Engineering at UNM in close partnership with the UNM Health Sciences Center, the College of Arts and Sciences and other research universities across New Mexico. BME is one of the fastest growing engineering disciplines nationwide, yet New Mexico remains one of the few states with substantial technological workforce that does not offer students degree programs in this area. There is significant and growing student interest in biomedical engineering at UNM; independently, two BME related professional societies have established student chapters at UNM. The proposed program will have a significant impact in diversifying the BME workforce nationwide. It will be only the second BME graduate program at a Hispanic Serving Institution. To meet increased demands for innovative biomedical engineers, we have designed an innovative curriculum utilizing hands-on training in research and familiarizing students with entrepreneurship. This program and how it meets the needs of the state of New Mexico is described in detail below.

2. Purpose of the Program

2.1 Objective

The objective of this form is establish a concentration of Biomedical Engineering (BME) within the Ph. D. of Engineering offered by the School of Engineering at the University of New Mexico. This program will educate and train our best students in the exciting new field of BME. Just as importantly, it will foster the production and application of new knowledge in an area that impacts the health and well-being of all New Mexico citizens. Furthermore, BME is a growing field and, by providing skilled local workers in BME, this program will drive development of the NM economy.

What is biomedical engineering? – This phrase refers to the application of *engineering principles and tools* to problems of medical or biological significance. Though the scope of biomedical engineering is very broad, key subtopics within biomedical engineering are clinical engineering, medical imaging, orthopedic engineering, rehabilitation engineering, systems physiology, bioinstrumentation, biosensors, biomaterials, biomechanics, cellular engineering, tissue engineering, and Molecular engineering. The output of the practicing biomedical engineer typically takes the form of a tangible product, such as a prosthetic, an engineered skin graft, a biosensor, a surgical tool, or an engineered protein. A remarkable number of key advances in medicine have been invented by engineers or engineering-oriented medical researchers, such as angioplasty, flu test kits, MRI, blood counters, endoscopic surgery, artificial hearts, blood dialysis machines, x-rays, and artificial limbs.

The proposed program will build upon our current collaborative efforts with local and regional industry and academic leaders engaged in state-of-the-art biomedical engineering research. These researchers are employed at TriCore Reference Labs in Albuquerque, Los Alamos National Laboratory (LANL), Sandia National Laboratories (SNL), and elsewhere. The program will be implemented by a productive and well-qualified group of faculty from SOE and selected other individuals. Many new courses have been created to support the proposed concentration.

The proposed BME concentration is envisioned to eventually address many topics in the area of BME. We anticipate growing the concentration by developing one focus area at a time and addressing new BME subtopics with additional focus areas as the need arises and resources are secured. Initially, the program will offer only one focus area track, namely Molecular and Cellular Systems. Future focus areas will be drawn from areas of strength of the UNM School of Engineering. Current candidates for new focus areas include "Biomedical Imaging", "Biomechanics", "Biocomputing" and "Bioelectrocatalysis and Biofuel Cells", four areas in which there is active teaching and research at UNM, and substantial interest by the faculty as possible new focus areas.

2.2 The proposed BME concentration is consistent with the role and scope of UNM

An objective of UNM's strategic plan, as approved by the faculty and Regents, is to:

> "*evaluate and restructure UNM's support for graduate education and raise the effectiveness and stature of our programs.*"

The proposed BME concentration is a direct response to this objective. In the past three decades, virtually all universities in the U.S. and abroad have begun to offer specific degree programs in BME. The University of New Mexico is one of only a handful of flagship state universities that does not currently offer an advanced degree in BME. Notably, the state of NM does not have a graduate degree in BME. This prevents the state of NM and UNM from providing specific training in BME to compete for many of the top students and faculty. To compete favorably with other universities for federal funds and for high quality students and faculty, it is imperative that UNM offer a Ph. D. in Engineering with a concentration in BME.

The proposed concentration is consistent with UNM's mission of providing graduate education and training in technical and scientific areas that are critical to the economy of the State of New Mexico, specifically, and to the U.S. economy generally. Our proposed concentration brings together a superlative combination of BME courses, labs, research programs, and a statewide network of biomedical engineering partners. This program will promote the acquisition and application of new knowledge in BME. It will produce highly trained and skilled graduates well-qualified to move into academic, industrial or federal BME-oriented positions of employment.

A new concentration in BME within the Ph. D. of Engineering will make it possible for UNM to prepare students for biomedical engineering careers. This training will prepare students for positions in academia and in laboratories across the nation and worldwide, where they will discover and create breakthroughs in medicine, biomedical engineering and basic scientific fields. Such programs will make UNM more competitive for research and training grant funding from NSF, DOE, NIH and other sources, and enhance UNM's research and training partnerships with other institutions, federal and state programs, and private industry. It will also enhance UNM's ability to attract and retain world-class faculty. In summary, the proposed concentration supports UNM's entire vision of growth and service to the citizens of New Mexico.

Dr. Arup Maji, the Interim Dean of the School of Engineering, is fully committed to ensuring that this program will succeed. He can answer questions about the program by e-mail at arup@unm.edu, or by phone at 505-277-5521.

2.3 Proposed concentration is an institutional priority

The School of Engineering places a high priority on establishing the proposed master's of science program in biomedical engineering. This is demonstrated by the extent to which research and graduate education in BME is already taking place in laboratories and classrooms across campus and at several UNM research centers, most especially the Center for Biomedical Engineering (CBME), which was formed to specifically pursue BME research at UNM and in NM.

Finally, one of the 13 "Regents' Goals for the President" in UNM's 2008 Strategic Long-range Plan is a call for economic development. This goal is directly supported by the proposed Biomedical Engineering master's degree program, as it will enlarge the local recruiting pool of talented biomedical engineers, enhance the attractiveness of New Mexico to outside companies considering relocating here, and stimulate a more robust local BME infrastructure. Details of these anticipated positive effects are provided below.

3. The BME concentration within the Ph. D. in Engineering meets a need of the State of New Mexico

3.1 There is a real-world need for professional Biomedical Engineers

A. The need for improved medical treatments provided by biomedical engineering is becoming critically important in the lives of all U.S. citizens. As new medical crises arise and the cost of effective treatment increases, the improved medical treatments and cost efficiencies offered via biomedical engineering are becoming critical for our children, our parents, and ourselves. These demands are only heightened by the needs of the aging U.S. population.

B. The number of biomedical engineering jobs will increase by 21 percent over the next decade, which is the highest growth rate of any engineering discipline (*source*: U.S. Department of Labor reports that Occupational Outlook Handbook, 2008-2009).

C. As an economic development engine, biomedical engineering is fast-growing and profitable. It is a major component of the U.S. economy today. In the first 5 months of 2009 alone, the U.S. ran a trade surplus in biotech of more than $3 billion (*source*: U.S. Dept. of Commerce, 2009). Hence, we have an excellent competitive advantage in this area over other countries.

D. Not surprisingly, more than three-fourths of all U.S. economic development organizations rank biomedical/biotechnology in their top two priorities. More than 40 states have economic development programs targeting the industry (*source:* Brookings Institute, Center on Urban & Metropolitan Policy, 2002).

E. With regards to the local economy, we in the state of New Mexico have the advantage of having a major research hospital, a major research university, and two national laboratories all within about 100 miles of each other. This density of research drives significant entrepreneurship in many areas and, as all the institutions have strong interests in biomedical engineering, it should be a driver for investment in biomedical engineering in the state of NM.

F. Federal funding agencies also recognize the importance of biotech. In 2002, the National Institutes of Health (NIH) established a new institute dedicated to fund biomedical engineering research, the "National Institute for Biomedical Imaging and Bioengineering". In it's first year, the new institute was appropriated $111 million. By 2009, this had nearly tripled to over $311 million (*source*: http://officeofbudget.od.nih.gov/pdfs/FY11/Actual%20Obligations%20by%20IC%201997-2009.pdf). In contrast to the NIH, BME funding levels at the National Science Foundation (NSF) are far harder to quantify. However we know anecdotally that the NSF just launched a new program area in biosensing, and that the budget for NSF's Division of Chemical, Bioengineering, Environmental, and Transport Systems increased from $109 to $159 million dollars from FY08 to FY09 (*source*: "CBET Division Overview" at http://www.nsf.gov/eng/cbet/programs/). Clearly, experts at the NIH and NSF are trying to increase funding allocations for biotech research because they recognize that the heavy and continuous demand for new technology will be satisfied, either in the U.S. or elsewhere, and that it is in our nation's interest to be on the leading edge of this important field.

3.2 A concentration within BME in the Ph. D. in Engineering at UNM can help meet this need

Across the U.S. there are over 100 biomedical engineering graduate programs. They are found at every leading university in the United States, and most flagship state universities (Table 3.1). In contrast, doctoral or master's program in biomedical engineering are not offered at any school in the State of New Mexico. New Mexico is one of only 13 flagship state universities in the U.S. which do not currently offer a BME program (the others are AR, AK, DE, ID, LA, MS, MO, MT, NH, ND, WV and WY). Although training in the repair of medical equipment is offered at two community colleges in our state (Doña Ana and NMSU-Alamogordo) neither program provides the scope of training of a master's program.

For those students determined to live in New Mexico, *and* to be trained in biomedical engineering, their only choice is to create an *ad hoc* biomedical engineering program, taking whatever relevant courses they can find, and getting whatever on-the-job training they can. For all such students, this is impractical, inefficient and unsatisfactory. As a consequence, most New Mexico students with BME career aspirations tend to exit the state, or abandon their BME career plans. *The concentration in BME proposed here will provide a remedy for this problem.*

Table 3.1. BME degree programs at flagship state universities in the U.S., as of March 2008

	School	Undergraduate degrees	Graduate degrees	Source
AL	University of Alabama	BS in BME	MS, Ph. D.	http://main.uab.edu/soeng/Templates/Inner.aspx?pid=49344
AZ	University of Arizona	"Undergraduate specialization in BME"	MS, Ph. D.	http://www.bme.arizona.edu/
CA	UCB & UCSF (joint program)	none	Ph. D.	http://bioeng.berkeley.edu/prospectivegrads.php
CA	Univ. California Berkeley	BS in BME	none	http://bioeng.berkeley.edu/
CA	Univ. California Davis	BS in BME	MS, Ph. D.	www.bme.ucdavis.edu/
CA	Univ. California Irvine	BS in BME	MS, Ph. D.	www.bme.uci.edu/
CA	Univ. California Los Angeles	BS in BME	MS, Ph. D.	www.bme.ucla.edu/
CO	University of Colorado Boulder	BS in BME	MS, Ph. D.	http://www.colorado.edu/engineering/BME/
CT	University of Connecticut	BS in BME	MS, Ph. D.	http://www.bme.uconn.edu/
FL	University of Florida	none	MS, Ph. D.	http://www.bme.ufl.edu/academics/degrees/index.php
GA	University of Georgia	BS in Biochemical Engineering	none	http://www.engineering.uga.edu/academics/index.php
HI	University of Hawaii	BS in Bioengineering	MS in Bioengineering	http://www.hawaii.edu/academics/degrees/
IL	University of Illinois UIUC	BS in Bioengineering	MS, Ph. D. in Bioengineering	http://www.bioen.uiuc.edu/about.html
IN	Indiana University	BS in BME	MS, Ph. D.	http://www.engr.iupui.edu/bme/
IA	University of Iowa	BS in BME	MS, Ph. D.	http://www.bme.engineering.uiowa.edu/
KS	University of Kansas	Bioengineering concentrations within BS ChE and ME	MS, Ph. D. in Bioengineering	http://bio.engr.ku.edu/
KY	University of Kentucky	none	MS, Ph. D.	http://www.cbme.uky.edu/faq.htm
ME	University of Maine	minor in BME	none	http://www.catalog.umaine.edu/preview_entity.php?catoid=47&ent_oid=3384&bc=1
MD	University of Maryland	BS in BME	MS, Ph. D.	http://www.bioe.umd.edu/index.php
MA	University of Massachusetts Dartmouth	none	MS, Ph. D.	http://www.umassd.edu/engineering/mtx/bmebt/
MI	University of Michigan	BS in BME	MS, Ph. D.	http://www.bme.umich.edu/
MN	University of Minnesota	BS in BME	MS, Ph. D.	http://www1.umn.edu/bme/
NE	University of Nebraska	BS in Biological Sys Eng	Ph.D.	http://www.engineering.unl.edu/specialty-units/BiomedicalEngineering/index.shtml
NV	University of Nevada Reno	BS in BME	MS, Ph. D.	http://www.unr.edu/bme/
NJ	Rutgers University	BS in BME	MS, Ph. D.	http://biomedical.rutgers.edu/facultyopenings.php
NY	SUNY Stony Brook	BS in BME	MS, Ph. D.	http://bme.sunysb.edu/bme/
NC	University of North Carolina	BS in BME	MS, Ph. D.	http://www.bme.unc.edu/
OH	Ohio University	none	MS in BME	http://www.ohio.edu/engineering/biomedical/research/
OK	University of Oklahoma	BS in Biotech ChE	MS, Ph. D.	http://www.oubc.ou.edu/degrees/g_biomedical_ame.htm
OR	Oregon Health Sci University	none	MS, Ph. D.	http://www.ogi.edu/bme/
PA	University of Pennsylvania	BS	MS, Ph. D.	http://www.seas.upenn.edu/be/grad.html
RI	University of Rhode Island	BS	MS, Ph. D.	http://bme.ele.uri.edu/
SC	University of South Carolina	BS	MS, Ph. D.	http://www.sc.edu/usctimes/articles/2006-03/biomedical_engineering.html
SD	University of South Dakota	none	MS, Ph. D.	http://www.usd.edu/gradsch/degreeProgs/biomedical_engineering.cfm
TN	University of Tennessee	BS in BME	MS, Ph. D.	http://www.utmem.edu/grad/PROGRAMS/Biomed_Eng_Program.htm
TX	University of Texas	BS in BME	MS, Ph. D.	http://www.bme.utexas.edu/
UT	University of Utah	BS in BME	MS, Ph. D. in Bioengineering	http://www.bioen.utah.edu/factsheet.php
VA	University of Virginia	BS in BME	MS, Ph. D.	http://bme.virginia.edu/
WA	University of Washington	BS in BME	MS, Ph. D.	http://depts.washington.edu/bioe/resources/
WI	University of Wisconsin	BS in BME	MS, Ph. D.	http://www.engr.wisc.edu/bme/

3.2 The State of New Mexico and its citizens will benefit from the concentration in BME

Specifically, the BME program will:

- train students for BME jobs already in New Mexico
- create economic growth
- satisfy students' strong demand for BME training
- fix the "informal BME program"

Table 3.2
New Mexico companies and research centers that will benefit from the BME program, ranked by number of employees resident in the State of New Mexico

Company	Product	NM employees	Location
TriCore Reference Laboratories	Clinical reference laboratory	>1000	Albuquerque
UNM Health Sciences Center	Research	~750	Albuquerque
Johnson & Johnson Ethicon Endo-Surgery	Surgical tool sterilization and packaging	590	Albuquerque
Lovelace Biomedical & Environmental Research Institute	Research	540	Albuquerque
OSO BioPharmaceuticals Manufacturing, LLC	Sterile injectables manufacturing	350	Albuquerque
Los Alamos National Laboratory (Divisions B, C, D, N, MST-CINT, etc.)	Biothreat research & development	~200	Los Alamos
Sandia National Laboratories	Biothreat research & development	~100	Albuquerque
Mind Research Network	Brain imaging, research	110	Albuquerque
AMO Wavefront Sciences LLC	Eye surgery devices	50	Albuquerque
Voss Scientific	Microwave and laser sources	36	Albuquerque
Lumidigm, Inc.	Biometric devices	28	Albuquerque
UNM Center for Biomedical Engineering	Research & development	20	Albuquerque
VeraLight	Non-invasive diabetes assays	18	Albuquerque
IntelliCyt Corp.	Flow cytometry technology	12	Albuquerque
TruTouch Technologies	Blood alcohol testing devices	11	Albuquerque
Eco Sensors Inc.	Ozone monitors for sterilization	7	Santa Fe
Vista Therapeutics	Nanowire-based biosensors	6	Santa Fe
Maas Biolab LLC	Drug development	7	Albuquerque
Biomoda Inc.	Early cancer diagnostics	5	Albuquerque
Theranostech Inc.	Protein synthesis	5	Albuquerque
Avanca Medical Devices, Inc.	Syringes	5	Albuquerque
Envirco Corporation	HEPA filtration systems	4	Albuquerque
SelraD Inc.	Gene expression software	4	Santa Fe
Interfasys	Lab automation	4	Albuquerque
STAR Cryoelectronics	Magnetic sensors	3	Santa Fe
Mesa Analytics & Computing LLC	Drug discovery software	3	Santa Fe
BioAssist Consulting Services Inc.	FDA consulting	2	Albuquerque
CerroSci LLC	R&D for overexpression & protein isolation	2	Albuquerque
Altaview Technologies Inc.	Human performance sensors	N/A	Albuquerque
Lapsurgical Systems Inc.	Surgical tools	N/A	Roswell
QTL Biosystems	Diagnostic assays	N/A	Santa Fe
InLight Solutions	Non-invasive diagnostics	N/A	Albuquerque
Kestrel Corporation	Hyperspectral imaging	N/A	Rio Rancho
Bioreason Inc.	Drug discovery software	N/A	Santa Fe
Caldera Pharmaceuticals	Drug & biomarker screening	N/A	Los Alamos
	Grand total	**>1822**	

Primary source: "New Mexico Business Weekly 2009 Book of Lists". Also Angel Gonzalez, Albuquerque Plant Manager, Johnson & Johnson; Lucy Eisele, Director of Human Resources, OSO BioPharmaceuticals Manufacturing, LLC; and Spencer Farr, CEO, Vista Therapeutics.

A. Train students for BME jobs already in New Mexico

There are a large number of biotech companies in New Mexico that require a trained workforce (Table 3.2), all of whom will benefit from the proposed program. Some of these companies are growing very quickly, and thus have a particularly acute need for trained employees. For instance, in December 2008, the Albuquerque biotech firm TruTouch Technologies, which manufactures and sells blood alcohol testing devices, was cited by *New Mexico Business Weekly* as the single fastest-growing small business in the state, increasing its headcount from 3 to 10 in just two years. Also on the list was biotech firm Lumidigm Inc., which increased its headcount from 12 to 27 in the same time period. Percentage increases such as these are unsustainable without trained graduates.

Finally, biomedical engineering is a major growth industry in the United States. It is imperative that we train New Mexico students to participate in this burgeoning field. A new BME degree program at UNM will expand the state's recruiting pool, and in turn make the state more attractive to new companies moving in, and enhance the competitiveness and growth of BME companies already here.

B. Create economic growth around BME in the State of New Mexico

In the early 1980s, Intel Corporation made a decision to locate a semiconductor chip factory in Rio Rancho. The decision to do so was based on the fact that New Mexico ranked at the top of Intel's site selection criteria. Most of the conditions which led to Intel's selection of Rio Rancho still exist today. For instance, Albuquerque was then a short non-stop flight away Silicon Valley;

- Retain talented New Mexico's brain drain
- enhance collaborations with local national laboratories
- promote UNM's stature in creating and applying new knowledge
- improve the integration of research and education at UNM

Each of these benefits is discussed in detail below.

we are now a short non-stop flight away from 2 of the 3 major U.S. centers of biotechnology, namely San Diego and the San Francisco Bay Area (the third is Boston). We have an excellent climate, a low cost of living, a natural environment that is relatively immune from natural disasters such as earthquakes, wildfires, hurricanes, tornadoes and volcanoes (recall the eruption of Mt. St. Helens in the 1980s which caused Intel's semiconductor chip factories to close temporarily in Portland, Oregon). We have a workforce that tends not to job-hop from company to company, or state to state. We offer competitive tax and revenue bond incentives. We have an outstanding medical school and hospital at UNM, with a superb faculty engaged in a variety of biomedical research. In short, we have nearly all of the ingredients for being selected by the next biotech "Intel". But Rio Rancho would never have been considered by Intel if the Albuquerque metropolitan area did not have a local university with strong teaching and research programs in electrical engineering, chemistry, chemical engineering and physics. So too New Mexico will never be considered by a major bioengineering company so long as there is no BME degree program at UNM. The proposed degree program is intended to fill a critical gap that can put the state in contention for new site selections by *growing* companies.

The development of the BME program will improve New Mexico's reputation as a key participant in the biomedical engineering field. As the demand for BME professionals increases, and the new BME program meets this demand, then New Mexico will benefit from increased revenue. More specifically, the many biotech companies already in the state will benefit materially from a program in biomedical engineering at UNM in the form of technical assistance from in-state BME faculty, and in a larger biotech infrastructure and network. Many of these companies already employ UNM graduates and former postdoctoral fellows. These companies have indicated their interest in the proposed BME program and in hiring from its pool of graduates. A list of these companies is included in Table 3.2.

In summary, the proposed educational program will improve New Mexico's attractiveness to numerous companies, new and old, based on improved availability of highly trained graduates, collaborations with faculty, available technology and facilities, and a highly supportive state environment.

C. Satisfy UNM students' strong demand for BME training

There is constant demand for technical developments in biomedical engineering. This demand is fueled by the prosperity of the biotech industry, and by government and citizen interest in improving health care. In turn, there is unrelenting demand for individuals trained in the field of biomedical engineering. According to a May 2009 report by the National Scientific Foundation, biomedical engineering continues to be "one of the fastest-growing engineering fields and has more than doubled in size since 2000." The number of Ph.D. degrees granted in this field increased nearly 250% over the nine-year period ending 2006. An advanced degree in BME prepares students for internships and career opportunities at national labs, hospitals, medical institutions, academia, industry, government regulatory agencies and healthcare institutions. Hence, it is seen by students as a highly attractive field with good job opportunities, good job stability and good wages -- precisely what we want in New Mexico.

UNM students know these facts, and naturally they are eager to be trained in BME. For more than a dozen years, UNM faculty have taught various courses in biomedical engineering (Table 3.3). The large number of students enrolled in these courses is

Table 3.3 Number of students enrolled in BME-relevant courses taught in the UNM School of Engineering, Spring 1999-Fall 2009.

	Biomedical Technology	Medical Radioisotopes	Biochemical Engineering Principles	Bioengineering Seminar	Biosensors: Fundamentals and Applications	Medical Imaging	Introduction to Medical Physics	Biomolecular Engineering	Mathematical methods for medical physics	Applied Biology for Engineers	Mechanics and Thermodynamics of Molecular Components in Cells	Methods of Analysis in Bioengineering	Total
Spring 99	8	1											9
Fall 99			7										7
Spring 00	9												9
Fall 00			8										8
Spring 01	6												6
Fall 01			12	12									24
Spring 02	7		7	10	18	11							53
Fall 02			6	14									20
Spring 03	7			13									20
Fall 03			11	15									26
Spring 04				14	21								35
Fall 04			13	18									31
Spring 05				19									19
Fall 05				15									15
Spring 06				16	17		6						39
Fall 06				18				18	9				45
Spring 07				18									18
Fall 07				12				21					33
Spring 08				9	10								19
Fall 08				10				22					32
Spring 09				4				10					14
Fall 09				7				22		8	3		40
Spring 10				8				5				5	10

Source: UNM Office of the Registrar

evidence of students' avid interest in BME, especially when one considers that none of the students had any prospect of receiving a BME degree at UNM or anywhere else in the state.

Perhaps even more remarkable is that the student chapter of UNM's Biomedical Engineering Society now has over 40 active members at UNM. This Society is a national professional organization founded in the 1960s to promote BME research and education. (UNM's chapter is notable for high levels of participation by female and minority students.) Of course, none of UNM's members have any immediate prospect of receiving a degree in biomedical engineering. Undaunted, they have organized themselves into a society for the purpose of enhancing their prospective professional careers *in biomedical engineering*.

If launched, the concentration of BME within the Ph. D. of Engineering program will enable UNM to compete successfully in attracting talented graduate students to one of the fastest growing fields in science, engineering and industry. It will enhance student recruitment at UNM with a degree program that is in large demand. And it will lead to a sizeable increase in the number of students enrolled in BME courses.

D. Retain New Mexico's biomedical engineering talent

Currently, we lose resident New Mexico students to other states' BME programs. Moreover, our ability to recruit students from other states is handicapped by the absence of a master's degree program to which out-of-state students can be recruited.

Most new BME knowledge and intellectual property in the state is produced as a result of *scientific engineering*, not as a result of deals, mergers, or acquisitions. If we want to grow our state's biotech economy, we need to grow it at home. And the first step in that process is to nurture students who are thoroughly adept at conducting BME-specific *scientific engineering*. These students can be either native-born or recruited beyond our borders. But either way, *students* are at the root of our success.

A group of a dozen or so UNM faculty spent significant time discussing and planning the curriculum for the new degree program proposed here. They have been motivated to do so for various reasons, which include a strong desire to boost the statewide economy and improve citizen health through biotech. They also have a keen interest in their own students' well-being, and in the quality of students they can attract to their labs. Indeed, the availability of a master's degree program in BME is important for both the recruiting *and* training of their own students. In turn, these students are the foundation of each professor's success as a researcher and recipient of federal grants, for it is well-recognized that faculty success depends on student success. If the concentration in BME graduate program is approved, then UNM will do a far better job *recruiting* and *retaining* in- and out-of-state students. We will reduce the pressure that causes most of our BME-focused students to exit the state. As our existing BME faculty become more successful, this will enable recruiting additional quality faculty, drive more industrial interactions, and create more biomedical engineering entrepreneurship opportunities.

E. Enhance collaborations with local national laboratories

Sandia National Labs (SNL) and Los Alamos National Lab (LANL) are heavily involved in biomedical engineering related disciplines to accomplish their national security missions in reducing the threat of bioterrorism and the development of sustainable energy such as biofuels. UNM's proximity to SNL and LANL is a golden opportunity for our students to conduct research at these prestigious labs via internships and summer employment, and for faculty to engage in research collaborations there. Already, some BME researchers at LANL and SNL have appointments at UNM, and some groups of UNM professors and national lab scientists pursue joint research in biomedical engineering. The proposed BME program will stimulate an expansion of such engagements. These kinds of collaborative efforts, with these scientists *in particular*, are important because they expose UNM to the sort of difficult but important BME problems that are *only* being tackled at the national labs. Also, the local national laboratories (LANL and SNL) are enthusiastic about hiring graduates from the proposed program. The absence of a BME program at UNM is an impediment to realizing the above opportunities.

F. Promote UNM's stature in creating and applying new knowledge

The proposed program fits well with New Mexico's long-standing role in conducting cutting-edge science education and research. The proposed program will introduce a coherent curriculum that stimulates the creation of new knowledge and insights for new applications, both on and off campus. It will bolster the faculty's efforts in creating knowledge and developing new applications. In sum, the development of the BME program at UNM will help maintain and grow New Mexico's prominence in biomedical engineering.

If launched, this will be one of a very few BME graduate programs at federally-designated Hispanic Serving Institutions.

Medical sciences ($16.5 billion) and biological sciences ($9.2 billion) accounted for more than one-half of all R&D at universities and colleges in this fiscal year (*source*: NSF, Survey of R&D Expenditures at Universities and Colleges, FY07). These two fields have held the two largest shares of academia's R&D performance total throughout the survey's history. By establishing a new concentration in BME within the Ph. D. in Engineering at UNM, we enable UNM to compete more effectively for these research dollars.

G. Improve the integration of research and education at UNM

UNM's lack of any BME degree program is contrary to the persistent requests of the National

Science Foundation (NSF) and the National Institutes of Health (NIH), two important national funding agencies, that we integrate our research with education. Once the concentration in BME within the Ph. D. in Engineering is established, UNM will be in an improved position to do so, and thereby improve our success in securing research grants.

3.3 Unique UNM effort

There are no formal BME degree programs in New Mexico. The nearest institutions that offer BME degree programs are, to the north, University of Colorado at Boulder; to the west, Arizona State University; and to the east, University of Texas at Austin. UTEP is just about to introduce an advanced degree program in BME.

To maximize the effectiveness of any biomedical engineering degree, the offering institution should be situated close to a medical school. UNM's main campus is contiguous with the UNM Health Sciences Center, and is the only such campus in the state so situated.

4. The concentration in BME within the Ph. D. in Engineering has an existing base of student support

4.1 There are many BME student sources in the state of NM

"Health and Biosciences" is one of six key "Career Clusters" in the state. It falls under the state-designated career path "Applied Research Engineering" (source: "*Work in New Mexico: New Mexico Career Clusters Guidebook*", State of New Mexico, 2006). Thus, the proposed program is strategically oriented to serve the needs of current and future industrial and government sectors of New Mexico.

BME students in this concentration are likely to come from a broad range of disciplines, such as health sciences, biology, biochemistry, chemistry, physics, engineering, or materials science. Also, we expect a significant number of students from existing biotech companies in the state, and from the three New Mexico-based government laboratories, SNL, LANL and the Kirtland Air Force Phillips Laboratory. National lab employees benefit from lab-sponsored mentorship and retraining programs, and these programs are likely to enhance the numbers of lab employees who decide to enroll.

The BME concentration will be consistent with state goals for equitable representation of various student groups. It is expected that the students in this program will reflect the present ethnic, gender and age make-up of the technical workforce in New Mexico. Biology, chemistry and chemical engineering programs have traditionally attracted a higher percentage of women than physics or other engineering disciplines. Thus, we expect that the proposed program will help recruit talented women to graduate programs at the SOE. Similarly, biology often attracts larger numbers of underrepresented students, and thus serves as a gateway program for introducing these students to scientific and engineering disciplines.

4.2 Projected enrollment

Table 4.1 shows the numbers of students projected to enroll in a master's or Ph.D. level BME program at UNM.

Table 4.1. Projected Enrollment

Year	*New students*
1	14
2	15
3	16
4	17
5	18

The number of new students in Year 1 shown in Table 4.1 above are computed as the sum of 5 components, "A", "B", "C", "D" and "E". Details of these components are as follows:

A = number of current UNM graduate students who would have enrolled in a BME graduate degree program if they had had the opportunity when they first applied to UNM

Source: In the Spring Semester of 2010, 2 graduate-level classes were chosen at random within the Department of Chemical and Nuclear Engineering. The students were read the following, then asked for a show of hands:

"If UNM had had a master's or Ph.D. degree program in biomedical engineering when you first applied to graduate school here, would you have considered enrolling, at that time, in that biomedical engineering graduate program, rather than in the program that you did?"

Of 5 respondents in one class, 1 replied "yes" (20%); of 10 respondents in the second class, 3 responded "yes" (30%). The lower of these 2 percentages was then multiplied by the average number of graduate students entering the department annually over the past 5 years (~10), viz., 20% x 10 = 2.

B = number of UNM undergraduates in the Department of Chemical Engineering who, projecting forward to the day they receive their bachelors degree, have said they would consider pursuing an advanced degree at UNM in biomedical engineering if such a program was offered at the time of graduation

Source: Two upper-division undergraduate classes were chosen at random from within UNM's Department of Chemical and Nuclear Engineering (ChNE). The students were read the following, then asked for a show of hands:

"Some of you will graduate with a B. S. degree from UNM this May, and others in the next year or 2. Thinking forward to that time when you graduate, if UNM offered a master's or Ph.D. degree program in biomedical engineering, would you consider enrolling in that program?"

Of 19 respondents in one of the 2 ChNE classes, 13 responded "yes" (68%). Of 14 respondents in the second of the 2 ChNE classes, 3 responded "yes" (21%). An average of 15 students have been graduated each year from the Department of ChNE (*source*: Dept. of ChNE). The lower of these 2 percentages, 21%, was then multipled by the average number of students who have graduated with bachelors degrees from the Department of Chemical and Nuclear Engineering over the past 5 years, viz., 21% x 15 = 3. This number was used as the number of expected enrollees for component "B".

C = number of UNM undergraduates in the Department of Biology who, projecting forward to the day they receive their bachelors degree, have said they would consider pursuing an advanced degree at UNM in biomedical engineering if such a program was offered at the time of graduation

Source: An upper-division undergraduate class in the Department of Biology was chosen by Biology Professor M. Werner-Washburne. The students of this class were read the following, then asked for a show of hands:

"Some of you will graduate with a B. S. degree from UNM this May, and others in the next year or 2. Thinking forward to that time when you graduate, if UNM offered a master's or Ph.D. degree program in biomedical engineering, would you consider enrolling in that program?"

Of 14 respondents in the class, 2 responded "yes" (14%). The average number of students who have graduated with B.S. degrees from UNM's Department of Biology over the past 5 years is 200 (*source*: UNM Department of Biology). To account for samping bias, the observed percentage of positive respondents, 14%, was divided by one-sixth, and the resultant number multiplied by 200, to give an estimated number of biology-derived enrollees of 5.

D = number of New Mexicans employed in the biotechnology industry who are projected to enroll annually in a master's or Ph.D. degree in biomedical engineering = 2

Source: UNM estimate

E = number of New Mexicans employees in BME-related research at Sandia National Labs and Los Alamos National Lab who are projected to enroll annually in a master's or Ph.D. degree in biomedical engineering = 2

Source: UNM estimate

A + B + C + D + E = 2 + 3 + 5 + 2 + 2 = 14

The number of new students in Year 2 was computed by assuming that enrollment would increase by 5%, in Years 3 and by 4%, and in Year 5 by 3%.

As shown in Table 4.1, projected enrollment begins with 14 in the first year, and reaches 18 full-time students in the fifth year.

The projected credit hours of these students is given in Table 4.2. Typically students take between 18 and 24 credit hours per hour. Table 4.2 assumes the average number of credit hours to be 21.

Table 4.2. Projected student credit hours

Year	Projected number of students	Projected credit hours per year
1	14	294
2	15	315
3	16	336
4	17	357
5	18	378

4.3 Recruitment strategies

In view of the strong industrial and governmental laboratory support for the program, we expect to attract a continuous pool of applicants from these laboratories and businesses. Robust recruitment strategies will be implemented to attract these and other potential students. Such strategies will include:

- Maintaining a frequently updated web page that tells the story of the opportunities, accomplishments, and excitement of the program.
- Faculty presentations about the program at various technical meetings that are devoted to science and engineering education.
- Faculty visits to other institutions with potential sources of students.
- Mass mailings and e-mailings of flyers and other publicity materials about the program.
- Contact with our alumni and other potential benefactors through open houses and email.

Statements to address budgetary and Faculty Load Implications and Long-range planning*

1. Budgetary Implications

1.A. Summary

The School of Engineering has secured recurring funds of $208,000 per year from the State Legislature to establish and operate a BME graduate degree effort. These funds will be used to pay the salaries of BME faculty members who have been hired specifically to teach the Core courses in this concentration and the staff that will enable this program. They will also be used to pay for program and course materials, recruitment, and administration of the program. The necessary support for graduate students will be in the form of Research Assistantships provided through externally funded research programs of program faculty or will be provided as arranged by the graduate students themselves (e.g., as part of their employment benefits). All physical resources required to teach the BME concentration courses are available in Centennial Engineering Center and Farris Engineering Center. Graduate student offices and lab space can also be accommodated in existing facilities. During the initial phase, no additional funds will be requested from the UNM SOE to support the initial focus area within the BME concentration (Biomolecular and Cellular Systems).

1.B. Faculty are in place for the initial concentration and new faculty hires are NOT required

As a result of a special project funded by the legislature in 2007, 4 new faculty members were hired in 2007-8. These 4 were hired specifically for the BME graduate program proposed here. Along with 17 other professors, they now comprise the 27 existing faculty who are prepared and committed to bear the teaching load of a state-sanctioned, fully-fledged BME degree program. These 27 are drawn from all 5 departments of UNM's School of Engineering:

- Chemical and Nuclear Engineering
- Computer Science
- Electrical and Computer Engineering
- Mechanical Engineering
- Physics & Astronomy

The 27 are listed in the catalog section of this application. All have expressed a commitment to work in the new program as mentors, advisors, or course instructors. Most have committed to all 3 roles.

The current budget has sufficient funds to offset instructional costs for faculty required to teach courses from their home departments.

1. C. The current budget and allocated space is sufficient for the administration of the program

The details of the administration of the program are found in the planning section below. The current budget allows is sufficient to pay for the program director, the time for several faculty for instruction, and a graduate advisor for the concentration. The program office will be co-located with the main offices of the Center for Biomedical Engineering. Separate offices are currently available for the Director and Program Manager. The conference room within the Center for Biomedical Engineering, the program office will be made available for use by the administration of the program.

1. D. Courses for the concentration have been designed and further resources for course design are <u>not</u> required.

Planned for the new curriculum are 5 core courses, 3 electives, a graduate seminar, a special topics course, Master's Thesis, and Dissertation. Details of these are provided in the catalog copy section of this application (Appendix A). For years, UNM professors have been teaching several of the core courses, or very close variants. Several existing courses have evolved to include instruction in BME, while keeping in mind plans for the BME concentration. Hence, the amount of faculty effort to introduce the new curriculum is minimal.

Initially, the concentration will offer only one area of focus, namely *Molecular and Cellular Systems*. Future focus areas will be added as need arises and resources are secured, in which case new courses are likely to be added to the program. Candidate new focus areas include "Biomedical Imaging", "Biomechanics", "Biocomputing" and "Bioelectrocatalysis and Biofuel Cells", four areas in which there is active teaching and research at UNM, and substantial interest by the faculty as possible new focus areas.

To maximize the efficient use of faculty resources, we will pursue cross-listing many BME courses where appropriate. Cross-listing is useful when the subject of a particular course is relevant to more than one degree program. Typically a single instructor teaches the cross-listed course to students from outside his or her own department, and thereby achieves an economy of scale. In turn, students benefit from access to a larger number and more frequent offering of courses, which satisfy their department's degree requirements.

The administrative structure of the new concentration includes a Curriculum Planning Subcommittee responsible for fostering the development of new BME courses, and promoting revisions in the syllabi of existing courses as warranted, including more biomedical engineering content or application. In addition, as described in long range planning, the BME courses will be assigned separate BME codes with cross-listing in relevant departments. Credit for courses and faculty mentoring will be allocated to both the participating department and the BME program.

1.E. Research programs and people are already in place

The School of Engineering now has vibrant research programs in the following areas:

- Biocomputing
- Bioelectrocatalysis and biofuel cells
- Bioimaging
- Biomaterials for controlled interactions with biomolecules, cells and tissues
- Biomechanical engineering
- Biosensors, diagnostics and high-throughput bioanalytical systems
- Micro and nanofluidic systems for Molecular separations

Moreover, there are now approximately 30 graduate students conducting BME research at UNM, and about 50 undergraduate students, all working in support of the seven research areas in the bulleted list above. UNM has thus attained a critical mass of BME researchers. UNM's 27 BME-affiliated faculty are prepared, committed and of sufficient numbers to mentor the research of students who want to pursue a Ph.D. in Engineering with a concentration in BME.

1. F. Financial resources for student research are already in place

Importantly, in the past 5 years, School of Engineering faculty, have received more than $17,000,000 in competitive grants for biomedical engineering research. The funding has been obtained from 16 different agencies, including the National Institutes of Health and the National Science Foundation. To date, the number of grant awards is 40.

This level of outside funding is more than adequate for sustaining the master's level research of an estimated 30 students. Going forward, it is expected that such funding levels will either remain at the present level, or grow.

1.G Facilities and equipment are already in place

UNM's beautiful new Centennial Engineering Center is an outstanding facility for education and training of master's students. This 147,500 square feet, $42 million building opened Fall semester of 2008. Inside, the Center for Biomedical Engineering operates a contiguous 15,000 square foot state-of-the-art laboratory. Designed in accordance with best practices of industrial and large academic labs, the lab features a common area of lab benches, flanked by enclosed rooms in which large and/or sensitive equipment is located. Within the common lab area are 6 fume hoods, 9 sinks, a large number of cabinets, and 22 lab benches each ~20 feet in length. Currently about 30 students conduct research in this space. It is expected that an additional 30 students can be accommodated easily. In addition to the main lab, there are 2 satellite labs, the 1300 square foot Keck Nanofluidics Laboratory, and the 980 square foot CBME North Labs dedicated to bacteria culture and manipulation. We have plenty of lab space for the research of our anticipated BME master's students.

UNM has already invested heavily in a BME research program. It has done so with the intention of complementing a yet-to-be-launched BME academic program. Hence, the facilities and equipment in the CBME labs and satellite labs are already adequate for a wide-range research in biomaterials engineering, surface analysis, cell and tissue engineering, biosensors engineering, biochemical engineering, microfluidics engineering, and bacteria culture and manipulation.

Finally, over the past twenty years, UNM has invested heavily in establishing other strategic centers of excellence, particularly CHTM (Center for High Technology materials), and CMEM (Center for Micro-Engineered Materials). These unique facilities provide access to an additional array of research equipment, which can be tapped to support research projects. For instance, CHTM is particularly important in providing access to nanofluidics chip fabrication capabilities, whereas CMEM provides back-end semiconductor chip fabrication capabilities. These sophisticated resources are vital for conducting some of the biomedical engineering research being conducted at UNM today, and anticipated in the future.

2. Faculty load implications

There are currently 27 faculty members who have committed to support this Ph.D. program in the proposed initial focus area of Molecular and Cellular Systems. Many of these faculty members are already teaching elective courses in their home departments that qualify as elective courses in this program. Furthermore, the dedicated new funding to the School of Engineering for the BMEGP described above provides the necessary additional BME faculty members who have been hired specifically to teach the Core courses. Additional lecturers and laboratory instructional support have been pledged by professionals at nearby national laboratories, industry (e.g., Tricore Reference Laboratories) and academic units. Importantly, a synergistic partnership with faculty from UNM Health Sciences Center and College of Arts and Sciences has been formalized (through cross-campus workshops) that will greatly expand relevant elective course offerings to BMEGP students.

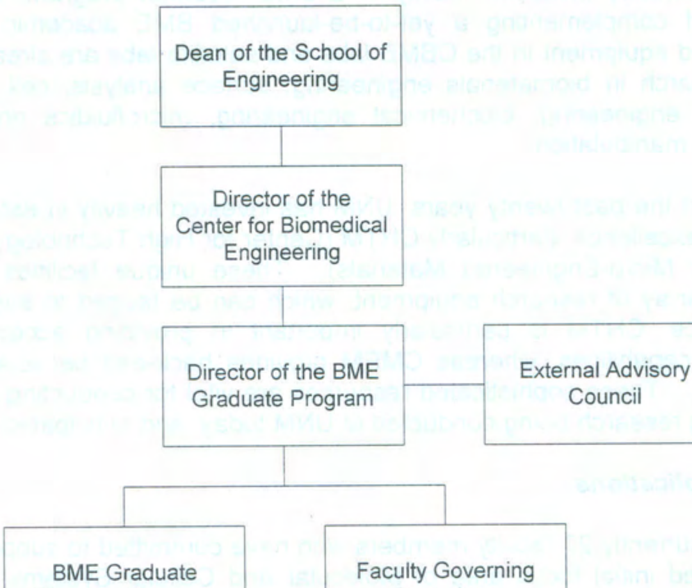
3. Long Range Planning

3. A. Summary

There are currently more than 20 research-funded graduate students, all of whom are engaged in BME-related research. The proposed new concentration targets a steady-state level of approximately 30 graduate students. This is deemed a conservative estimate of growth for the following 3 reasons: (i) of 15+ faculty members currently affiliated with the Center for Biomedical Engineering, 4 are recent hires (Canavan, Dirk, Graves, Petsev); (ii) as solutions to fundamental problems with health care and health care costs become more important here and abroad, there will be an inevitable rise in demand for students with BME science and technology expertise; and (iii) as the reputation of BME research at UNM increases, there will be a commensurate increase in the attractiveness of the program to prospective students. Flexible yet rigorous entry requirements for the program will ensure that students from colleges and universities across New Mexico and beyond are able to benefit from the proposed educational offering. There are several potential areas of synergy between the HSC and SOE biomedical education initiatives. For example, SOE and HSC officials are in active discussions on how the education of SOE engineers might be integrated with HSC translational clinical research. This non-trivial dialogue is prompted by directives of the NIH, NSF and members of the academy. Although daunting, the dialogue is considered worth the effort because of the fact that a myriad of engineering innovations are at the root of today's rapid advances in medicine.

3. B. Administration

The administrative structure of the BME concentration is depicted as follows:.



The roles of each of the parties from the above diagram are as follows:

<u>*Dean of the School of Engineering:*</u> The Dean of the School of Engineering is responsible for: (i) carrying out a yearly performance evaluation of the BME program, faculty in the program, and the Faculty Governing Committee; (ii) establishing policy and procedures for the BME Graduate Degree Program; (iii) approving revisions of the curriculum and other procedures for

C 07

Policy

FACULTY DISCIPLINARY PROCEDURES

1. The University encourages a supportive problem-solving approach to performance problems, but the University recognizes that misconduct may require disciplinary action. The University normally uses ~~the~~a progressive discipline ~~process which may include the disciplinary sanctions mentioned above~~ to address possible misconduct ~~and continued performance problems~~. Progressive discipline is intended to be corrective, *not* punitive in nature. It is designed to provide ~~employees,~~ faculty ~~and staff,~~ with notice of deficiencies and an opportunity to improve. However, some violations of policies and procedures, or continued negative behavior, may be of such serious nature that suspension without pay or discharge pursuant to Faculty Handbook policies may be appropriate.

2. Any member of the faculty, including any serving as an academic administrator, who violates a published University policy ~~shall~~may be subject to warning, censure, suspension without pay, or dismissal. Teaching or research assistants in their faculty capacity are considered faculty members for purposes of this Policy.

a) "Warning" means an oral censure.

b) "Censure" means a written reprimand or expression of disapproval, which should include an explanation of the nature of the misconduct, and the specific action to be taken by the faculty member *and/or* chair to correct the problem, including mentoring, if appropriate, and a statement that further disciplinary action~~, up to and including discharge,~~ could occur should the problem persists.

c) “Suspension without pay” means disciplinary suspension without regular salary for a stated period of time.

d) "Dismissal" means termination of employment (see Faculty Handbook sections B.5.3, B.6.4.3, and B.5.4).

3. The~~se~~ procedures specified in this Policy provide for the consideration and determination of proposed disciplinary actions against faculty members short of dismissal. Consideration and determination of disciplinary actions that may result in a proposed dismissal of a tenured faculty member, or dismissal of an untenured faculty member prior to expiration of his or her contract term, are governed by sections B.5.3, B.6.4.3, or B.5.4, respectively, of the Faculty Handbook and are not covered by these procedures. However, cases in which faculty dismissal has been considered pursuant to sections B.5.3, B.6.4.3, or B.5.4, and a lesser sanction is ultimately

proposed instead by the administration, shall be handled under this policy, without duplicating steps that have already taken place. In particular, if the chair and dean conclude that suspension without pay is appropriate in a case in which dismissal was considered but rejected, the faculty member is entitled to request a peer hearing as provided below in sections ~~8~~10 and ~~9.~~11 ~~Teaching or research assistants in their faculty capacity are considered faculty members for purposes of this Policy.~~

4. In the case of allegations against a faculty member that appear to be within the scope of another specific University policy that has its own procedures for investigation and resolution (including but not limited to allegations of research misconduct, discrimination, or sexual harassment), the chair or dean shall forward such allegations to the appropriate person or department for handling pursuant to the applicable policy. If such a process requires the chair to make a disciplinary determination after an investigation and recommendation from another University body, this policy will be followed in determining the appropriate discipline. If the other procedure involved a hearing before a faculty committee, any factual determinations will not be subject to reconsideration by faculty peer review under this policy.

5. References to the department chair in this policy also include the program director or associate or vice dean in a non-departmentalized school or college. If allegations are made against a department chair or other administrator, the next higher academic authority shall perform the functions assigned in this Policy to the chair, and the provisions shall be modified as appropriate. Any individual(s) bringing an allegation of faculty misconduct to the chair's attention is protected by, and subject to, the University's policy on reporting misconduct (UBPPM section 2200, Whistleblower Protection and Reporting Suspected Misconduct and Retaliation).

6. In all cases other than those set forth in paragraphs 3 and 4 above, if a member of the faculty is alleged to have violated a policy of the University, the department chair shall provide the faculty member a written notice explaining the nature and specific content of the alleged violation, together with a copy of this policy, and shall discuss the alleged violation with the faculty member. The faculty member may be accompanied by one person in meeting with the chair. The faculty member and the chair shall notify each other at least two working days prior to the scheduled meeting who, if anyone, will be accompanying them at the meeting. The chair should issue a written report within ~~a week~~five (5) working days after the meeting summarizing the discussion with the faculty member, keep a copy in the faculty member's file, and send a signed copy to the faculty member. Before, during or after the meeting, the chair may ask the faculty member to respond in writing to the notice and present any relevant written material within a reasonable time specified by the chair. Likewise the faculty member shall be free to submit any materials reasonably desired on his/her own volition. The matter may be concluded at this point by the mutual consent of all parties.

7. The department chair or the faculty member may initiate conciliation proceedings at any time prior to the chair's decision by contacting the Faculty Dispute Resolution program as provided in Section C345 with notice to the other parties. Conciliation may be undertaken if both parties agree.

8. If a mutually agreeable resolution (with or without conciliation) is not achieved, the department chair shall make a decision in the matter and communicate it to the faculty member in writing within ~~two weeks~~ten (10) working days after meeting with the faculty member or the termination of conciliation efforts if they are unsuccessful, whichever is later. The faculty member shall have ~~two weeks~~ten (10) working days from receipt of the written decision to submit a written request for review by the appropriate dean, who will issue a written decision concerning whether the chair's decision is upheld, modified or reversed. Prior to making a decision, the dean shall meet with the department chair and the faculty member, and their representatives if desired, together or separately, and shall receive and consider any documents the parties wish to submit. Documents shall be submitted within ~~one week~~five (5) working days of the faculty member's request for review. If formal conciliation has not been attempted previously, the dean may refer the matter to Faculty Dispute Resolution. The dean will communicate his/her decision to the parties in writing within ~~two weeks~~ten (10) working days after meeting with the faculty member or the termination of conciliation efforts if they are unsuccessful, whichever is later.

9. If the faculty member does not agree with the dean's action, he/she may submit a written request for review by the Provost or EVPHS within ~~one week~~five (5) working days of receipt of the dean's decision. The Provost/EVPHS will decide the matter on the record unless he/she determines that it would be helpful to meet with the parties, together or separately. Within ~~two weeks~~ten (10) working days after receipt of the complete record or after meeting with the parties, whichever is later, the Provost/EVPHS shall uphold, modify or reverse the dean's decision by written notice to the parties. The Provost/EVPHS may seek an advisory investigation and opinion from the Faculty Ethics Committee. The decision of the Provost/EVPHS is subject to discretionary review by the President or Board of Regents if requested by the faculty member~~ as provided in University Business Policies Section 3220.10~~.

10. If the chair, after meeting with the faculty member and considering all materials submitted pursuant to section ~~5~~6, proposes to suspend the faculty member without pay, the chair shall meet with the dean to review the matter. If the proposal is supported by the dean after meeting with the chair and the faculty member~~, if requested as provided in section 7~~, the faculty member is entitled to a faculty peer hearing. The faculty member shall send such a request to the Provost/EVPHS within ~~one week~~five (5) working days of receipt of the dean's determination.

11. If a faculty peer hearing is requested ~~in a proper case~~as provided in this Policy, the chair of the Faculty Ethics Committee will arrange for a hearing before two members of that Committee

from outside the faculty member’s department, chosen by the Ethics Committee, and one uninvolved department chair from a different school or college chosen by the Provost/EVPHS. The hearing will be held as soon as reasonably possible and shall be conducted according to the University’s Dispute Resolution Hearing Procedures. The University Secretary’s office shall make arrangements for the hearing. Hearings shall be recorded and shall be private unless both parties agree that the hearing be open. The hearing panel may uphold or reverse the proposal to suspend the faculty member without pay. If the panel’s decision is to reverse the proposal, the panel may direct the chair and dean to impose a lesser disciplinary measure. The panel’s decision may be reviewed on the record by the Provost/EVPHS, but the panel’s decision shall not be reversed or modified except in the case of clear error, which shall be detailed in writing by the Provost/EVPHS. The decision of the Provost/EVPHS is subject to discretionary review by the President or Board of Regents if requested by the faculty member ~~as provided in University Business Policies Section 3220.10~~.

12. The faculty member may bring a complaint before the Committee on Academic Freedom and Tenure if he/she believes the matter or its handling is within the jurisdiction of the Committee. The Committee will determine whether the matter is within its jurisdiction and, if so, shall handle the matter under the Policy on Academic Freedom and Tenure. Normally, review by the AF&T Committee should be sought after the determination by the Provost/EVPHS. If the faculty member pursues the matter before the AF&T Committee, AF&T shall accept the facts as determined by the faculty peer hearing, if one was held.

13. If the final determination is that no misconduct occurred, efforts shall be undertaken to the extent possible and appropriate to fully protect, restore, or maintain the reputation of the faculty member.

14. These procedures do not supersede Appendix VIII to Part B of the Faculty Handbook, concerning the Faculty Ethics Committee, and a faculty member who believes that he/she has been improperly accused of unethical behavior may bring the matter to the attention of the Ethics Committee under Appendix VIII after determination by the Provost/EVPHS.

The eScholar Innovation Center (eSIC)
A collaborative initiative of the libraries[1] at UNM

Introduction
The eScholar Innovation Center (eSIC) is a collaborative initiative of the libraries at UNM[1], and is part of the Office for eScholarship Services. The purpose of eSIC is to be an advocate within the UNM community for e-scholarship and to support the transition from print to digital authoring. The concept of the Center is to provide specialized facilities, applications and resources to promote electronic publishing, online research collaboration, shared data sets, and open access scholarship, leveraging the support of the libraries, museums, and the press at UNM,

The services of eSIC include consultation on author rights as well as the production of various digital media as scholarly products; facilitating dialog by offering of discussion groups and classes in collaborative writing and ePublishing; and supporting digital publishing, including editing, peer review processes, graphic design, marketing, distribution, measurement of use; and archiving, curation, and preservation of digital works. Specific services are:

1) Support Services
    a. **Self-Service eScholarship Workstation**, with specialized software packages, onside assistance, training, and support
    b. **Article/Manuscript Preparation**, including graphic designers, data presentation specialists, editors
    c. **Depository Submission Assistance**, with help preparing and submitting scholarly works for open access repositories and assistance meeting NSF, PubMed or other depository and open access publishing requirements
    d. **Facilitating Sharing and Storage of Data Sets**, including digital asset management services, organizing, archiving, publishing scholarly data as well as support for individual and collaborative data curation
    e. **On-demand Printing** and sales of ebooks and ejournals
    f. Tools for collaboration **(e.g., file sharing, e-lab notebooks, workflow tools)**

2) Innovation Services
    a. Provision of **Software Tools** for capture, archiving, and documentation of research data; open seminar production; electronic publishing; subscription and payment management systems
    b. **Standards Development, Use, and Implementation**, such as development of metadata structures, and research information architectures
    c. Development of **Best Practices**
    d. Development of **Systems and Storage Solutions**, such as cloud storage and remote data management
    e. **Product and Service Research**, such as secondary research into existing tools, products & technologies for digital scholarship.

3) Educational Services
    a. Workshops and Institutes
    b. **Credit Course** in research methods that includes, foundations in informatics, digital research, data management, and how to be effective in digital scholarship

[1] Health Sciences Library and Informatics Center
Law Library
University Libraries

c. Building **Awareness** through listservs and blogs

Rationale

First, digital authorship, data creation systems, the use of electronic workflows, and related data curation activities are increasing across the U.S. The Association of College & Research Libraries (ACRL) recently identified scholarly communications and intellectual property services as one of the top ten trends in academic libraries.[2]

Studies on the creation and use of eBooks for use within the curriculum are now found in various disciplines.[3] While the sciences have encouraged (if not required) collaborations among researchers for some time, scholars in the humanities have been able to be "solo practitioners". As noted by Spiro[4] this is changing and collaborative authorship in the humanities is becoming more common and there is a growing relationship between collaboration and digital scholarship.

UNM faculty members serve as editors of numerous national and international research journals. At least six academic journals are published on campus, of which three are based on the *Dspace* Institutional Repository infrastructure. Open Access digital authoring is encouraged at UNM and some scientists are adopting this philosophy, e.g., *Biomed Central* authors have increased over the years so that during the past year, at least 21 articles had at least one author from UNM. Twenty-two UNM authors have published in *PLOS ONE* since 2007 (2 in 2007, 4 in 2008, 11 in 2009 and 5 in 2010 , through May). And finally, teaching is increasingly informed by digital products and services embedded in WebCT and other teaching management systems.

These developments call for a focused effort to enable digital publishing and the evolving e-scholarship environment, which ultimately is cost effective because every UNM department won't have to create local systems and support.

Key Leadership

Health Sciences Library and Informatics Center: Jonathan Eldredge, PhD, Associate Professor, Coordinator, Evidenced Based and Translational Sciences Services
Law Library: Carol Parker, Professor of Law, Associate Dean
University Libraries: Amy Jackson, Assistant Professor, Digital Initiatives Librarian

Objectives

Years One & Two

- Identify existing resources within each of the three libraries that can be leveraged for start-up of the Center, including, establishing initial budget, identifying physical space(s), and developing implementation plans for the following.
- Gain endorsement from Provost , EVP of Health Sciences, and School of Law Dean for the Center
- Create webpages that detail services of the Center

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[2] ACRL Research Planning and Review Committee. 2010 Top Ten Trends in Academic Libraries: a review of the current literature. Available online at: http://crln.acrl.org/content/71/6/286.short

[3] Morton, David A., et al. TK3 eBook software to author, distribute, and use electronic course content for medical education. Advan. Physiol. Edu. 31: 55-61, 2007; doi:10.1152/advan.00036.2006 1043-4046/07

[4] Lisa Spiro. Collaborative authorship in the humanities. 2009. Available online at: http://digitalscholarship.wordpress.com/2009/04/21/collaborative-authorship-in-the-humanities/

- Submit at least one grant/contract proposal to fund a program of the Center
- Develop usage metrics
- Pilot OJS with at least one journal and a newsletter
- Implement Espresso service

Years Three & Four

- Increase submission of grant proposals and awards
- Increase use of Center

Year Five

- Continue to increase use of Center
- Secure funding for dedicated staffing

SUBMITTED, September 20, 2010, BY:
Holly Shipp Buchanan, Kevin Comerford, Ernesto Longa, Johann Van Reenen

File: eScholar Innovation Center _20100922_hsb.docx

NMERB NEW MEXICO EDUCATIONAL RETIREMENT BOARD

Benefit Plan Design Changes – DRAFT

This table is a draft summary of the defined benefit plan design changes approved by the ERB board on November 8, 2010. The board's actuarial goals are to achieve 80% funding for the ERB plan and amortize the unfunded liabilities within 30 years. These recommendations are needed to ensure the long term solvency of the ERB fund. The combination of these proposals exceeds ERB's actuarial goals and as a result some proposals may be scaled back. The board is in the process of fine-tuning the proposal and will vote on a final set of recommendations at the December 10, 2010 board meeting.

PLAN ELEMENTS	***TIER 1***[1]	***TIER 2***[2]	***PROPOSED PLAN REDESIGN – WOULD APPLY TO ALL ACTIVE MEMBERS***[3]
Multiplier	2.35%	2.35%	2.35%
Member Contributions (including current shift)	7.9% - Salary $20,000 or less; 9.4% - Salary greater than $20,000	7.9% - Salary $20,000 or less; 9.4% - Salary greater than $20,000	8.4% - Salary $20,000 or less; 9.9% - Salary greater than $20,000
Final Ave. Salary	Highest consecutive 5 years	Highest consecutive 5 years	Highest consecutive 7 years
Years of Service Retirement	25 years – any age, no Benefit Reduction	30 years – any age, no Benefit Reduction	35 years – any age, no Benefit Reduction
Age + Service Retirement ——— ***Benefit Reduction***	Rule of 75 (Age + Earned Service Credit = 75) ——— Benefit reduction: Age 55 to 60 - 2.4% per year (0.6% each ¼ year after 55 & before 60); Prior to Age 55 – 7.2% per year (1.8% each ¼ year prior to age 60);	Rule of 80 (Age + Earned Service Credit = 80) ——— Benefit Reduction: Age 60 to 65 - 2.4% per year (0.6% each ¼ year after 60 & before 65); Prior to Age 60 – 7.2% per year (1.8% ¼ year prior to 60)	Age 60 + 30 years (30 years Earned Service Credit required; no benefits with less than 30 years) ——— Benefit Reduction: Below Age 60 + 30 years' service - 2.4% per year (0.6% each ¼ year below age 60); No provision for retirement before age 60 with fewer than 30 years
Age + 5 yrs service[4]	65 + 5 years Earned Service Credit	67 + 5 years Earned Service Credit	67 + 5 years Earned Service Credit
Safe Harbor	N/A	N/A	22 yrs. service as of effective date of Plan change, grandfathered to Tier 1 requirements
Employer Contribution	Increases per Section 22-11-21 to 13.9%	Increases per Section 22-11-21 to 13.9%	Increases per Section 22-11-21 to 13.9%

[1] Tier 1 – Member on or before June 30, 2010; have not withdrawn all member contributions.
[2] Tier 2 – New member on or after July 1, 2010 (effective retroactively July 1, 2011); includes individuals who previously were members but who withdrew all member contributions prior to July 1, 2010 and did not repurchase service credit.
[3] Nov. 8, 2010 Proposed Plan Redesign would apply to all Tier 1 and Tier 2 current active members; it would not apply to retirees.
[4] Members may retire upon completion of five years of earned service credit and upon becoming the stated age.

MAY 10 2010

NEW GRADUATE DEGREE OR GRADUATE CERTIFICATE
FORM D

UNIT PREPARES IN QUADRUPLICATE
Route as indicated below under approvals. Return to the Registrar's Office once all signatures have been obtained.

Date: May 6, 2010

***Allow up to one year for the process to be completed for a certificate, and 18 months for a degree.**

Steven W. Graves
(Name of individual initiating Graduate Degree or Graduate Certificate)

Associate Professor, 505-277-6395
(Title, position, telephone number)

graves@unm.edu
(Email address)

Center for Biomedical Engineering
(Department/Division/Program)

Note: Proposals for new graduate degrees or graduate certificates need to follow an approved format. Please call the Office of Graduate Studies and ask for an outline. Revisions of graduate degrees and some new certificates also may need state approval, depending on the extent of changes proposed. Please consult the Office of the Provost for advice prior to initiating this form.

RECEIVED
AUG 02 2010
Graduate Office
University of New Mexico

Attach the following required documents:

1. Executive Summary.
2. Program Proposal (in the approved format).
3. Catalog Description (to include program curriculum).
4. Graduate Program Projected Costs (only for new degrees).
5. Library Impact Statement.

Does this new degree affect any existing program? Yes ☐ No ☒ If yes, attach statement.

Proposed date to admit new students: Term Spring Year 2011

Required Signatures:

Department Chair	[signature]	Date 5/7/2010
College Curricula Committee	[signature]	Date 10 May 2010
College or School Dean	[signature]	Date 10 May 2010
Dean of Library Services	[signature]	Date 7/28/10
Office of the Registrar—Catalog	Elizabeth A. Barton	Date 07/15/10
FS Graduate Committee	[signature]	Date 10.21.10
Dean of Graduate Studies	[signature]	Date 10-20-10
FS Curricula Committee	[signature]	Date 11-9-10
Office of the Provost		Date
Faculty Senate		Date
Board of Regents		Date

Additional Approvals for Degrees:

Board of Regents		Date
Council of Graduate Deans		Date
Academic Council of Higher Education		Date
Higher Education Department		Date
State Board of Finance		Date

For Registrar's Office ONLY: Entered Banner ___ Entered Catalog ___ Copies Mailed ___

A Proposal for the Master's of Science Degree Program in Biomedical Engineering at the University of New Mexico

A program to be administered by the School of Engineering Albuquerque, New Mexico

Contact person who can answer specific questions about the program:

Dr. Arup Maji
Interim Dean, School of Engineering
e-mail: amaji@unm.edu
phone 505-277-5521
fax 505-277-1422

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Chapter 1
Executive Summary

Biomedical engineering (BME) is one of the fastest growing engineering fields and a key area of U.S. competitiveness around the globe today. Many established New Mexico businesses are already involved in offering services and products in biomedical engineering, and they need locally-trained graduates. Accordingly, students within the state want to be trained in the field. However, no such programs are offered anywhere in New Mexico. Hence, these students leave the state to pursue degree programs elsewhere, such as those at the state-run flagship universities of Arizona, California, Colorado, Texas, and Utah, all of which have thriving degree programs in BME. BME workers have been identified as a critical missing element of the state of New Mexico's workforce (source: "*Work in New Mexico: New Mexico Career Clusters Guidebook*", State of New Mexico, 2006). To avoid a brain drain of talented New Mexican's to other states, and to stimulate the state economy in a vibrant area by providing a talented local workforce, it is proposed that the University of New Mexico offer advanced degrees in BME.

The propose BME degree program will be synergistic with the BME research program at UNM funded by the State of New Mexico. This synergy will be evident as the research program will provide a training venue for BME students and BME students will provide a source of talented researchers for the research program.

This proposal represents the fruition of funding provided to UNM by the NM Legislature to develop a plan for introducing a new advanced degree program in BME at UNM. The proposal describes the details of those plans and the accomplishments to date in securing all necessary resources for launching the new program. It is proposed that the state approve a new Master's of Science degree program in BME. This proposal is being moved forward in tandem with a new BME concentration in the Ph.D. in Engineering degree, which does not require state approval. Together, the M.S. and Ph.D. programs will form a complete graduate program in BME. The success of these efforts will complement an already successful research program in BME at the University of New Mexico, and thereby strengthen UNM and the State of New Mexico simultaneously.

Chapter 2
Purpose of the Program

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2.1 Objective

The purpose of this proposal is to establish a master's of science (M.S.) degree program in Biomedical Engineering (BME) at the University of New Mexico. This graduate degree program will educate and train our best students in the exciting new field of BME. Just as importantly, it will foster the production and application of new knowledge in an area that impacts the health and well-being of all New Mexico citizens. Furthermore, BME is a growing field and, by providing skilled local workers in BME, this program will drive development of the NM economy.

What is biomedical engineering?

This phrase refers to the application of *engineering principles and tools* to problems of medical or biological significance. Though the scope of biomedical engineering is very broad, key subtopics within biomedical engineering are clinical engineering, medical imaging, orthopedic engineering, rehabilitation engineering, systems physiology, bioinstrumentation, biosensors, biomaterials, biomechanics, cellular engineering, tissue engineering, and biomolecular engineering. The output of the practicing biomedical engineer typically takes the form of a tangible product, such as a prosthetic, an engineered skin graft, a biosensor, a surgical tool, or an engineered protein. A remarkable number of key advances in medicine have been invented by engineers or engineering-oriented medical researchers, such as angioplasty, flu test kits, MRI, blood counters, endoscopic surgery, artificial hearts, blood dialysis machines, x-rays, and artificial limbs.

The proposed program will build upon our current collaborative efforts with local and regional industry and academic leaders engaged in state-of-the-art biomedical engineering research. These researchers are employed at TriCore Reference Labs in Albuquerque, Los Alamos National Laboratory (LANL), Sandia National Laboratories (SNL), and elsewhere. The program will be implemented by a productive and well-qualified group of faculty from SOE and selected other individuals. Many new courses have been created to support the proposed master's degree. These courses will also be available to undergraduate students and candidates for the Ph.D. in Engineering with a concentration in Biomedical Engineering.

The proposed degree program follows the pattern of most other programs in the U.S. in which the *master's* degree is granted specifically in the topical area of "biomedical engineering", whereas the *Ph.D.* is granted in Engineering *with a concentration in biomedical engineering.* (In parallel with the present effort to establish a master's degree in BME at UNM, there is an effort to add BME to the list of approved concentrations within UNM's long-standing degree "Ph.D. in Engineering", but this parallel effort does not entail creating a *new degree*, hence does not require state-level approval.)

The proposed BME program is envisioned to eventually address many topics in the area of BME. We anticipate growing the program by developing one focus area at a time and addressing new BME subtopics with additional focus areas as the need arises and resources are secured. Initially, the program will offer only one focus area, namely *Molecular and Cellular Systems*. Future focus areas will be drawn from areas of strength of the UNM School of Engineering. Current candidates for new focus areas include "Biomedical Imaging", "Biomechanics", "Biocomputing", and "Bioelectrocatalysis and Biofuel Cells". There is active teaching and research in all four of these areas, and there are faculty interested in developing them as new focus areas.

2.2 Program is consistent with the role and scope of UNM

An objective of UNM's strategic plan, as approved by the Regents and faculty, is to:

"*evaluate and restructure UNM's support for graduate education and raise the effectiveness and stature of our programs.*"

The proposed BME program is a direct response to this objective. In the past three decades, virtually all universities in the U.S. and abroad have begun to offer specific degree programs in BME. The University of New Mexico is one of only a handful of flagship state universities that does not currently offer an advanced degree program in BME. Notably, the state of NM does not have a graduate program in BME. This prevents the State of NM and UNM from providing specific training in BME to compete for many of the top students and faculty. To compete favorably with other universities for federal funds and for high quality students and faculty, it is imperative that UNM offer a master's of science degree program in BME.

The proposed degree program is consistent with UNM's mission of providing graduate education and training in technical and scientific areas that are critical to the economy of the State of New Mexico, specifically, and to the U.S. economy generally. Our proposed program brings together a superlative combination of BME courses, labs, research programs, and a statewide network of biomedical engineering partners. This program will promote the acquisition and application of new knowledge in BME. It will produce highly trained and skilled graduates well-qualified to move into academic, industrial or federal BME-oriented positions of employment.

An advanced degree program in BME will make it possible for UNM to prepare students for biomedical engineering careers. This training will prepare students for positions in academia and in laboratories across the nation and worldwide, where they will discover and create breakthroughs in medicine, biomedical engineering and basic scientific fields. Such programs will make UNM more competitive for research and training grant funding from NSF, DOE, NIH and other sources, and enhance UNM's research and training partnerships with other institutions, federal and state programs, and private industry. It will also enhance UNM's ability to attract and retain world-class faculty. In summary, the proposed graduate degree program supports UNM's entire vision of growth and service to the citizens of New Mexico.

Dr. Arup Maji, the Interim Dean of the School of Engineering, is fully committed to ensuring that this program will succeed. As the designated Contact Person for this proposal, he can answer questions about the program by e-mail at arup@unm.edu, or by phone at 505-277-5521.

2.3 Proposed program is an institutional priority

The School of Engineering places a high priority on establishing the proposed master's of science program in biomedical engineering. This is demonstrated by the extent to which research and graduate education in BME is already taking place in laboratories and classrooms across campus and at several UNM research centers, most especially the Center for Biomedical Engineering (CBME), which was formed to specifically pursue BME research at UNM and in NM. Furthermore, the Provost has made it one of her priorities to create a new master's degree program in BME.

Finally, one of the 13 "Regents' Goals for the President" in UNM's 2008 Strategic Long-range Plan is a call for economic development. This goal is directly supported by the proposed Biomedical Engineering master's degree program, as it will enlarge the local recruiting pool of talented biomedical engineers, enhance the attractiveness of New Mexico to outside companies considering relocating here, and stimulate a more robust local BME infrastructure. Details of these anticipated positive effects are provided below.

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3.1 Need

The need for improved medical treatments provided by biomedical engineering is becoming critically important in the lives of all U.S. citizens. As new medical crises arise and the cost of effective treatment increases, the improved medical treatments and cost efficiencies offered via biomedical engineering are becoming critical for our children, our parents, and ourselves. These demands are only heightened by the needs of the aging U.S. population.

The number of biomedical engineering jobs will increase by 21 percent over the next decade, which is the highest growth rate of any engineering discipline (*source*: U.S. Department of Labor reports that Occupational Outlook Handbook, 2008-2009).

As an economic development engine, biomedical engineering is fast-growing and profitable. It is a major component of the U.S. economy today. In the first 5 months of 2009 alone, the U.S. ran a trade surplus in biotech of more than $3 billion (*source*: U.S. Dept. of Commerce, 2009). Hence, we have an excellent competitive advantage in this area over other countries.

Not surprisingly, more than three-fourths of all U.S. economic development organizations rank biomedical/biotechnology in their top two priorities. More than 40 states have economic development programs targeting the industry (*source:* Brookings Institute, Center on Urban & Metropolitan Policy, 2002).

With regards to the local economy, we in the state of New Mexico have the advantage of having a major research hospital, a major research university, and two national laboratories all within about 100 miles of each other. This density of research drives significant entrepreneurship in many areas and, as all the institutions have strong interests in biomedical engineering, it should be a driver for investment in biomedical engineering in the state of NM.

Federal funding agencies also recognize the importance of biotech. In 2002, the National Institutes of Health (NIH) established a new institute dedicated to fund biomedical engineering research, the "National Institute for Biomedical Imaging and Bioengineering". In it's first year, the new institute was appropriated $111 million. By 2009, this had nearly tripled to over $311 million (*source*: http://officeofbudget.od.nih.gov/pdfs/FY11/Actual%20Obligations%20by%20IC %201997-2009.pdf). In contrast to the NIH, BME funding levels at the National Science Foundation (NSF) are far harder to quantify. However we know anecdotally that the NSF just launched a new program area in biosensing, and that the budget for NSF's Division of Chemical, Bioengineering, Environmental, and Transport Systems increased from $109 to $159 million dollars from FY08 to FY09 (*source*: "CBET Division Overview" at http://www.nsf.gov/eng/cbet/ programs/). Clearly, experts at the NIH and NSF are trying to increase funding allocations for biotech research because they recognize that the heavy and continuous demand for new technology will be satisfied, either in the U.S. or elsewhere, and that it is in our nation's interest to be on the leading edge of this important field.

A BME degree program at UNM can help meet this need.

Across the U.S. there are over 100 biomedical engineering graduate programs. They are found at every leading university in the United States, and most flagship state universities (Table 3.1). In contrast, doctoral or master's program in biomedical engineering are not offered at any

Table 3.1. BME degree programs at flagship state universities in the U.S., as of March 2008

	School	Undergraduate degrees	Graduate degrees	Source
AL	University of Alabama	BS in BME	MS, Ph. D.	http://main.uab.edu/soeng/Templates/Inner.aspx?pid=49344
AZ	University of Arizona	"Undergraduate specialization in BME"	MS, Ph. D.	http://www.bme.arizona.edu/
CA	UCB & UCSF (joint program)	none	Ph. D.	http://bioeng.berkeley.edu/prospectivegrads.php
CA	Univ. California Berkeley	BS in BME	none	http://bioeng.berkeley.edu/
CA	Univ. California Davis	BS in BME	MS, Ph. D.	www.bme.ucdavis.edu/
CA	Univ. California Irvine	BS in BME	MS, Ph. D.	www.bme.uci.edu/
CA	Univ. California Los Angeles	BS in BME	MS, Ph. D.	www.bme.ucla.edu/
CO	University of Colorado Boulder	BS in BME	MS, Ph. D.	http://www.colorado.edu/engineering/BME/
CT	University of Connecticut	BS in BME	MS, Ph. D.	http://www.bme.uconn.edu/
FL	University of Florida	none	MS, Ph. D.	http://www.bme.ufl.edu/academics/degrees/index.php
GA	University of Georgia	BS in Biochemical Engineering	none	http://www.engineering.uga.edu/academics/index.php
HI	University of Hawaii	BS in Bioengineering	MS in Bioengineering	http://www.hawaii.edu/academics/degrees/
IL	University of Illinois UIUC	BS in Bioengineering	MS, Ph. D. in Bioengineering	http://www.bioen.uiuc.edu/about.html
IN	Indiana University	BS in BME	MS, Ph. D.	http://www.engr.iupui.edu/bme/
IA	University of Iowa	BS in BME	MS, Ph. D.	http://www.bme.engineering.uiowa.edu/
KS	University of Kansas	Bioengineering concentrations within BS ChE and ME	MS, Ph. D. in Bioengineering	http://bio.engr.ku.edu/
KY	University of Kentucky	none	MS, Ph. D.	http://www.cbme.uky.edu/faq.htm
ME	University of Maine	minor in BME	none	http://www.catalog.umaine.edu/preview_entity.php?catoid=47&ent_oid=338 4&bc=1
MD	University of Maryland	BS in BME	MS, Ph. D.	http://www.bioe.umd.edu/index.php
MA	University of Massachusetts Dartmouth	none	MS, Ph. D.	http://www.umassd.edu/engineering/mtx/bmebt/
MI	University of Michigan	BS in BME	MS, Ph. D.	http://www.bme.umich.edu/
MN	University of Minnesota	BS in BME	MS, Ph. D.	http://www1.umn.edu/bme/
NE	University of Nebraska	BS in Biological Sys Eng	Ph.D.	http://www.engineering.unl.edu/specialty-units/BiomedicalEngineering/index.shtml
NV	University of Nevada Reno	BS in BME	MS, Ph. D.	http://www.unr.edu/bme/
NJ	Rutgers University	BS in BME	MS, Ph. D.	http://biomedical.rutgers.edu/facultyopenings.php
NY	SUNY Stony Brook	BS in BME	MS, Ph. D.	http://bme.sunysb.edu/bme/
NC	University of North Carolina	BS in BME	MS, Ph. D.	http://www.bme.unc.edu/
OH	Ohio University	none	MS in BME	http://www.ohio.edu/engineering/biomedical/research/
OK	University of Oklahoma	BS in Biotech ChE	MS, Ph. D.	http://www.oubc.ou.edu/degrees/g_biomedical_ame.htm
OR	Oregon Health Sci University	none	MS, Ph. D.	http://www.ogi.edu/bme/
PA	University of Pennsylvania	BS	MS, Ph. D.	http://www.seas.upenn.edu/be/grad.html
RI	University of Rhode Island	BS	MS, Ph. D.	http://bme.ele.uri.edu/
SC	University of South Carolina	BS	MS, Ph. D.	http://www.sc.edu/usctimes/articles/2006-03/biomedical_engineering.html
SD	University of South Dakota	none	MS, Ph. D.	http://www.usd.edu/gradsch/degreeProgs/biomedical_engineering.cfm
TN	University of Tennessee	BS in BME	MS, Ph. D.	http://www.utmem.edu/grad/PROGRAMS/Biomed_Eng_Program.htm
TX	University of Texas	BS in BME	MS, Ph. D.	http://www.bme.utexas.edu/
UT	University of Utah	BS in BME	MS, Ph. D. in Bioengineering	http://www.bioen.utah.edu/factsheet.php
VA	University of Virginia	BS in BME	MS, Ph. D.	http://bme.virginia.edu/
WA	University of Washington	BS in BME	MS, Ph. D.	http://depts.washington.edu/bioe/resources/
WI	University of Wisconsin	BS in BME	MS, Ph. D.	http://www.engr.wisc.edu/bme/

school in the State of New Mexico. New Mexico is one of only 13 flagship state universities in the U.S. which do not currently offer a BME program (the others are AR, AK, DE, ID, LA, MS, MO, MT, NH, ND, WV and WY). Although training in the repair of medical equipment is offered at two community colleges in our state (Doña Ana and NMSU-Alamogordo) neither program provides the scope of training of a master's program.

For those students determined to live in New Mexico, *and* to be trained in biomedical engineering, their only choice is to create an *ad hoc* biomedical engineering program, taking whatever relevant courses they can find, and getting whatever on-the-job training they can. For all such students, this is impractical, inefficient and unsatisfactory. As a consequence, most New Mexico students with BME career aspirations tend to exit the state, or abandon their BME career plans. *The BME program proposed here will remedy this problem.*

3.2 Justifications for establishing a graduate program in biomedical engineering

The overarching justification for establishing this new program is that the State of New Mexico and its citizens will benefit from it.

Specifically, the BME program will:

- train students for BME jobs already in New Mexico
- create economic growth
- satisfy students' strong demand for BME training
- fix the "informal BME program"
- retain New Mexico's biomedical engineering talent
- enhance collaborations with local national laboratories
- promote UNM's stature in creating and applying new knowledge
- improve the integration of research and education at UNM

Each of these benefits is discussed in detail below.

A. Train students for BME jobs already in New Mexico

There are a large number of biotech companies in New Mexico that require a trained workforce (Table 3.2), all of whom will benefit from the proposed program. Some of these companies are growing very quickly, and thus have a particularly acute need for trained employees. For instance, in December 2008, the Albuquerque biotech firm TruTouch Technologies, which manufactures and sells blood alcohol testing devices, was cited by *New Mexico Business Weekly* as the single fastest-growing small business in the state, increasing its headcount from 3 to 10 in just two years. Also on the list was biotech firm Lumidigm Inc., which increased its headcount from 12 to 27 in the same time period. Percentage increases such as these are unsustainable without trained graduates.

It is no surprise, therefore, that recruiters from local industry have indicated their strong interest in the establishment of a BME graduate degree program at UNM in order that they might hire graduates from that program (letters of support, Appendix A). That message has been reiterated by both Sandia and Los Alamos national labs (Appendix A). It is clear that as the

Table 3.2
New Mexico companies and research centers that will benefit from the BME program, ranked by number of employees resident in the State of New Mexico

Company	Product	NM employees	Location
TriCore Reference Laboratories	Clinical reference laboratory	>1000	Albuquerque
UNM Health Sciences Center	Research	~750	Albuquerque
Johnson & Johnson Ethicon Endo-Surgery	Surgical tool sterilization and packaging	590	Albuquerque
Lovelace Biomedical & Environmental Research Institute	Research	540	Albuquerque
OSO BioPharmaceuticals Manufacturing, LLC	Sterile injectables manufacturing	350	Albuquerque
Los Alamos National Laboratory (Divisions B, C, D, N, MST-CINT, etc.)	Biothreat research & development	~200	Los Alamos
Sandia National Laboratories	Biothreat research & development	~100	Albuquerque
Mind Research Network	Brain imaging, research	110	Albuquerque
AMO Wavefront Sciences LLC	Eye surgery devices	50	Albuquerque
Voss Scientific	Microwave and laser sources	36	Albuquerque
Lumidigm, Inc.	Biometric devices	28	Albuquerque
UNM Center for Biomedical Engineering	Research & development	20	Albuquerque
VeraLight	Non-invasive diabetes assays	18	Albuquerque
IntelliCyt Corp.	Flow cytometry technology	12	Albuquerque
TruTouch Technologies	Blood alcohol testing devices	11	Albuquerque
Eco Sensors Inc.	Ozone monitors for sterilization	7	Santa Fe
Vista Therapeutics	Nanowire-based biosensors	6	Santa Fe
Maas Biolab LLC	Drug development	7	Albuquerque
Biomoda Inc.	Early cancer diagnostics	5	Albuquerque
Theranostech Inc.	Protein synthesis	5	Albuquerque
Avanca Medical Devices, Inc.	Syringes	5	Albuquerque
Envirco Corporation	HEPA filtration systems	4	Albuquerque
SelraD Inc.	Gene expression software	4	Santa Fe
Interfasys	Lab automation	4	Albuquerque
STAR Cryoelectronics	Magnetic sensors	3	Santa Fe
Mesa Analytics & Computing LLC	Drug discovery software	3	Santa Fe
BioAssist Consulting Services Inc.	FDA consulting	2	Albuquerque
CerroSci LLC	R&D for overexpression & protein isolation	2	Albuquerque
Altaview Technologies Inc.	Human performance sensors	N/A	Albuquerque
Lapsurgical Systems Inc.	Surgical tools	N/A	Roswell
QTL Biosystems	Diagnostic assays	N/A	Santa Fe
InLight Solutions	Non-invasive diagnostics	N/A	Albuquerque
Kestrel Corporation	Hyperspectral imaging	N/A	Rio Rancho
Bioreason Inc.	Drug discovery software	N/A	Santa Fe
Caldera Pharmaceuticals	Drug & biomarker screening	N/A	Los Alamos
	Grand total	**>1822**	

Primary source: "New Mexico Business Weekly 2009 Book of Lists". Also Angel Gonzalez, Albuquerque Plant Manager, Johnson & Johnson; Lucy Eisele, Director of Human Resources, OSO BioPharmaceuticals Manufacturing, LLC; and Spencer Farr, CEO, Vista Therapeutics.

national labs continue to work to fight bioterrorism, develop medical diagnostics and treatments, and research biofuels, they will need engineers trained in BME.

Finally, biomedical engineering is a major growth industry in the United States. It is imperative that we train New Mexico students to participate in this burgeoning field. A new BME degree program at UNM will expand the state's recruiting pool, and in turn make the state more attractive to new companies moving in, and enhance the competitiveness and growth of BME companies already here.

B. Create economic growth

In the early 1980s, Intel Corporation made a decision to locate a semiconductor chip factory in Rio Rancho. The decision to do so was based on the fact that New Mexico ranked at the top of Intel's site selection criteria. Most of the conditions which led to Intel's selection of Rio Rancho still exist today. For instance, Albuquerque was then a short non-stop flight away Silicon Valley; we are now a short non-stop flight away from 2 of the 3 major U.S. centers of biotechnology, namely San Diego and the San Francisco Bay Area (the third is Boston). We have an excellent climate, a low cost of living, a natural environment that is relatively immune from natural disasters such as earthquakes, wildfires, hurricanes, tornadoes and volcanoes (recall the eruption of Mt. St. Helens in the 1980s which caused Intel's semiconductor chip factories to close temporarily in Portland, Oregon). We have a workforce that tends not to job-hop from company to company, or state to state. We offer competitive tax and revenue bond incentives. We have an outstanding medical school and hospital at UNM, with a superb faculty engaged in a variety of biomedical research. In short, we have nearly all of the ingredients for being selected by the next biotech "Intel". But Rio Rancho would never have been considered by Intel if the Albuquerque metropolitan area did not have a local university with strong teaching and research programs in electrical engineering, chemistry, chemical engineering and physics. So too New Mexico will never be considered by a major bioengineering company so long as there is no BME degree program at UNM. The proposed degree program is intended to fill a critical gap that can put the state in contention for new site selections by *growing* companies.

The development of the BME program will improve New Mexico's reputation as a key participant in the biomedical engineering field. As the demand for BME professionals increases, and the new BME program meets this demand, then New Mexico will benefit from increased revenue. More specifically, the many biotech companies already in the state will benefit materially from a program in biomedical engineering at UNM in the form of technical assistance from in-state BME faculty, and in a larger biotech infrastructure and network. Many of these companies already employ UNM graduates and former postdoctoral fellows. These companies have indicated their interest in the proposed BME program and in hiring from its pool of graduates. A list of these companies is included in Table 2.

In summary, the proposed educational program will improve New Mexico's attractiveness to numerous companies, new and old, based on improved availability of highly trained graduates, collaborations with faculty, available technology and facilities, and a highly supportive state environment.

C. Satisfy students' strong demand for BME training

There is constant demand for technical developments in biomedical engineering. This demand is fueled by the prosperity of the biotech industry, and by government and citizen interest in improving health care. In turn, there is unrelenting demand for individuals trained in the field of biomedical engineering. According to a May 2009 report by the National Scientific Foundation, biomedical engineering continues to be "one of the fastest-growing engineering fields and has more than doubled in size since 2000." The number of Ph.D. degrees granted in this field increased nearly 250% over the nine-year period ending 2006. An advanced degree in BME prepares students for internships and career opportunities at national labs, hospitals, medical institutions, academia, industry, government regulatory agencies and healthcare institutions. Hence, it is seen by students as a highly attractive field with good job opportunities, good job stability and good wages -- precisely what we want in New Mexico.

UNM students know these facts, and naturally they are eager to be trained in BME.

For more than a dozen years, UNM faculty have taught various courses in biomedical engineering (Table 3.3). The large number of students enrolled in these courses is evidence of students' avid interest in BME, especially when one considers that none of the students had any prospect of receiving a BME degree at UNM or anywhere else in the state.

The student enrollment numbers shown in Table 3.3 are for courses taken *solely* as electives. Even within UNM's existing chemical engineering undergraduate major, many students study for and receive a B.S. in Chemical Engineering *with a concentration in biomedical engineering.*

Table 3.3
Number of students enrolled in BME-relevant courses taught in the UNM School of Engineering, Spring 1999-Spring 2010.

	Biomedical Technology	Medical Radioisotopes	Biochemical Engineering Principles	Bioengineering Seminar	Biosensors: Fundamentals and Applications	Medical Imaging	Introduction to Medical Physics	Biomolecular Engineering	Mathematical methods for medical physics	Applied Biology for Engineers	Mechanics and Thermodynamics of Molecular Components in Cells	Methods of Analysis in Bioengineering	Total
Spring 99	8	1											9
Fall 99			7										7
Spring 00	9												9
Fall 00			8										8
Spring 01	6												6
Fall 01			12	12									24
Spring 02	7		7	10	18	11							53
Fall 02			6	14									20
Spring 03	7			13									20
Fall 03			11	15									26
Spring 04				14	21								35
Fall 04			13	18									31
Spring 05				19									19
Fall 05				15									15
Spring 06				16	17		6						39
Fall 06				18				18	9				45
Spring 07				18									18
Fall 07				12				21					33
Spring 08				9	10								19
Fall 08				10				22					32
Spring 09				4				10					14
Fall 09				7				22		8	3		40
Spring 10				8				5				5	18

Source: UNM Office of the Registrar; Spring 2010 figures provided by the instructors.

A Department of Labor report indicates that a graduate degree is required for many entry level jobs in this field (*source*: U.S. Occupational Outlook Handbook, 2008-2009).

Perhaps even more remarkable is that the student chapter of UNM's Biomedical Engineering Society now has over 40 active members at UNM. This Society is a national professional organization founded in the 1960s to promote BME research and education. (UNM's chapter is notable for high levels of participation by female and minority students.) Of course, none of UNM's members have any immediate prospect of receiving a degree in biomedical engineering. Undaunted, they have organized themselves into a society for the purpose of enhancing their prospective professional careers *in biomedical engineering*.

If launched, the BME master's degree program will enable UNM to compete successfully in attracting talented graduate students to one of the fastest growing fields in science, engineering and industry. It will enhance student recruitment at UNM with a degree program that is in large demand. And it will lead to a sizeable increase in the number of students enrolled in BME courses.

D. Fix the "informal BME graduate program"

Many UNM engineering graduate students currently pursue BME training *despite* the absence of a BME degree program. The scholastic interest of these students simply does not coincide with any degree program UNM now offers, but nevertheless they remain committed to graduating from UNM with BME training. Fortunately, many BME-relevant courses *are* taught within the School. So these students routinely cobble together as best they can an *informal program* of BME graduate study. In this sense, the School is already "doing BME", but in a scattered and disjointed way. Obviously this is not how we want to serve our student population. Indeed, the current situation forces students to take more than a few irrelevant courses merely to fulfill the requirements of whatever second-best degree program they are in. Even worse, none of the BME-relevant courses they *can* take are offered in the context of a carefully designed BME curriculum.

Establishing a new BME graduate program immediately remedies these problems. With a new graduate degree program, students will be able to pursue a coherent course of study customized for their BME training, with each course offered in the context of a unified curriculum. The relevance and completeness of that curriculum has been established by a group of more than a dozen UNM professors who know the field thoroughly, know the core courses which must be taught, and know which elective courses should be offered. Details of this new curriculum are in the proposed catalog copy shown in Appendix C.

E. Retain New Mexico's Biomedical Engineering Talent

Currently, we lose resident New Mexico students to other states' BME programs. Moreover, our ability to recruit students from other states is handicapped by the absence of a master's degree program to which out-of-state students can be recruited.

Most new BME knowledge and intellectual property in the state is produced as a result of *scientific engineering*, not as a result of deals, mergers, or acquisitions. If we want to grow our state's biotech economy, we need to grow it at home. And the first step in that process is to nurture students who are thoroughly adept at conducting BME-specific *scientific engineering*. These students can be either native-born or recruited beyond our borders. But either way, *students* are at the root of our success.

A group of a dozen or so UNM faculty spent significant time discussing and planning the curriculum for the new degree program proposed here. They have been motivated to do so for various reasons, which include a strong desire to boost the statewide economy and improve citizen health through biotech. They also have a keen interest in their own students' well-being, and in the quality of students they can attract to their labs. Indeed, the availability of a masters degree program in BME is important for both the recruiting *and* training of their own students. In turn, these students are the foundation of each professor's success as a researcher and recipient of federal grants, for it is well-recognized that faculty success depends on student success. If the BME graduate program is approved, then UNM will do a far better job *recruiting* and *retaining* in- and out-of-state students. We will reduce the pressure that causes most of our BME-focused students to exit the state. As our existing BME faculty become more successful, this will enable recruiting additional quality faculty, drive more industrial interactions, and create more biomedical engineering entrepreneurship opportunities.

F. Enhance collaborations with local national laboratories

Sandia National Labs (SNL) and Los Alamos National Lab (LANL) are heavily involved in biomedical engineering related disciplines to accomplish their national security missions in reducing the threat of bioterrorism and the development of sustainable energy such as biofuels. UNM's proximity to SNL and LANL is a golden opportunity for our students to conduct research at these prestigious labs via internships and summer employment, and for faculty to engage in research collaborations there. Already, some BME researchers at LANL and SNL have appointments at UNM, and some groups of UNM professors and national lab scientists pursue joint research in biomedical engineering. The proposed BME program will stimulate an expansion of such engagements. These kinds of collaborative efforts, with these scientists *in particular*, are important because they expose UNM to the sort of difficult but important BME problems that are *only* being tackled at the national labs. Also, the local national laboratories (LANL and SNL) are enthusiastic about hiring graduates from the proposed program (Appendix A). The absence of a BME program at UNM is an impediment to realizing the above opportunities.

G. Promote UNM's stature in creating and applying new knowledge

The proposed program fits well with New Mexico's long-standing role in conducting cutting-edge science education and research. The proposed program will introduce a coherent curriculum that stimulates the creation of new knowledge and insights for new applications, both on and off campus. It will bolster the faculty's efforts in creating knowledge and developing new applications. In sum, the development of the BME program at UNM will help maintain and grow New Mexico's prominence in biomedical engineering.

If launched, this will be one of a very few BME graduate programs at federally-designated Hispanic Serving Institutions.

Medical sciences ($16.5 billion) and biological sciences ($9.2 billion) accounted for more than one-half of all R&D at universities and colleges in this fiscal year (*source*: NSF, Survey of R&D Expenditures at Universities and Colleges, FY07). These two fields have held the two largest shares of academia's R&D performance total throughout the survey's history. By establishing a new BME graduate program at UNM, we enable UNM to compete more effectively for these research dollars.

H. Improve the integration of research and education at UNM

UNM's lack of a BME degree program is contrary to the persistent requests of the National Science Foundation (NSF) and the National Institutes of Health (NIH), two important national funding agencies, that we integrate our research with education. Once the BME degree program is established, UNM will be in an improved position to do so, and thereby improve our success in securing research grants.

3.3 Duplication

There are no formal BME degree programs in New Mexico. The nearest institutions that offer BME degree programs are, to the north, University of Colorado at Boulder; to the west, Arizona State University; and to the east, University of Texas at Austin. UTEP is in the process of introducing a new advanced degree program in BME.

To maximize the effectiveness of any biomedical engineering degree program, the offering institution should be situated close to a medical school. UNM's main campus is contiguous with the UNM Health Sciences Center, and is the only such campus in the state so situated.

Chapter 4
Clientele, Projected Enrollment, and Recruitment Strategies

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4.1 Clientele

"Health and Biosciences" is one of six key "Career Clusters" in the state. It falls under the state-designated career path "Applied Research Engineering" (source: "*Work in New Mexico: New Mexico Career Clusters Guidebook*", State of New Mexico, 2006). Thus, the proposed program is strategically oriented to serve the needs of current and future industrial and government sectors of New Mexico.

BME students in this program are likely to come from a broad range of disciplines, such as health sciences, biology, biochemistry, chemistry, physics, engineering, or materials science. Also, we expect a significant number of students from existing biotech companies in the state, and from the three New Mexico-based government laboratories, SNL, LANL and the Kirtland Air Force Phillips Laboratory. National lab employees benefit from lab-sponsored mentorship and retraining programs, and these programs are likely to enhance the numbers of lab employees who decide to enroll.

The BME program will be consistent with state goals for equitable representation of various student groups. It is expected that the students in this program will reflect the present ethnic, gender and age make-up of the technical workforce in New Mexico. Biology, chemistry and chemical engineering programs have traditionally attracted a higher percentage of women than physics or other engineering disciplines. Thus, we expect that the proposed program will help recruit talented women to graduate programs at the SOE. Similarly, biology often attracts larger numbers of underrepresented students, and thus serves as a gateway program for introducing these students to scientific and engineering disciplines.

4.2 Projected enrollment and student credit hours

Table 4.1 shows the numbers of students projected to enroll in a master's or Ph.D. level BME program at UNM.

Table 4.1. Projected enrollment

Year	*New students*
1	14
2	15
3	16
4	17
5	18

The number of new students in Year 1 shown in Table 4.1 above are computed as the sum of 5 components, "A", "B", "C", "D" and "E". Details of these components are as follows:

A = number of current UNM graduate students who would have enrolled in a BME graduate degree program if they had had the opportunity when they first applied to UNM

Source: In the Spring Semester of 2010, 2 graduate-level classes were chosen at random within the Department of Chemical and Nuclear Engineering. The students were read the following, then asked for a show of hands:

"If UNM had had a master's or Ph.D. degree program in biomedical engineering when you first applied to graduate school here, would you have considered enrolling, at that time, in that biomedical engineering graduate program, rather than in the program that you did?"

Of 5 respondents in one class, 1 replied "yes" (20%); of 10 respondents in the second class, 3 responded "yes" (30%). The lower of these 2 percentages was then multiplied by the average number of graduate students entering the department annually over the past 5 years (~10), viz., 20% x 10 = 2.

B = number of UNM undergraduates in the Department of Chemical Engineering who, projecting forward to the day they receive their bachelors degree, have said they would consider pursuing an advanced degree at UNM in biomedical engineering if such a program was offered at the time of graduation

Source: Two upper-division undergraduate classes were chosen at random from within UNM's Department of Chemical and Nuclear Engineering (ChNE). The students were read the following, then asked for a show of hands:

"Some of you will graduate with a B. S. degree from UNM this May, and others in the next year or 2. Thinking forward to that time when you graduate, if UNM offered a master's or Ph.D. degree program in biomedical engineering, would you consider enrolling in that program?"

Of 19 respondents in one of the 2 ChNE classes, 13 responded "yes" (68%). Of 14 respondents in the second of the 2 ChNE classes, 3 responded "yes" (21%). An average of 15 students have been graduated each year from the Department of ChNE (*source*: Dept. of ChNE). The lower of these 2 percentages, 21%, was then multiplied by the average number of students who have graduated with bachelors degrees from the Department of Chemical and Nuclear Engineering over the past 5 years, viz., 21% x 15 = 3. This number was used as the number of expected enrollees for component "B".

C = number of UNM undergraduates in the Department of Biology who, projecting forward to the day they receive their bachelors degree, have said they would consider pursuing an advanced degree at UNM in biomedical engineering if such a program was offered at the time of graduation

Source: An upper-division undergraduate class in the Department of Biology was chosen by Biology Professor M. Werner-Washburne. The students of this class were read the following, then asked for a show of hands:

"Some of you will graduate with a B. S. degree from UNM this May, and others in the next year or 2. Thinking forward to that time when you graduate, if UNM offered a master's or Ph.D. degree program in biomedical engineering, would you consider enrolling in that program?"

Of 14 respondents in the class, 2 responded "yes" (14%). The average number of students who have graduated with B.S. degrees from UNM's Department of Biology over the past 5 years is 200 (*source*: UNM Department of Biology). To account for sampling bias, the observed percentage of positive respondents, 14%, was divided by one-sixth, and the resultant number multiplied by 200, to give an estimated number of biology-derived enrollees of 5.

D = number of New Mexicans employed in the biotechnology industry who are projected to enroll annually in a master's or Ph.D. degree in biomedical engineering = 2

Source: UNM estimate

E = number of New Mexicans employees in BME-related research at Sandia National Labs and Los Alamos National Lab who are projected to enroll annually in a master's or Ph.D. degree in biomedical engineering = 2

Source: UNM estimate

$A + B + C + D + E = 2 + 3 + 5 + 2 + 2 = 14$

The number of new students in Year 2 was computed by assuming that enrollment would increase by 5%, in Years 3 and by 4%, and in Year 5 by 3%.

As shown in Table 4.1, projected enrollment begins with 14 in the first year, and reaches 18 full-time students in the fifth year.

The projected credit hours of these students is given in Table 4.2. Typically students take between 18 and 24 credit hours per hour. Table 4.2 assumes the average number of credit hours to be 21.

Table 4.2. Projected student credit hours

Year	Projected number of students	Projected credit hours per year
1	14	294
2	15	315
3	16	336
4	17	357
5	18	378

4.3 Recruitment strategies

In view of the strong industrial and governmental laboratory support for the program, we expect to attract a continuous pool of applicants from these laboratories and businesses. Robust recruitment strategies will be implemented to attract these and other potential students. Such strategies will include:

- Maintaining a frequently updated web page that tells the story of the opportunities, accomplishments, and excitement of the program.
- Faculty presentations about the program at various technical meetings that are devoted to science and engineering education.
- Faculty visits to other institutions with potential sources of students.
- Mass mailings and e-mailings of flyers and other publicity materials about the program.
- Contact with our alumni and other potential benefactors through e-mail and open houses.

Chapter 5
Institutional Readiness for the Program

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5.1 UNM has prepared for this program in 4 critical areas

UNM's has made preparations for the proposed BME program in 4 critical areas:

- all necessary resources have been secured by UNM for the program
- all key stakeholders support the program
- there is a plan for the administrative structure of the program
- there are a set of procedures on how students enroll and meet their degree program requirements

The first three items above are described in the present chapter; the fourth item is discussed in Chapter 10.

5.2 All necessary resources have been secured by UNM for the program

The following necessary resources have already been secured by UNM in preparation for launching the new program:

A. UNM faculty are prepared and committed to teach BME students
B. Courses are already available for the new BME curriculum
C. UNM faculty are prepared and committed to mentor the research of BME students
D. There is adequate space for BME student research
E. There is adequate equipment for BME student research
F. There is adequate money to pay for BME student research
G. School of Engineering is prepared and committed to pay the salary expenses of Program Management
H. There is adequate space for the offices of the Director and staff

The above set of resources is a comprehensive list of expense-related items, which must be in-hand to avoid financial surprise. All the above items have been secured by UNM.

Details of these resources are as follows.

A. UNM faculty are prepared and committed to teach BME students

As a result of a special project funded by the legislature in 2007, 4 new faculty members were hired in 2007-8. These 4 were hired specifically for the BME graduate program proposed here. Along with 23 other professors, they now comprise the 27 faculty who are prepared and committed to bear the teaching load of a state-sanctioned, fully-fledged BME degree program. These 27 are drawn from all 5 departments of UNM's School of Engineering:

- Chemical and Nuclear Engineering
- Computer Science
- Electrical and Computer Engineering
- Mechanical Engineering
- Physics & Astronomy

The 27 faculty are listed in Appendix B. All have expressed a commitment to work in the new program as mentors, advisors, or course instructors. Most have committed to all 3 roles.

There are no headcount shortages at UNM that impede introducing the new degree program. UNM faculty are now in position and fully ready to teach all requisite master's level BME courses. The current budget has sufficient funds to offset instructional costs for faculty required to teach courses from their home departments.

B. Courses are already available for the new curriculum

Planned for the new curriculum are 5 core courses, 3 electives, a graduate seminar, a special topics course, and Master's Thesis. Details of these are provided in Appendix C. For years, UNM professors have been teaching several of the core courses, or very close variants (Table 3.3). Several existing courses have evolved to include instruction in BME, while keeping in mind plans for the BME graduate degree program. Hence, the amount of faculty effort to introduce these courses is minimal. Curricula vitae of instructors are provided in Appendix E.

Initially, the program will offer only one focus area, namely *Molecular and Cellular Systems*. Future focus areas will be added as need arises and resources are secured, in which case new courses are likely to be added to the program. Candidate new focus areas include *Biocomputing*, *Bioimaging*, *Biomechanics*, and *Bioelectrocatalysis and Biofuel Cells*. These four areas are of importance to UNM's biomedical engineering-oriented faculty, and for each there is faculty expertise within the School of Engineering to begin a new focus area. Future focus areas will be proposed by interested SOE faculty and will utilize existing courses where possible. If and when additional focus areas are initiated, it is anticipated that the initial and new focus areas will each be proposed as a separate *emphasis* within the degree.

To maximize the efficient use of faculty resources, we will cross-list many BME courses where appropriate. Cross-listing is useful when the subject of a particular course is relevant to more than one degree program. Typically a single instructor teaches the cross-listed course to students from outside his or her own department, and thereby achieves an economy of scale. In turn, students benefit from access to a larger number and more frequent offering of courses, which satisfy their department's degree requirements. Upon program approval, the Director will consult with relevant department chairs, and pursue the cross-listing of as many relevant courses as possible.

The administrative structure of the new program includes a Curriculum Planning Subcommittee responsible for fostering the development of new BME courses, and promoting revisions in the syllabi of existing courses as warranted, including more biomedical engineering content or application. In addition, the BME courses will be assigned separate BME codes with cross-listing in relevant departments. Credit for courses and faculty mentoring will be allocated to both the participating department and the BME program.

C. UNM faculty are prepared and committed to mentor the research of BME students

In addition to 4 new professors hired from special funding by the state legislature, UNM hired one new tenure-track BME professor and 4 research-track BME professors. With these recent additions, plus existing faculty already working and teaching in the area of biomedical engineering, the School of Engineering now has vibrant research programs in the following areas:

- Biocomputing
- Bioelectrocatalysis and biofuel cells
- Bioimaging
- Biomaterials for controlled interactions with biomolecules, cells and tissues
- Biomechanical engineering
- Biosensors, diagnostics and high-throughput bioanalytical systems
- Micro- and nano-fluidic systems for biomolecular separations

Moreover, there are now approximately 30 graduate students conducting BME research at UNM, and about 50 undergraduate students, all working in support of the seven research areas in the bulleted list above. UNM has thus attained a critical mass of BME researchers. UNM's 21 BME-affiliated faculty are prepared, committed and of sufficient numbers to mentor the research of students who want to pursue a master's degree in BME.

D. There is adequate space for BME student research

UNM's beautiful new Centennial Engineering Center is an outstanding facility for education and training of master's students. This 147,500 square feet, $42 million building opened Fall semester of 2008. Inside, the Center for Biomedical Engineering operates a contiguous 15,000 square foot state-of-the-art laboratory. Designed in accordance with best practices of industrial and large academic labs, the lab features a common area of lab benches, flanked by enclosed rooms in which large and/or sensitive equipment is located. Within the common lab area are 6 fume hoods, 9 sinks, a large number of cabinets, and 22 lab benches each ~20 feet in length. Currently about 30 students conduct research in this space. It is expected that an additional 30 students can be accommodated easily. In addition to the main lab, there are 2 satellite labs, the 1300 square foot Keck Nanofluidics Laboratory, and the 980 square foot CBME North Labs dedicated to bacteria culture and manipulation. We have plenty of lab space for the research of our anticipated BME master's students.

E. There is adequate equipment for BME student research

UNM has already invested heavily in a BME research program. It has done so with the intention of complementing a yet-to-be-launched BME academic program. Hence, the facilities and equipment in the CBME labs and satellite labs are already adequate for a wide-range of master's level research in biomaterials engineering, surface analysis, cell and tissue engineering, biosensors engineering, biochemical engineering, microfluidics engineering, and bacteria culture and manipulation.

Special facilities and equipment in the CBME labs are as follows:

(i) apparatus and materials for **biomaterials engineering and surface analysis**, including flow cytometry, ellipsometry, tensiometer, contact angle goniometry, circular dichroism spectrophotometry, surface plasmon resonance spectroscopy, UV/Vis spectroscopy, and various commercial and custom-built fluorescence spectrometers; a Zeiss LSM 510 confocal scanning laser microscope; 2 fluorescence microscopes; and electrophoresis equipment, including a Beckman Pace 5000 capillary electrophoresis instrument.

(ii) apparatus and materials for **cell and tissue engineering**, including laminar flow hoods, shakers, incubators, centrifuges, sonicators, cryogenic refrigerator, walk-in cold room, walk-in warm room, a BioSafety Level 2 room, Millipore ultrapure water systems, autoclaves, thermocycler, optical tweezers, hemocytometers, stereomicroscope, and conventional microscopes; researchers using the tissue culture facility are able to perform a wide range of standard mammalian tissue culture procedures;

(iii) apparatus and materials for **biosensors engineering** including metal evaporator, soft lithography processing station (with photoresist spin coater, Pirannha etch, bake oven, UV exposure lamp, wet station and UV mask aligner), high-precision mill, Biodot computer-controlled spotting system, knife plotter, fluorescence microscope and stereo microscope; thin film

engineering and characterization;
(iv) apparatus and materials for **biochemical engineering** including a complete set of organic and bioorganic synthesis equipment and fume hoods, probe sonicator, absorption spectrophotometer, high-pressure liquid chromatograph, and Langmuir trough, a horizontal biomaterials deposition trough, chemostats, instron, and protein adsorption apparatus; and

(v) an **optics laboratory** (~300 sq. ft.) that contains several optics tables, optomechanics, and optics.

In addition to the main 15,000 sq. ft. lab are: (i) the Keck Nanofluidics Laboratory with a full suite of equipment for **microfluidics engineering**; and (ii) the CBME North Labs, offering a full suite of equipment for **bacteria culture and manipulation**.

Finally, over the past twenty years, UNM has invested heavily in establishing other strategic centers of excellence, particularly CHTM (Center for High Technology materials), and CMEM (Center for Micro-Engineered Materials). These unique facilities provide access to an additional array of research equipment which can be tapped to support master's thesis projects. For instance, CHTM is particularly important in providing access to nanofluidics chip fabrication capabilities, whereas CMEM provides back-end semiconductor chip fabrication capabilities. These sophisticated resources are vital for conducting some of the biomedical engineering research being conducted at UNM today, and anticipated in the future.

F. There is adequate money to pay for BME student research

In the past 5 years, School of Engineering faculty have received more than $17,000,000 in competitive grants for biomedical engineering research (Table 5.2). The funding has been obtained from 16 different agencies, including the National Institutes of Health and the National Science Foundation. To date, the number of grant awards is 40.

This level of outside funding is more than adequate for sustaining the master's level research of an estimated 18 students in Year 5. Going forward, it is expected that such funding levels will either remain at the present level, or grow. We feel we are in an excellent to position to attract New Mexico's best and brightest students to this program, and thereby reduce the current brain drain.

The necessary support for graduate students will be in the form of Research Assistantships provided through externally funded research programs of program faculty or will be provided as arranged by the graduate students themselves (e.g., as part of their employment benefits).

G. School of Engineering is prepared and committed to pay the salary expenses of Program Management

The Director will be a tenured faculty member in one of the departments, and will draw 0.5 FTE. The Program Manager will draw 1.0 FTE. These fixed expenses will recur annually. The School of Engineering has secured recurring funds of $208,000 per year from the State Legislature to establish and operate a BME graduate degree program. These funds will be used to pay the salaries of BME faculty members who have been hired specifically to teach the Core courses in this concentration, and the staff -- Director and Program Manager -- that will enable this program. They will also be used to pay for program and course materials, recruitment, and administration of the program. During the initial phase, no additional funds will be requested from the UNM SOE to support the initial focus area within the BME concentration (Biomolecular and Cellular Systems).

SOE has committed to bear ultimate financial responsibility for the BME graduate program. A letter stating the commitments of the School of Engineering is found in Appendix D.

H. There is adequate space for the offices of Program Management

The program office will be co-located with the main offices of the Center for Biomedical Engineering. Separate offices are currently available for the Director and Program Manager. With the Center for Biomedical Engineering, the program office will share a conference room, kitchen area, mail facilities, photocopier, reception area, and storage area.

I. No new journal subscriptions are required

The field of biomedical engineering dates back more than 40 years, and has been a component of research at UNM's School of Engineering for at least 20 years. Hence, there are no new journal required which are not already within the library's list of current subscriptions, or are not already considered in the library's routine review and selection process. Current resources are considered adequate for the new program outlined here.

Table 5.2

Competitive grants received in biomedical engineering by UNM School of Engineering

Source	FY2004-5	FY 2006	FY 2007	FY 2008	FY 2009
National Science Foundation	$1,995,424				
National Science Foundation	$335,179				
Office of Naval Research	$300,000				
Air Force Office of Strategic Research		$3,499,760			
Office of Naval Research		$300,000			
Defense Threat Reduction Agency		$255,000			
Sandia National Laboratories		$50,000			
Sandia National Laboratories		$11,861			
National Science Foundation			$2,537,500		
Defense Threat Reduction Agency			$1,599,799		
Army Research Office			$450,000		
Sandia National Laboratories			$40,000		
Sandia National Laboratories			$10,000		
Future Technology Fund			$6,000		
Defense Threat Reduction Agency				$720,070	
National Institutes of Health				$683,804	
Defense Threat Reduction Agency				$423,000	
Office of Naval Research & Defense Threat Reduction Agency				$402,065	
National Science Foundation				$159,748	
National Science Foundation				$75,000	
Asemblon Inc.				$60,000	
Sandia National Laboratories				$40,000	
Science & Technology Corporation				$25,000	
American Cancer Society & UNM Health Sciences Center				$20,000	
Office of Naval Research				$15,000	
3M Corporation				$15,000	
American Chemical Society				$20,000	
Future Technology Fund				$10,000	
Oak Ridge Associated Universities				$5,000	
Los Alamos National Laboratory					$748,189
National Institutes of Health					$696,912
National Science Foundation					$476,899
National Institutes of Health					$343,461
National Science Foundation					$337,339
Office of Naval Research					$318,358
Defense Threat Reduction Agency					$200,125
Oak Ridge Associated Universities					$5,000
Office of Naval Research					$5,000
Total	$2,630,603	$4,116,621	$4,643,299	$2,513,939	$3,131,283
				Grand total	$17,035,745

Source: UNM Center for Biomedical Engineering Program Office

5.3 All key stakeholders support the new degree program

Critical to a successful launch of UNM's BME program is the support of all key stakeholders. This support has been obtained from the following five key stakeholders:

A. the students
B. the New Mexico Legislature
C. the faculty of the School of Engineering
D. the School of Engineering Administrative Committee
E. the Center for Biomedical Engineering

A. Students support the new degree program

There is strong student pressure for an education program at UNM that leads to BME degree credentials.

Planning for the new Centennial Engineering Center (CEC) building began over 20 years ago. Funding for the building came from a variety of sources, including severance tax bonds, general obligation bonds, state general fund surpluses, private support, and, quite remarkably, UNM students. A significant portion of the new Center's costs were borne by the students of UNM who voted in 2005 to increase student fees specifically to help fund construction of the new CEC building. It is a testament to the support of students that they helped fund a building whose purpose in part was to provide space for the proposed Biomedical Engineering graduate program.

For more than a dozen years, UNM faculty have taught various courses in biomedical engineering (Table 3.3). The large number of students enrolled in these courses is evidence of students' avid interest in BME, especially when one considers that none of the students had any prospect of receiving a BME degree at UNM or anywhere else in the state.

The relatively large numbers of students whose enrollment is shown in Table 3.3 is for courses taken *solely* as electives. Even within UNM's existing chemical engineering undergraduate major, many students now receive training that bestows upon them, at graduation, the B.S. degree in chemical engineering *with a concentration in biomedical engineering*.

Perhaps even more remarkable is that the student chapter of UNM's Biomedical Engineering Society now has over 40 active members at UNM. This Society is a national professional organization founded in the 1960s to promote BME research and education. (UNM's chapter is notable for high levels of participation by female and minority students.) Of course, none of UNM's members have any immediate prospect of receiving a degree in biomedical engineering. Undaunted, they have organized themselves into a society for the purpose of enhancing their prospective professional careers *in biomedical engineering*.

B. New Mexico Legislature supports the new degree program

In the New Mexico Legislature, there has been over a decade of support for biomedical engineering initiatives at UNM. Most of this support has been requested as part of UNM's long-term strategy to build in advance the capital infrastructure necessary for the new degree program, and to prepare UNM's faculty ranks for the new degree program, particularly with regard to assuming instructional and research mentorship responsibilities of the new program. Over many years, State House Representative Larry Larrañaga and former State Senator Diane Snyder have been particularly supportive in leadership roles among their fellow legislators. A highlight of this advance planning was the construction of the new Centennial Engineering Center. Planning for that building began over 20 years ago. A main source of funding for the $42 million building was the New Mexico Legislature. Just recently, HB2 of 2008 provided $200,000 for recurring funding to UNM's BME effort, SB611 provided $372,000 in non-recurring funding, and SB827 provided $400,000 in capital funding.

C. Faculty of the School of Engineering support the new degree program

In May 2009 the entire faculty of the School of Engineering reviewed plans for the Biomedical Engineering Graduate Program. By a nearly unanimous vote, the faculty approved moving forward with the plans. Naturally, the faculty wants to participate in one of the most technically, economically and socially important fields of study today, biomedical engineering. Their desire is unlikely to change any time soon, as the incentives to participate are large and growing.

D. School of Engineering Administrative Committee supports the new degree program

The SOE Administrative Committee is comprised of the Dean, Associate Deans and SOE Department Chairs. In August 2009, this Committee reviewed and voted on its top Special Projects priorities. BME was selected as the top priority for the School.

E. Center for Biomedical Engineering supports the new degree program

The UNM Center for Biomedical Engineering (CBME) is an interdisciplinary center that coordinates research activities in biomedical engineering among engineers, biologists and clinicians. The center has been instrumental in fostering research among disciplines and with the high-tech industry, hiring key BME-engaged faculty, and launching a highly successful outreach program for K-12 students. It has also been heavily involved with outreach to university-level females and under-represented minorities.

Establishment of the Center has been one among several strategic steps taken by UNM to achieve its goal of improving New Mexico's educational, research, and economic environment. The Center was launched in 2005 by the School of Engineering and the Office of the Vice President for Research and Economic Development. It has been supported under the auspices of the Office of the Provost's Areas of Marked Distinction/Opportunity Strategic Initiative. The Center has been one of several important driving forces behind the effort to introduce new BME educational opportunities at UNM. In particular, CBME has been active in driving the efforts of the School of Engineering to formalize the granting of a "Ph.D. in Engineering With Concentration in Biomedical Engineering". CBME has also been behind the present effort to secure state approval for a new master's degree in biomedical engineering. Naturally, the Center is fully supportive of the effort embodied in the present proposal.

5.4 State and university approval is the only missing element

A. The only missing element

The faculty that are needed are already here, the facilities are in place, the curriculum is designed, the space is allocated, the equipment is purchased, the funding is available, and there are students anxious for the program to begin.

What elements are missing? To launch this program, the single missing element is state and university approval.

B. UNM has been preparing for over 10 years to launch this new program

The present proposal is the result of a concerted effort by UNM leadership for more than 10 years. The absence of missing elements, other than HED approval, is the result of the successful execution of a strategic long-range plan, which included:

(i) raising the number of BME faculty to a critical mass;
(ii) constructing a new building on campus to house both the teaching and research portions of the new degree program;
(iii) gaining the support of the New Mexico Legislature; and
(iv) launching a new organization, the Center for Biomedical Engineering, and chartering it with the task of bringing the proposed program to fruition.

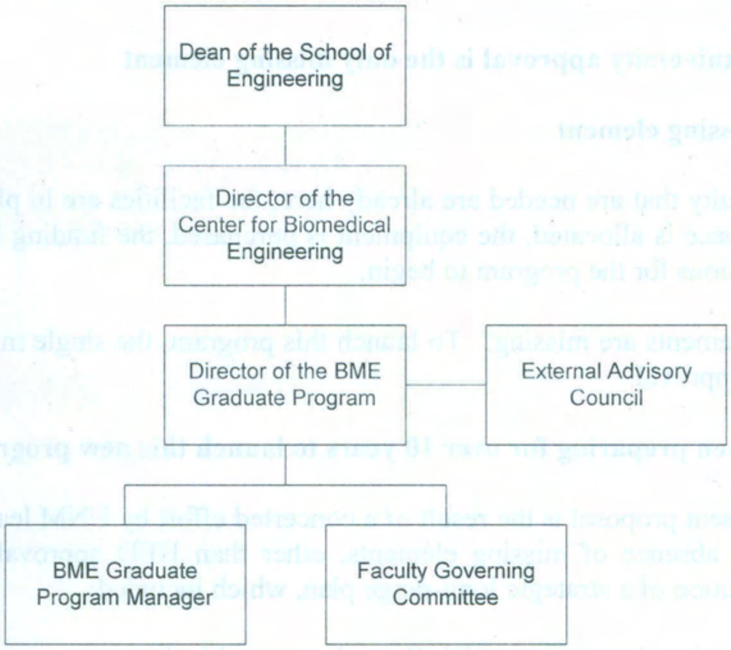
UNM is ready and committed to establish the proposed BME degree program. From the highest levels of the UNM administration, we have received approval and encouragement to develop this program and to commit all necessary resources to implement it. The BME program will build on the biomedical engineering research already in place at UNM. Much of the current research occurs through the Category III research center, Center for Biomedical Engineering. Additional work occurs at CHTM and CMEM, as well as individual and collaborative research projects and grants that cut across the various departments in the School of Engineering, the College of Arts and Sciences, and, especially, the School of Medicine. While we provide excellent research training for students at UNM, we lack a formal curriculum that leads to the credentials desired by many of our students and their prospective employers in private industry, academia, and federal labs.

5.5 Degree program administrative plan

To ensure a smoothly functioning program, we have carefully reflected upon and developed the following administrative plan.

A. Overall administrative structure

The administrative structure of the BME program is depicted as follows:.



B. School of Engineering

The proposed program is to be administered by the School of Engineering.

The primary reason for this program to be administrated by the School of Engineering is the quantitative mathematical approach that is required for an excellent BME program. This program will seek out interaction with the School of Medicine to provide medical relevance and some medical education. However, as BME is an engineering discipline it is appropriate to administer it from the School of Engineering where the appropriate engineering courses in mathematics, design, and engineering are easily taught. Joint administration of the program by both the School of Engineering and School of Medicine is not practical due to the differing class schedules where the School of Medicine uses classes structured in 2 to 3 week modules and the School of Engineering uses classes structured in 16 week lectures. Additionally, the proposed BME program is an engineering program where the emphasis is on training students to function in a research lab, development lab, or design and manufacturing site where mathematical models and deterministic phenomena are the norm. A biomedical engineer needs all the core coursework of the classic engineering curriculum, namely, chemical kinetics, heat and mass transport, thermodynamics, physics, structural mechanics, process control, information processing and statistics. This differs from a traditional medical education where students are trained to function in a clinic or hospital where stochastic phenomena and personal interactions with patients are a central feature of the workplace. Though there would be benefits to expose students to both types of instruction, a true hybrid curriculum of the two will fail to provide adequate training for either the aspiring biomedical engineer, or the aspiring medical practitioner, unless the length of training were to be extended significantly. And to do so would be quite untenable given the already long times needed by engineers and medical students to attain proficiency (4 to 6 years).

Though the program will be administered by the School of Engineering the BME program is working diligently to assure that a close partnership with the School of Medicine is attained to ensure that few boundaries exist between the biomedical engineering program and classical medical education. Also, to ensure the usefulness of the output of biomedical engineers, a regular dialogue and collaboration between engineers and those trained in medicine and the health sciences will be continuously pursued.

The administration of a BME program through the School of Engineering is similar to other universities around the nation. Of the approximately 80 BME degree-granting institutions in the U.S., most administer their BME programs through an engineering school. We are aware of only one BME program that is administered jointly by an engineering and medical school (A BME program is run jointly by the School of Medicine at the University of California at San Francisco in conjunction with the School of Engineering at the University of California at Berkeley).

In conclusion, we consider it both prudent and standard for the proposed BME program to be administered by UNM's School of Engineering.

C. Dean of the School of Engineering

The Dean of the School of Engineering is responsible for: (i) carrying out a yearly performance evaluation of the BME program, faculty in the program, and the Faculty Governing Committee; (ii) establishing policy and procedures for the BME Graduate Degree Program; (iii) approving revisions of the curriculum and other procedures for awarding degrees; (iv) appointing the Director; (v) appointing the members of the External Advisory Board; and (vi) serving as arbiter of faculty or student complaints.

D. External Advisory Board

The External Advisory Board will assist the Dean of the School of Engineering and the Director by providing broad oversight and recommendations on how the program should be improved. Ideally and probably, this Board will include members from other units at UNM, including the School of Medicine, College of Pharmacy, and the Science and Technology Corporation. It will also have representatives from regional research laboratories, such as Sandia National Laboratories and Los Alamos National Laboratory. Other representatives will be added at the discretion of the Dean. The Board will meet regularly once a year. The Director will nominate members of the Board for approval by the Dean.

E. Director and Staff

Minimum qualifications of the Director are a tenure track appointment in one of the participating departments, and active participation in biomedical engineering research. The Dean of the School of Engineering will appoint the Director of the BME degree program. The Director will report to the Dean of the School of Engineering. The Dean is responsible for carrying out a yearly performance evaluation of the Director. The Director will be allotted 0.5 FTE release time from established teaching responsibilities. Responsibilities of the Director are: (i) ensuring the overall success of the program; (ii) overseeing the activities of the Program Manager; (iii) providing timely and adequate communication to the Dean.

Reporting to the Director will be a full-time Program Manager. Responsibilities of the Program Manager are as follows: (i) maintaining student records from applications to graduations, and through post-graduation career follow-ups; (ii) monitoring and reporting on students' progress toward degree status; (iii) answering inquiries from prospective and current students, faculty and the public; (iv) coordinating outreach activities; (iv) responding to faculty requests; (v) assisting the Faculty Governing Committee with scheduling meetings and follow-up; and (vi) various other tasks under the direction of the Director, including administrative assistant. In consultation with chairs of participating departments, the Director will nominate for approval of the Dean all members of the Faculty Governing Committee and subcommittees.

F. Faculty Governing Committee

The BME Faculty Governing Committee will be comprised of faculty representing all the departments and centers affiliated with the BME program. Each faculty representative will be an active researcher in BME, or an active instructor of one or more courses listed under the BME course code. Each faculty representative will be selected by their respective department. A term of office will be three years. The Committee will have an official Chair and Vice Chair, to be nominated by the members for approval of the Dean. The Chair and Vice Chair will advise and report to the Director in the performance of several administrative functions, including: (i) developing proposals for changes in policy or practice that are then brought to the Dean; (ii) planning additional curriculum and symposium offerings as needed; (iii) assisting with recruitment; (iv) oversight of the Admissions Subcommittee's processing and dispensation of student applications; (v) assessment of course offerings to ensure curricular goals are met; (vi) planning the semester-by-semester and year-by-year timing of when courses are offered to minimize conflicts and ensure efficient progression of student coursework ; and (vii) assisting the Director with managing and resolving student or student-faculty conflicts and problems. Revisions in the program requirements and relevant courses will be proposed through a subcommittee of the Faculty Governing Committee. These revisions will be reviewed first by the Faculty Governing Committee and Director, then submitted for final review and approval of the Deane. By authority of the Faculty Governing Committee, the following 3 subcommittees will be initiated, each composed of representatives selected by the Committee:

(i) ***Admissions Subcommittee*** of the Faculty Governing Committee will review applications and admit qualified students to the BME master's degree program.

(ii) ***Curriculum Planning Subcommittee*** is responsible for planning course offerings each semester to ensure that students' needs for courses are met and prevent scheduling conflicts, and will encourage development of new courses to be added to the curriculum.

(iii) ***Graduate Subcommittee*** is empowered to make the final decision on pass/fail of the Master's oral examination that is recommended by a student's Committees on Studies. Students will be allowed at most two attempts to pass the Oral Exam. The Graduate Subcommittee will be the first body to review requests and appeals by graduate students who fail to pass examinations, or to resolve other conflicts on academic matters.

In addition to these sub-committees, The Faculty Governing Committee and/or the Director are also authorized to create short-lived, Ad Hoc Task Forces to study and advise on any issue deemed of importance by the Faculty Governing Committee, for example, program administration, curriculum, faculty participation, processes, procedures, etc.

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6.1 Substantial investments have already been made

Investments have already been made at UNM in 11 critical areas, as described in detail below.

A. Commitments to teach

The BME program will *not* require additional teaching faculty. All required instructors are already UNM faculty members, they have the appropriate skills and knowledge, and are already teaching the proposed core courses, or have committed to do so. A list of participating faculty is to be found in Appendix B.

B. Research mentors

As with all graduate degree programs at UNM, this program requires a substantial number of faculty to mentor the thesis research of enrolled students. *All such faculty are already at UNM.*

C. Office space

Standard UNM offices to house the BME Program Office, comprising the Director and

Program Manager, are already available and committed; no additional space is needed. Students actively engaged in their thesis research will be assigned cubicles in the existing graduate student bullpen adjacent to the main laboratory of the CBME, or to desks within the lab proper.

D. Specialized courses

Initially, the BME curriculum will consist of a carefully selected set of existing and new courses. The full set of courses are described below in Appendix C. In concert with the leadership and guidance of the Curriculum Planning Subcommittee, additional courses will be developed later to provide instruction on important but narrowly-defined topics of biomedical engineering, such as recent breakthroughs. These additional courses will also be offered as electives in the participating departments. The Curriculum Planning Subcommittee will review biomedical engineering courses offered at other New Mexico universities, and arrange with the host institutions to offer these through web-based methods or distance-learning technology.

E. Graduate teaching assistantships

Funding is *not* required for additional graduate teaching assistantships to support the BME program. Sources of funding will be pursued such as the U.S. Department of Education Graduate Assistance in Areas of National Need (GAANN). BME students interested in teaching will be supported through existing state-funded GA monies.

F. Research training facilities

UNM already has excellent BME research facilities and equipment that will be used in the training of BME students. These will be used in the performance of students' BME thesis research. The Center for Biomedical Engineering operates a contiguous 15,000 square foot laboratory suite in UNM's new Centennial Engineering Center (opened September 2008). Designed in accordance with best practices of industrial and large academic labs, the CBME lab features a common area of lab benches, flanked by enclosed rooms in which large and/or sensitive equipment is located. Within the common lab area are 6 fume hoods, 9 sinks, a large number of cabinets, and 22 lab benches each ~20 feet in length. Details of the equipment in this lab and elsewhere is found in section 4.1.E, above.

G. ***Salary expenses of director and staff***

The Director will be a tenured faculty member in one of the departments, and will draw 0.50 FTE. The Program Manager will draw 1.0 FTE. These fixed expenses will recur annually. They will be borne by the School of Engineering. SOE has committed to bearing ultimate financial responsibility for the BME graduate program. The present proposal has been developed under the auspices of the School of Engineering, and, once the program is launched, the School will continue to provide direct fiscal and programmatic oversight through the Dean.

H. Library resources

Due to the fact that biomedical engineering is among the most attractive new research areas in the sciences and engineering, there are a large number of journals and other resources that have sprung to life in the last few years. The needs for our program are much more selective. Although it is estimated that the total figure for library resources needed for this program is about $40,000, a good number of these journals are already available through our science and technology library. However, we are fully cognizant of the current crisis of the University Library System, given planned major budget cuts and current journal price increases for both hard copies and on-line subscriptions. Therefore, the BME program Faculty Governing Committee under the leadership of the Program Director will take the following measures to alleviate the situation as much as possible:

(i) Commit the BME program to find creative ways to obtain research resources or funding for those resources, some of which are identified below.

(ii) Establish a library resources review process to identify journal subscriptions that are relevant, and to prioritize which are most vs. least critical, and whether there are other sources (individual, departmental, center, LANL, SNL) for obtaining access to these media.

(iii) Strongly encourage faculty to post pre- and post-publication prints of publications in a community collection (UNM Dspace at Dspace.unm.edu) archive for use by and distribution to those who need access to these resources.

(iv) Take measures to ensure that all major and large biomedical engineering grants include a budget line to fund research information resources that are needed for the BME program students and faculty, and the University Library System agrees to use those funds to purchase and make those resources accessible to those who need them.

(v) With assistance from the External Advisory Board, investigate and pursue options for sharing information resources that are available to and at LANL and SNL, both through the Fair Use process and through formal collaborative agreements.

I. Laboratory course development, equipment and additional fees

Starting a new BME graduate program will *not* require allocating faculty time to develop laboratory courses. Nor will there be *any* need to procure lab course equipment. This is because the proposed program is at the master's level, a level at which lab courses are essentially non-existent due to the fact that each student conducts his or her own novel research under the one-on-one direction of a thesis advisor. (In the highly unlikely event that any such masters-level lab course were to be offered in the future, a flat fee per credit hour would be charged for high cost lab or computer equipment and materials; and the fee structure would be comparable to fees charged for engineering, physics and chemistry courses.)

J. Student support services

Student Support Services will not need to provide support beyond what is ordinarily provided to graduate students who are part of the UNM community.

K. ITS requirements

Information Technology Services (ITS) will *not* need to provide support beyond what is ordinarily provided to graduate students who are part of the UNM community.

6.2 Expected benefits of establishing the BME degree programs

A. Greater employability of New Mexico graduates

The immediate users and beneficiaries of this proposed program are current and incoming graduate students seeking advanced training in biomedical engineering. Graduates of the program will use their knowledge to discover new knowledge, start new businesses, and/or gain employment in existing biomedical engineering companies and labs. This will enhance the well being of all of NM.

B. UNM established as a leader in creating, disseminating and using new knowledge

If launched, this will be one of a very few BME graduate programs at Hispanic Serving Institutions. We can continue to take pride in our leadership in providing a vigorous and up-to-date education to our students.

C. Improved graduate student recruitment

The proposed BME program capitalizes on the national research reputation of the University in biomedical engineering. It will attract many high quality graduate students who wish to pursue a course of study in BME, especially those who wish to improve their knowledge and skills for positions in the national laboratories and industry. We find that many highly qualified graduate students have elected to go to elsewhere because UNM lacks a formal graduate degree program in biomedical engineering.

D. Attractiveness of a BME masters degree

The BME program will recruit students from various disciplines who want graduate training specifically in BME. These students will have a department home in the BME Graduate Program, not distributed among the various traditional departments. They will receive their BME master's of science degree from the BME Graduate Program. Since all participating faculty are affiliated with a UNM department, it is expected that the graduate students will also participate in seminars (and other academic functions) in their advisor's home department. The BME degree will provide career opportunities that are not as readily available with a traditional physical or engineering science degree program. The degree can also enhance career opportunities for students in traditional fields who take BME courses. Participating departments across the UNM campus can establish an area of concentration in BME and their students can take courses as electives for their traditional degree programs.

E. BME program will enrich undergraduate education

Undergraduate students cannot apply to a graduate level program, of course. However, establishing the BME program improves their opportunity to take BME graduate-level courses as electives. In turn, high-quality graduate elective courses in BME are likely to be effective in enticing UNM's top undergraduates to pursue an advanced degree in BME at UNM.

F. Attract high-quality faculty

The BME program will attract outstanding biomedical engineering research faculty to UNM. This will strengthen not only UNM departments but also the BME program. New faculty will enhance the excellence of biomedical engineering research at UNM, especially at the departmental level.

G. Greatly enhanced capacity to obtain research funding

Biomedical engineering is an important research arena with increasing opportunities for receiving priority funding from federal agencies. Because of the state-of-the-art research being conducted at the New Mexico national laboratories in biomedical engineering, and the collaborative programs already in place between UNM and national lab researchers, UNM occupies an excellent position to become one of the leading universities conducting biomedical engineering and offering a comprehensive BME-oriented course of study. The BME program provides an opportunity for the integration of research and education, which is an important criterion for research funding as it provides for broader impact.

H. Enhance the New Mexico economy

The establishment and growth of the UNM BME would provide a trained pool of talented BME researchers for currently existing New Mexico high tech businesses and the national labs. It could attract and provide a strong inducement for other high tech companies, new or old, especially those based on biomedical engineering, to locate in New Mexico.

The average annual pay of biotech workers nationally is $51,000. Local wages in biotech are comparable. For example, the average pay of 590 workers employed in Albuquerque at the Johnson & Johnson Ethicon Endo-Surgery facility is more than $67,000 (source: Angel Gonzalez, Albuquerque Plant Manager, Johnson & Johnson, personal communication). These wages bring about $40,000,000 per year directly into the state's economy.

I. Support the goals of the State of New Mexico Higher Education Department

The proposed program supports Strategic Priorities 2, 3 and 4 of the State of New Mexico Higher Education Department (HED) "Strategic Priorities and Goals 2006 - 2010". Within these three Strategic Priorities, the following 9 HED goals (quoted in bold type below) are specifically supported by BME (comments in italics):

HED Goal 2.5: Improve the recruitment and retention of high quality faculty and staff.

To date, the Biomedical Engineering Program has resulted in the recruitment of 5 new tenure-track faculty, and 3 research professors.

HED Goal 3.1: Recognize and fund the role of research in our state's economy.

To date, UNM's BME-affiliated professors have brought in grants totaling more than $17,000,000 (Table 5.1).

HED Goal 3.2: Align programs and services with statewide career clusters.

The career cluster with which the proposed program is aligned is specifically, the "Health and Biosciences" Career Cluster, career path "Applied Research Engineering", as described in the "Work in New Mexico: New Mexico Career Clusters Guidebook", August 29, 2006.

HED Goal 3.4: Improve collaboration between two and four year institutions to create programs that increase the number of educational opportunities for all New Mexicans.

Under the auspices of the Center for Biomedical Engineering, UNM has current, active collaborations with New Mexico Highlands University, San Juan College, New Mexico Tech, CNM, New Mexico State University and the Southwest Polytechnic Institute. In addition, we have research collaborations with Albuquerque Public Schools, TriCore Reference Laboratories, Sandia National Laboratory, Los Alamos National Laboratories, and others.

HED Goal 3.5: Support regional vitality by contributing artistic, cultural, and civic assets that attract employers and other residents seeking a higher quality of life.

Intel's decision to locate in NM was based in part because UNM had good programs in electrical engineering, chemistry, chemical engineering and physics (for a more detailed discussion, see section 3.1.B) . If the state doesn't have a program in BME, we will never make it on the short-list of bioengineering companies who are thinking about locating new facilities here.

HED Goal 3.6: Create funding mechanisms and support for collaborative technology projects that serve the needs of the state.

See notes under "HED Goal 3.4", above.

HED Goal 4.2: Create funding mechanisms that encourage research institutions to be top tier.

Currently there are no institutions in the State of New Mexico which offer a graduate degree in biomedical engineering, even though this a field of major competitiveness for the United States in the global economy, and virtually all other state universities in the U.S. offer such a program. Also, see notes under "HED Goal 3.1", above.

HED Goal 4.4: Develop incentives to keep our best New Mexico students in our state institutions.

No doctoral or master's program in biomedical engineering is offered at any *school in the State of New Mexico. For those students who are determined to live in New Mexico, and want training in biomedical engineering, their only choice is to create an ad hoc biomedical engineering program, taking whatever relevant courses they can find at UNM, and procuring whatever on-the-job training they can find. For virtually all students, this is impractical, inefficient, and burdensome. The central problem is that, as a consequence, New Mexico students tend to exit the state, or abandon their career plans in BME. The BME master's degree program is intended to remedy this precise problem.*

HED Goal 4.6: Support institutions' efforts to compete globally and to prepare their student to do so.

BME is a leading discipline that is not formally represented in New Mexico. The BME Program prepares students to compete in this burgeoning field. BME is a growing effort across the state. Also, see notes under "HED Goal 4.2", above.

Chapter 7
Summary of Costs and Benefits

The creation of a master's degree program ordinarily requires a substantial investment of money. However, nearly the entire investment has already been made by UNM over the past twenty years in new faculty hires, curriculum development, student training options, strategic centers of excellence, facilities, buildings, and collaborations with national laboratories and industry partners. ***The only significant remaining expenses are the annual salaries of the Director and the Program Manager.*** Details of the projected expenses are given in Table 7.1.

Table 7.1
Resource Allocation/Reallocation Table

Resources		*What is needed*	*Who pays/ paid for it*	*Recurring*
1.0 Faculty Salaries		$119,368	SOE	yes
2.0 Student Fellowships		Student research fellowship stipends	Competitive research grants	yes
3. Staff	Sr. Program Manager + Academic Advisor	SPM @ 0.15 FTE ($9,584) AA @ 1.0FTE ($35,000) + 5% increase/year	SOE	yes
4.0 Fringe Benefits		$46,169	SOE	yes
5.0 Office Supplies		$3,000/year	Provost, SOE	yes
6.0 Office Equipment		$2100/year	Provost, SOE	yes
7.0 Library Resources		$10,000 Y1, then $7K/year	SOE	yes
8.0 Other	Director	0.5 FTE position ($52,500) + benefits ($15,750)	SOE	yes
	Teaching Laboratory	Not needed	N/A	no
	Office Space	Standard offices for Director and Program Manager	SOE	yes
	Student recruitment materials, mailing, travel	$10,000	SOE	yes
	Web site development and maintenance	$10,000	SOE	yes

A Director of the program has been named. To launch the program, there is nothing left to do but hire the Program Manager, and begin accepting applications from students.

We expect the BME program will benefit from significant continued funding from the

NSF and NIH to BME faculty members, plus support from industry, national labs and other UNM benefactors. We believe continued vibrant research funding will ensure that the degree program will be maintained at a level that is commensurate with other SOE degree programs.

Benefits of the new program are:

- Training of students for BME jobs already in New Mexico
- Creation of economic growth in New Mexico
- Satisfy students' strong demand for BME training
- Retain talented New Mexico resident workforce
- Enhance collaborations with local national laboratories
- Promote UNM's stature in creating and applying new knowledge
- Improve the integration of research and education at UNM
- Enhance UNM student and faculty recruitment

If the program is launched, UNM will join the ranks of 37 out of 50 other flagship state universities who already offer graduate degrees in biomedical engineering.

Given the significance of the BME degree program, it is clear that the academic and research benefits to UNM and the School of Engineering far outweigh the costs. Most of the required funding of the Biomedical Engineering M.S. degree program is *already covered* from existing resources that are available to participating departments from the college offices and other sources. The BME program fits well into the existing framework of science and engineering courses, and within all budget constraints on campus.

Chapter 8
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Program quality will be comparable or better than the standards of all M.S. programs in the School of Engineering. The Faculty Governing Committee will establish metrics and a process for evaluating quality goals. To maintain the highest quality program possible, the following areas will receive special attention by the Director, program manager, affiliated faculty and Faculty Governing Committee:

Students. Admission standards and requirements for completing the M.S. will meet or exceed the requirements of the departments in the School of Engineering. Details are provided in Chapter 8 on the requirements students must meet to gain acceptance into the program, and to obtain the M.S. degree.

Faculty. The field of biomedical engineering is currently at the forefront of scientific research, and advancing rapidly. It is imperative that BME faculty possess expert knowledge of the current state of BME research and its applications. The faculty will consist mostly of professors from SOE.

Research Facilities and Equipment. Participating faculty and departments will continually seek funding to upgrade the BME facilities and equipment with grant proposals to federal, state and private funding sources.

Course Curriculum. The BME curriculum has been carefully developed to ensure that it is of the highest academic quality. The curriculum is currently comprised of a total of 9 courses, 6 of which are courses that are already taught on campus; and 3 new courses. Initially, the program will offer only one focus area, namely *Molecular and Cellular Systems*. Future focus areas will be added as need arises and resources are secured, in which case new courses, both core and elective, are likely to be added to the program. SOE faculty have identified at least 4 candidate new focus areas: *Biocomputing, Bioimaging, Biomechanics and Bioelectrocatalysis and Biofuel Cells.* The present proposal is explicitly designed to allow the development and introduction of other focus areas, and to accommodate changes in the field in the years to come.

All students must complete the 5 core lecture courses (3 credit hours each for a total of 15 credit hours), and then complete electives from a large cross-listed selection. No courses remain under development, therefore there is no requirement of faculty release time. To ensure continued high quality in course offerings, proposals for new courses in any of the categories will be encouraged to enhance the curriculum in terms of new developments in BME. These proposals will first be reviewed and approved by the BME Curriculum Planning Subcommittee, then the Faculty Governing Committee and ultimately by the Dean.

Instruction. To ensure high quality instruction, there will be a constant and productive interplay between lectures and graduate thesis research projects.

Student and Faculty Group Identity. A characteristic of all successful graduate programs is a sense of group identity among students and faculty. Typically, newly-launched programs must strive to cultivate this sense of identity. In the present case, however, the work of cultivating an identity is largely *completed* as a result of three events:

(i) the start-up in 2007 of the new Center for Biomedical Engineering, which brought together approximately 20 faculty from 8 departments within SOE, the School of Medicine, and the College of Arts and Sciences;

(ii) the construction and occupation in 2008 of the new Centennial Engineering Center by many of the faculty who have now committed to being part of the BME graduate program, and by their students; and

(iii) the series of meetings and other prior planning activities by the affiliated faculty which resulted in the BME curriculum proposed here.

Together, these 3 events have produced an authentic sense of group identity among students and faculty. It is important that this continue after the program has been launched. To ensure this, various additional activities will be planned and organized by the Director. These will include speakers' events followed by receptions, symposia with research presentations by BME faculty and graduate students, and an Annual BME Symposium. Such events will provide an opportunity for faculty and graduate students to highlight research and academic work on campus to external constituents, particularly the regional federal laboratories and industry liaisons. Students will prepare posters to showcase their research and be given opportunities to visit with guest speakers. Other events will include planned group trips to professional conferences, local and regional cultural and recreational events and activities, and a potluck picnic. Interactions will also be encouraged outside the classroom or laboratory among the BME students with as many participating BME faculty as possible, such as visits to industry locations, particularly start-up companies.

Chapter 9
Assessments of Operations and Impact

The assessment of the BME program will conform to the guidelines that govern all other graduate programs at the University of New Mexico. In consultation with the Dean, the BME Director will establish the goals for the program, and the process for assessing the extent to which goals are achieved. The Director and Faculty Governing Committee will arrange for external reviews by panels of distinguished members in the biomedical engineering academic and industrial research communities. It is anticipated that these reviews will be conducted as part of the graduate reviews that are scheduled periodically. The assessments will be performed by the Program Manager under the supervision of the Director. Results will be submitted in the form of a written report to the Faculty Governing Committee and the Dean.

Assessment criteria will include the following:

(i) Development of new knowledge, and maintaining a leadership role for UNM: Number of research grants awarded to faculty, fellowships awarded to students, publications by faculty, publications by faculty co-authored with students, applications and proposals awarded for patents and trademarks, conferences attended by faculty and students, and presentations given by students and faculty.

(ii) Application and admission records: how many students applied, their qualifications, which students (high/mid/low quality) were accepted, and which of those enrolled.

(iii) Enrollment and grade records: Tracking enrollment and grades of students in the BME program, and their career development activities.

(iv) The number of students that receive BME graduate degrees; and of those, how many go on to secure academic, industrial or federal positions in New Mexico, elsewhere in the nation, and abroad.

(v) Conducting and assessing student evaluations of each course and lecture period as well as each instructor at the end of each semester, with anonymous results provided to each instructor and to the Director.

(vi) Metrics on how well the BME program prepares its graduates for positions in the field. The External Advisory Board may be asked to conduct on-site assessments and report the results to the Dean, with recommendations for improvement.

(vii) Development and implementation of a formal one-on-one exit interview procedure to solicit comments, criticism, and recommendations from each program graduate before they leave campus.

(viii) Creation of and results of a tracking program to monitor the post-graduation careers of the BME program graduates and to conduct periodic surveys to determine the impact that participation in the program has had on their careers, as well as on the careers of faculty participants.

Chapter 10
Admission Criteria and Requirements for the Master's Degree (M.S.)

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10.1 Overview

To serve the diversity of backgrounds and interests of students, two plans are offered leading to the M.S. degree in BME. Plan I requires the student to conduct research, to write a research thesis, and to complete coursework. Plan II is generally intended for students working full time in industry or the national labs, and requires only coursework and successful passage of an oral examination. Plan I, but not Plan II, is recognized to be preliminary to advancement to candidacy for the Ph.D. degree in Engineering. If a successful recipient of the master's degree is later admitted to the Ph.D. program, they must pass the standard Ph.D. examination, regardless of whether their M.S. was earned under Plan I or II. The Admissions Subcommittee of the Faculty Governing Committee will decide under which Plan a student is to be admitted.

10.2 Degree Requirements

A. Admission prerequisites

General admission requirements given in the Graduate Program of the UNM Catalog apply to the BME master's degree program. An applicant must hold a bachelor's degree from an accredited institution, and have a scholastic average of B (at least 3.0 on a 4.0 scale). Admission decisions are based on a consideration of the applicant's undergraduate grade point average, letters of recommendation, and Graduate Record Examination scores. Applicants who plan to apply to the BME program must have a bachelor's degree in a natural science or engineering field. A sophisticated level of mathematical ability is expected, at least through differential equations.

Those who meet all requirements except mathematics, but are otherwise well prepared, can meet the mathematics requirement by completing Math 316 during the first semester with a B or better, or by taking and passing with a B or better an equivalency test that certifies sufficient competency in mathematics.

B. Application process

To apply, domestic applicants must complete and submit the on-line application form with a $50 nonrefundable application fee and two unopened official transcripts to the Office of Graduate Studies (OGS) by the annual deadline January 31. OGS will forward these materials to the BME Program Office for the Admissions Subcommittee review and selection. In addition, applicants must submit the following directly to the BME Program Office:

a. letter of intent from the applicant about why this program is of interest

b. three sealed letters of recommendation, sent directly to the BME Program Office

c. GRE entrance examination scores

d. any other materials that are relevant to the application, such as experiential credit

International applicants must submit additional materials as identified in the Catalog to the UNM International Admissions Office, including undergraduate education documents, demonstrated proficiency in English, and evidence of adequate financial resources and health insurance.

C. Admission and advising roles

All applications will be reviewed to determine whether all required materials have been submitted. Applicants will then be contacted immediately to communicate whether the application has been formally accepted or awaits receipt of additional required items. The Admissions Subcommittee of the Faculty Governing Committee will review applications and make admission decisions. Applicants who are selected will be sent a notice of acceptance and program information to guide them in making decisions as they complete their studies and degree programs. This includes whether they qualify for fellowships, how they can apply for fellowships, and details of matriculation, such as obtaining a student identification card, and procedures for enrolling in classes.

(i) Selecting a Faculty Advisor/Mentor. Students will be sent information on how to select a faculty mentor. Once selected, the mentor will guide the student in the process of establishing a Committee on Studies. To facilitate this process, faculty will present their areas of research at the beginning of each fall semester, and indicate how many students they can support within their research groups. Students will indicate their choice of research areas, and based on openings available and student interest, assignment of students to research groups will be made. The Admissions Subcommittee will facilitate this process.

(ii) Committee on Studies. The student and faculty mentor will invite three faculty members to serve on each student's Committee on Studies. This Committee will guide the student in planning a list of courses that meets the student's interests and needs (known as a Program of Studies), which will be counted toward meeting the degree requirements. This plan

must be approved by the student's advisor and the BME Director prior to submission to the OGS. The Committee will also supervise the student's progress, and it will conduct the required thesis exams.

D. General degree completion requirements

The average time to achieve an M.S. degree is expected to be 18-24 months. The maximum time for a student to spend working towards the M.S. degree is 7 years. All students in the program must be enrolled full time for at least three consecutive semesters, unless a written request for a waiver is approved by the Dean. To be a full time student, 9 credit hours must be taken per semester, or 6 credit hours if the student has an assistantship. Students must complete 4 core courses, and 4 courses within BME. Students must maintain a minimum cumulative grade point average of 3.0 in graduate-level courses taken in graduate status, and a grade point average of at least 3.0 for courses listed in the Program of Studies. Students cannot graduate with Incompletes pending, nor while on probation.

Two types of degree programs are offered, a thesis-based program (Plan I), and a course-based degree program (Plan II). Details of these two plans are as follows.

E. Completion requirements of a thesis-based M.S. degree (Plan I)

The minimum requirements for the thesis-based M.S. include 6 hours of thesis credit (BME 599) and 24 hours of course work that must include 18 hours of mandatory courses, as approved by the Committee on Studies, and at least 3 hours from the electives such as those listed below. Plan I automatically meets the requirement of at least 12 hours of course work at the 500 level or higher, exclusive of thesis credit, as stipulated by the UNM Catalog for this plan.

Plan I students must consult with one or more faculty members prior to selecting the topic of their thesis research. Final selection of their topic must be approved by one or more faculty members who agree to mentor the student's research. The student's Thesis Committee must approve the topic before the student begins work.

Copies of a student's completed M.S. thesis must be provided to each Thesis Committee member. Once approved by the Committee, the student must give an oral defense of the thesis in a presentation to the Thesis Committee to which other interested members of the university and general public have been invited.

F. Completion requirements of a course-based M.S. degree (Plan II)

The minimum requirements of the Plan II Course-Based M.S. degree program include 33 hours of course work for credit, with at least 24 hours drawn from the list of BME required and elective courses and 3 hours of research seminar/problems course. At most, 6 hours of *400 level SOE courses are allowed. Also, at least 12 hours of course work should be at a 500 level or higher, as stipulated by the Catalog for this Plan. All students in the Plan II M.S. degree program must pass an Oral Examination. This examination is administered by the student's Committee on Studies. The purpose the Examination is: (i) to determine the extent to which the student has attained knowledge of the subject matter of his or her BME courses; and (ii) to decide whether the student's knowledge meets a level appropriate to a Plan II master's degree in biomedical engineering. Subsequent to the Oral Examination, the student's Committee on Studies decides on a recommendation that is then forwarded to the BME Graduate Subcommittee. The Subcommittee makes a final pass/fail decision. Students are allowed no more than two attempts to pass the Oral Examination.

10.3 Other Details and Problem Resolutions

A. Notice of Intent to Graduate.

Students who expect to graduate must submit their intent to the BME Program Office and the Office of Graduate Studies early in the semester of graduation: October 1 for Fall Semester, March 1 for Spring Semester, and July 1 for Summer Semester.

B. Catalog Details About Meeting Degree Requirements.

The Catalog provides significant details about requirements that master's candidates must meet to complete their degree, which apply equally for students in the BME Graduate Degree Program. These include what is necessary if a student wishes to defer entry into the program, or have a leave of absence, or to have credits transferred, or issues regarding academic standing or petitions to modify academic requirements.

C. Requests for Changes in Advisor or Committee Member, and Appeals of Decisions.

In the event that issues arise between a student and a committee member (Committee on Studies, Thesis Committee, Dissertation Committee) at any time, students are encouraged to speak with their advisor/mentor to determine whether a change is needed and they will consult with the Director of the BME Program before implementing a change in committee membership. All such communications will be maintained in strict confidentiality. If a student experiences conflict with their faculty mentor/advisor, they are expected to speak with the Director of the BME Program, who will determine whether the Graduation Committee should be asked to intervene and seek a solution. The Dean will be informed about all such requests and incidents.

All decisions regarding approval of the dissertation and passing the defense, can be appealed to the Director and the Graduate Subcommittee, who will follow the *Graduate Student Academic Grievance Procedures* described in the Catalog. The Dean will be advised about the situation and may elect to assist with mediating a dispute.

10.4 Graduate Degree Program Curriculum

The BME curriculum is comprised of 5 core courses, 3 electives, a graduate seminar, a special topics course, and Master's Thesis. In addition, cross-listed electives will also be available. Many of the necessary courses for the BME curriculum are already taught on campus, and some of these have been revised in response to the need to teach biomedical engineering. The proposed Catalog Materials are in Appendix C.

Initially, the program will offer only one focus area, namely *Molecular and Cellular Systems*. Future focus areas will be added as need arises and resources are secured, in which case new courses, both core and elective, are likely to be added to the program. SOE faculty have identified at least 4 candidate new focus areas: *Biocomputing*, *Bioimaging*, *Biomechanics*, and Bioelectrocatalysis and Biofuel Cells. The present proposal is explicitly designed to allow the development and introduction of other focus areas, and to accommodate changes in the field in the years to come.

A. *BME Program Core courses*

The BME core courses offer a fundamental introduction to the concepts of biomedical engineering. The suggested prerequisites for the core courses are modern physics, general chemistry and differential equations. The set of courses proposed here will cover students' needs in terms of the core required curriculum.

Biomedical Engineering (BME) Core Courses

BME 517. **Applied Biology for Biomedical Engineers.** (3)
Emphasis on engineering principles and analysis of: (i) the cell as a complete system including cellular subsystems, structures and functions; and (ii) select higher order systems of human physiology. Restriction: Permission of the instructor. {Fall}

BME 544. **Mechanics and Thermodynamics of Molecular Components in Cells.** (3)
Chemical thermodynamics and physics are used to establish a material science perspective of the molecular components – chemical kinetics – and structural properties needed for both understanding cell behavior and advancing biotechnology. Restriction: Permission of the instructor. {Fall}

BME 547. **Biomedical Engineering Research Practices.** (3)
Students will develop research, presentation, and scientific writing skills for theses, proposals, invention disclosures and journal articles. The course includes oral presentations, case studies of research ethics, technology transfer and manuscript preparation. Restriction: Permission of the instructor. {Fall}

BME 556. **Protein and Nucleic Acid Engineering.** (3)
Students will learn the scientific principles and methods for engineering and manufacturing custom proteins, peptides, nucleic acids, and carbohydrates. The course will explicitly discuss methods and tools used in the production of engineered biomacromolecules. Restriction: Permission of the instructor. {Spring}

BME 558. **Methods of Analysis in Bioengineering.** (3)
Presents applied analytical and numerical mathematical methods in the context of biomedical engineering problems. Introduces statistical methods for the design of experiments and analysis of experimental data in research and development activities. Restriction: Permission of the instructor. {Spring}

BME 567. **Biomedical Engineering Seminar.** (1)
Students will gain insight into scientific presentations and current biomedical engineering research by presenting their research and actively participating in an external research seminar which will feature outstanding external and internal researchers as speakers. Restriction: Permission of the instructor. {Fall, Spring}

BME 598. **Special Topics**

BME 599. **Master's Thesis**

B. BME Program Elective Courses

Biomedical Engineering (BME) Electives

BME 570. **Physical Bioanalytical Methods.** (3)
Introduction to the physics and chemistry of classical physical methods of analyzing biological and biologically-related samples. Topics include fluorescence microscopy, chemiluminescence, chromatography, electrophoresis, mass spectrometry, electrochemistry, ultracentrifugation, SPR, SEM, TEM, AFM, XPS, radiochemistry and flow cytometry. Restriction: Permission of the instructor. {Fall}

BME 572. **Biomaterials Engineering.** (3)
Introduction to biomaterials currently in use, including commercial and research applications. Includes an understanding of a material's properties, biological responses to the materials, clinical context of their use, manufacturing processes, and regulatory issues. Restriction: Permission of the instructor. {Fall}

BME 579. **Tissue Engineering.** (3)
A review of the current strategies involved in the design of engineered tissues and organs. The principles underlying the implementation of selected cells, biomaterial scaffolds, soluble regulators, and culture conditions will be addressed. Restriction: Permission of the instructor. {Spring}

C. General Electives.

UNM offers numerous courses of direct relevance to the subject matter of biomedical engineering, including the following:

BIOL ** 351 **General Microbiology**
BIOL 547 **Advanced Techniques in Light Microscopy**
BIOM507/BIOL 581 **Advanced Molecular Biology**
BIOM508/BIOL 582 **Advanced Cell Biology**
BIOM 509 **Principles of Neurobiology**
BIOM 510 **Physiology**
BIOM 514 **Immunobiology**
BIOM 515 **Cancer Biology**
BIOM 516 **Molecular Genetics and Genomics**
CHNE/NSMS 522L. **Fundamentals of Nanofluidics**
CHNE/NSMS 530 **Surface and Interfacial Phenomena**
CHNE/NSMS 538/438. **Biosensors Fundamentals and Applications**
CHNE 504 **Nanomaterials**
CHNE 521 **Advanced Transport Phenomena I**
CS 529 **Introduction to Machine Learning**
CS 530 **Geometric and Probabilistic Methods in CS**
CS 561 **Algorithms and Data Structures**
CS 590 **Topics: Complex Adaptive Systems**

ECE 510 **Medical Imaging**
ECE 500 **Theory of Linear Systems**
ECE 533 **Digital Image Processing**
ECE 537 **Foundations of Computing**
ECE 539 **Digital Signal Processing I**
ME 501 **Advanced Mechanics of Materials**
ME 504 **Computational Mechanics**
ME 512 **Intro to Continuum Mechanics**
ME 530 **Theoretical Fluid Mechanics I**
ME 571 **Advanced Materials Science**

Upon program approval, the Director will consult with relevant department chairs, and pursue the cross-listing of as many relevant courses as possible.

Appendix A
Letters of support

1. New Mexico Biotechnology and Biomedical Association (NM Bio)

   Signed by: Dr. Shannon Sheehan, President

2. Sandia National Laboratories

   Signed by: Dr. J. Stephen Rottler, Chief Technical Officer, Vice President of Science and Technology

3. Los Alamos National Laboratory

   Signed by: Dr. I. Gary Resnick, Division Leader, Bioscience Division

4. University of New Mexico School of Medicine

   Signed by:
   Dr. Deborah Helitzer, Associate Dean, Biomedical Research Education Program
   and
   Dr. Helen Hathaway, Program Director, Biomedical Sciences Graduate Program

NMBIC

January 22, 2010

Arup Maji, Ph.D.
Interim Dean, School of Engineering
University of New Mexico
Albuquerque, New Mexico 87131

Dear Interim Dean Maji,

As President of The New Mexico Biotechnology and Biomedical Association (NMBio) I am pleased to declare my support of the University of New Mexico's proposal for a new graduate program in biomedical engineering.

The mission of NMBio is perfectly in alignment with the main goal and outcome expected of the new degree program, namely, the in-state training of students in the area of biomedical engineering. This will provide a local source of graduates, enhance the economic productivity of biotech companies already located here, and create a more favorable environment for both the start-up of new biotech companies, and the relocation of existing companies to New Mexico.

In specific, let me note our main common goals with UNM's proposal:

(i) to enhance the ability of New Mexico workers to find well-paying jobs in the fields of health care and biomedical engineering;

(ii) to stimulate New Mexico's economic development through new commercial opportunities in biotechnology; and

(iii) to attract and build biotech companies by advancing the quality and availability of bio tech workers in New Mexico.

Naturally, I lend my full support to bringing this new program to fruition.

Sincerely,

Shannon Sheehan, Ph.D., M.B.A.
President
New Mexico Biotechnology and Biomedical Association

www.nmbio.org

Sandia National Laboratories

Operated for the U.S. Department of Energy's
National Nuclear Security Administration
by **Sandia Corporation**

P.O. Box 5800
Albuquerque, NM 87185-0351

P.O. Box 969
Livermore, CA 94551-0969

Dr. J. Stephen Rottler
Chief Technology Officer
Vice President of Science and Technology

Phone: (505) 844-3882
Fax: (505) 844-4394
Internet: jsrottl@sandia.gov

February 15, 2010

Arup Maji, Ph.D.
Interim Dean, School of Engineering
University of New Mexico
Albuquerque, New Mexico 87131

Dear Dr. Maji:

I am writing this letter to endorse the development and implementation of a graduate program in Biomedical Engineering at the University of New Mexico. Though biomedical engineering is a growing element of our state's economy, no university in New Mexico offers graduate degrees in Biomedical Engineering. This forces New Mexico students to leave the state after receiving their Bachelors degree, creating a risk that they will not return to employment upon completion of their academic career.

Sandia National Laboratories employs staff at all degree levels, but we typically seek technical staff that have completed at least one graduate degree in engineering or science. We believe graduate degrees provide the training required and are an excellent indicator of preparedness to work on the challenging problems we are called upon to address. Further, as you know, we seek strategic partnerships with universities to fill gaps in our capabilities, perform joint research and development projects that have national impact, create a pool of future employees, educate on-roll employees, and build a constituency within the state and university. We are pleased to count UNM among the small number of universities with whom we have such relationships, and believe that development of the proposed degree program will be of value to our relationship.

A high quality graduate degree program in Biomedical Engineering at UNM would be of benefit to the State of New Mexico, as well as Sandia National Laboratories and other employers in the state, and I am supportive of your effort to establish such a degree program.

Sincerely,

Steve

Exceptional Service in the National Interest

Los Alamos
NATIONAL LABORATORY
EST. 1943

Bioscience Division
P.O. Box 1663, MS-M888
Los Alamos, New Mexico 87545
505-667-2690/Fax 505-667-8339

Date: February 9, 2010
Refer To: BDO-10-010

Arup Maji, Ph.D.
Interim Dean, School of Engineering
University of New Mexico
Albuquerque, New Mexico 87131

Dear Interim Dean Maji,

I am delighted to declare both my personal support and the support of the Los Alamos National Laboratory for the Biomedical Engineering Graduate Program at UNM you are proposing for approval by the New Mexico Health and Education Department. This degree program is precisely what we need to find and recruit new employees who strengthen our competency in this nationally-important and burgeoning area of research.

Biomedical engineering is at the core of our large and on-going efforts to fight bioterrorism, and it is one of the growth areas at Los Alamos. For example, we currently host the National Flow Cytometry Resource and have a large program in affinity reagents and biosensors. We avidly seek new graduates, but are keenly aware of the absence of any biomedical engineering degree program in the entire State of New Mexico, which makes it virtually impossible for us to find New Mexico graduates with the right training. Naturally, we are highly motivated to see this critical gap filled. We lend our fullest support to UNM's initiative to launch this new program.

Sincerely,

I. Gary Resnick
Division Leader
Bioscience Division

Cy: file

UNM
SCHOOL of MEDICINE
Biomedical Research Education Programs

Deborah L. Helitzer, Sc.D.
Associate Dean for Research Education

Helen J. Hathaway, Ph.D.
Director, Biomedical Sciences Graduate Program

October 5, 2010

Arup Maji, Ph.D.
Interim Dean, School of Engineering
University of New Mexico
Albuquerque, New Mexico 87131

Dear Interim Dean Maji,

The UNM Health Sciences Biomedical Research Education Program (BREP) and Biomedical Sciences Graduate Program (BSGP) lend their enthusiastic support to your proposal to launch a new Biomedical Engineering Graduate Program (BMEGP) within the UNM School of Engineering.

We consider the proposed graduate program to be an important and vital adjunct to the medical school's BSGP, which we oversee. Indeed, the two programs and curricula are complementary, and together will substantially enhance the quality of education at UNM. Although the program names are similar, the emphasis of each program and the courses offered are different: our program has a strong emphasis on the biomedical-oriented training of graduate students, whereas your proposed new program in the School of Engineering has a strong emphasis on the engineering-oriented training of graduate students. With the two programs, UNM can offer a breadth of educational opportunities for both cohorts of students. We fully expect to maintain collaborative ties between faculty members of the two programs and use our complementary approaches to learn from each other. We believe the result of our shared interests and expertise will strengthen the quality of both programs.

Over the past several years, we have been kept abreast of the plans of the School of Engineering to launch this program. Communication has been facilitated by regular meetings with the Director of the BMEGP, Professor Steven Graves, and by occasional meetings with the former Director of the SOE Center for Biomedical Engineering, Professor Gabriel Lopez. In addition, we are aware of a series of meetings on this and related topics between UNM SOE administrators and Vice President for Research Richard Larson. In all these meetings, there has been a spirit of support and keen interest in the development of the BMEGP.

We recognize that there is a nationally competitive environment in the area of biotechnology educationand a strong job market for biomedical engineers. We support the School of Engineering's effort to launch a graduate program in biomedical engineering, particularly as it will enable our students at the Health Sciences Center to have a greater variety of options when developing their training programs and meeting their educational goals.

Sincerely,

Deborah Helitzer, Sc.D.
Associate Dean, Biomedical Research Education Program
UNM Health Sciences Center

Helen Hathaway, Ph.D.
Biomedical Sciences Graduate Program
UNM Health Sciences Center

Appendix B. Affiliated faculty members

Alphabetical listing of affiliated faculty members

Kateryna Artyushkova, Chemical and Nuclear Engineering
Plamen Atanassov, Chemical and Nuclear Engineering
C. Jeffrey Brinker, Chemical and Nuclear Engineering
Vince Calhoun, Electrical and Computer Engineering
Heather Canavan, Chemical and Nuclear Engineering
Thomas Caudell, Electrical and Computer Engineering
Eva Chi, Chemical and Nuclear Engineering
Elizabeth L. Dirk, Chemical and Nuclear Engineering
Jeremy Edwards, Molec. Genetics & Microbiol., Chemical & Nucl. Eng.
Evan Evans, Chemical and Nuclear Engineering
Steven W. Graves, Chemical and Nuclear Engineering
Sang Han, Chemical and Nuclear Engineering
Steven J. Koch, Physics & Astronomy
Ravi Jain, Electrical Engineering
Terran Lane, Computer Science
Zayd C. Leseman, Mechanical Engineering, and Electrical and Computer Engineering
Gabriel P. Lopez, Chemical and Nuclear Engineering
Marek Osinski, Electrical and Computer Engineering
Marios Pattichis, Electrical and Computer Engineering
Dimiter Petsev, Chemical and Nuclear Engineering
Scott S. Sibbett, Chemical and Nuclear Engineering
Darko Stefanovic, Computer Science
David Whitten, Chemical and Nuclear Engineering
John E. Wood, Mechanical Engineering
Steve A. Young, Pathology

Listing of faculty members by department within the School of Engineering

Chemical & Nuclear Engineering

Kateryna Artyushkova
Plamen Atanassov
C. Jeffrey Brinker
Heather Canavan
Eva Chi
Elizabeth L. Dirk
Jeremy Edwards
Evan Evans
Steven W. Graves
Sang Han
Gabriel P. Lopez
Dimiter Petsev
Scott S. Sibbett
David Whitten

Electrical & Computer Engineering

Vince Calhoun
Thomas Caudell
Ravi Jain
Zayd C. Leseman
Marek Osinski
Marios Pattichis

Physics & Astronomy

Steven J. Koch
Kevin K. Malloy

Computer Science

Terran Lane
Darko Stefanovic

Mechanical Engineering

Zayd C. Leseman
John E. Wood

Appendix C. Catalog Copy

CATALOG COPY FOR MS DEGREE IN BIOMEDICAL ENGINEERING

BIOMEDICAL ENGINEERING GRADUATE PROGRAM

Steven W. Graves, Director

Center for Biomedical Engineering

M.S. in Biomedical Engineering

The Biomedical Engineering (BME) Graduate Program prepares individuals for careers in one of the fastest growing disciplines of engineering. The program currently offers one focus area in Molecular and Cellular Systems. Future focus areas will be added as need arises and resources are secured. Instructors from a spectrum of backgrounds in biomedical engineering offer a comprehensive core curriculum comprising 5 courses and a seminar course. Electives are accepted from a number of courses taught in the School of Engineering, College of Arts and Sciences, College of Pharmacy and School of Medicine. Graduates of this program will have the technological background to solve important problems in a number of areas including health care, biomedical research, biotechnology and bioengineering.

M.S. Admission Requirements

The general admission requirements described in the Graduate Program in this Catalog apply to the BMEGP. The following additional requirements hold for the initial focus area in Molecular and Cellular Systems. They may be modified or augmented as other focus areas are added to the program. Successful applicants to the BMEGP must have a bachelor's degree in a natural science or engineering field in which they attained a sophisticated level of ability to study, model or manipulate biological systems at the molecular or cellular level. Because of the multifaceted nature of BME research, the Admissions Committee will make admissions decisions on a case-by-case basis. The following subject areas will be used to judge the suitability of students for admission:

- Introductory Molecular and Cellular Biology
- General Chemistry and Organic Chemistry
- Calculus and Ordinary Differential Equations
- Thermodynamics
- General Physics
- Biochemistry or Biomolecular Engineering

Persons who have not passed courses in one or more of these subject areas may be admitted to the BMEGP, but may be required to take undergraduate courses to eliminate deficiencies in their background. Each case is considered individually.

Application Process

Please see the Graduate Program section of this Catalog for the general process for applying to graduate school. In addition to those requirements, successful applicants to the M.S. program in Biomedical Engineering must submit the following directly to the BMEGP Program Office for review by the Admissions Committee:

- a letter of intent on why the BMEGP is of interest
- three confidential letters of recommendation
- GRE entrance examination scores

M.S. Degree Completion Requirements

The general requirements for this degree are identical to those specified in the Graduate Program section of this catalog. (Please see the Graduate Program section for detailed requirements and procedures common to all UNM graduate programs.) In addition to the general requirement specified in the Graduate Program, graduates must complete the core and elective BME M.S. curriculum specified below. The BMEGP offers both Plan I (thesis) and Plan II (non-thesis) options for completion of an M.S. in Biomedical Engineering. BME 567 (Biomedical Engineering Seminar) should be taken every semester, but a student can only apply a maximum of 4 credit hours of this seminar toward their course degree requirements.

Curriculum for Students in the BME M.S. Degree Program:
Focus area: Molecular and Cellular Systems

The following core courses are required of all Master's students in Biomedical Engineering.

BME 517 Applied Biology for Biomedical Engineers
BME 544 Mechanics and Thermodynamics of Molecular Components in Cells
BME 547 Biomedical Engineering Research Practices
BME 556 Protein and Nucleic Acid Engineering
BME 558 Methods of Analysis in Bioengineering

Equivalent graduate-level courses taken at other institutions may be used to satisfy these requirements. The BMEGP Graduate Advisor or the BMEGP Curriculum Committee must approve such substitutions.

For completion of the BME M.S. degree the student must complete a minimum of 6 credit hours of elective courses from the list below. (Please see the Graduate Program section for detailed requirements and procedures common to all UNM M.S. Plan I and Plan II programs.)

Master's students may substitute electives other than those listed below as approved by the BMEGP Graduate Advisor or the BMEGP Curriculum Committee.

Engineering Electives

CHNE/NSMS 522L. Fundamentals of Nanofluidics
CHNE/NSMS 530 Surface and Interfacial Phenomena
CHNE 536/436. Biomedical Technology
CHNE/NSMS 538/438. Biosensors Fundamentals and Applications.
CHNE 504 Nanomaterials
CHNE 521 Advanced Transport Phenomena I
CS 529 Machine Learning
CS 530 Geometric and Probabilistic Methods in CS
CS 561 Algorithms/Data Structures
CS 590 Topics: Complex Adaptive Systems
ECE 510 Medical Imaging
ECE 500 Theory of Linear Systems
ECE 533 Digital Image Processing
ECE 537 Foundations of Computing
ECE 539 Digital Signal Processing
ECE 547/CS 547 Neural Networks
ECE 561 Engineering Electrodynamics
ECE 581 Colloidal Nanocrystals for Biomedical Applications
ME 501 Advanced Mechanics of Materials
ME 504 Computational Mechanics
ME 512 Intro to Continuum Mechanics
ME 530 Theoretical Fluid Mechanics
ME 571/NSMS 569 Advanced Materials Science

Biology/Biomedical Sciences Electives

BIOM 509 Principles of Neurobiology
BIOM 510 Physiology
BIOM 514 Immunobiology
BIOM 515 Cancer Biology
BIOM 516 Molecular Genetics and Genomics
BIOL **351 Microbiology
BIOC 545L Intensive Introductory Biochemistry
BIOL 547 Advanced Techniques in Light Microscopy

Biomedical Engineering (BME) Courses

BME 517. Applied Biology for Biomedical Engineers. (3)
Emphasis on engineering principles and analysis of: (i) the cell as a complete system including cellular subsystems, structures and functions; and (ii) select higher order systems of human physiology. Restriction: Permission of the instructor. {Fall}

BME 544. Mechanics and Thermodynamics of Molecular Components in Cells. (3)
Chemical thermodynamics and physics are used to establish a material science perspective of the molecular components – chemical kinetics – and structural properties needed for both understanding cell behavior and advancing biotechnology. Restriction: Permission of the instructor. {Fall}

BME 547. Biomedical Engineering Research Practices. (3)
Students will develop research, presentation, and scientific writing skills for theses, proposals, invention disclosures and journal articles. The course

includes oral presentations, case studies of research ethics, technology transfer and manuscript preparation. Restriction: Permission of the instructor. {Fall}

BME 556. Protein and Nucleic Acid Engineering. (3)
Students will learn the scientific principles and methods for engineering and manufacturing custom proteins, peptides, nucleic acids, and carbohydrates. The course will explicitly discuss methods and tools used in the production of engineered biomacromolecules. Restriction: Permission of the instructor. {Spring}

BME 558. Methods of Analysis in Bioengineering. (3)
Presents applied analytical and numerical mathematical methods in the context of biomedical engineering problems. Introduces statistical methods for the design of experiments and analysis of experimental data in research and development activities. Restriction: Permission of the instructor. {Spring}

BME 567. Biomedical Engineering Seminar. (1)
Students will gain insight into scientific presentations and current biomedical engineering research by presenting their research and actively participating in an external research seminar which will feature outstanding external and internal researchers as speakers. Restriction: Permission of the instructor. {Fall, Spring}

BME 570. Physical Bioanalytical Methods. (3)
Introduction to the physics and chemistry of classical physical methods of analyzing biological and biologically-related samples. Topics include fluorescence microscopy, chemiluminescence, chromatography, electrophoresis, mass spectrometry, electrochemistry, ultracentrifugation, SPR, SEM, TEM, AFM, XPS, radiochemistry and flow cytometry. Restriction: Permission of the instructor. {Fall}

BME 572. Biomaterials Engineering. (3)
Introduction to biomaterials currently in use, including commercial and research applications. Includes an understanding of a material's properties, biological responses to the materials, clinical context of their use, manufacturing processes, and regulatory issues. Restriction: Permission of the instructor. {Fall}

BME 579. Tissue Engineering. (3)
A review of the current strategies involved in the design of engineered tissues and organs. The principles underlying the implementation of selected cells, biomaterial scaffolds, soluble regulators, and culture conditions will be addressed. Restriction: Permission of the instructor. {Spring}

BME 598. Special Topics. (1-3, no limit) Δ
{Offered upon demand}

BME 599. Master's Thesis. (1-6, no limit) Δ
See Graduate Programs section for total credit requirements.

Appendix D. Letter of the Dean of the School of Engineering

UNM SCHOOL of ENGINEERING

Office of the Dean

Memorandum

TO: Suzanne Ortega, Provost & EVP

FROM: Arup Maji, Interim Dean

DATE: May 3, 2010

RE: School of Engineering's Support for Biomedical Engineering Graduate Program

In consideration of leadership transition in the SOE, I am summarizing the commitments of the School for the proposed Biomedical Engineering Graduate Program. These commitments are a reflection of extensive SOE faculty and SOE committee discussion to date, culminating in two key votes. In May 2009, the entire faculty of the School of Engineering reviewed plans for the Biomedical Engineering Graduate Program. By a near unanimous vote, the faculty approved moving forward with the plans. In August 2009, the SOE Administrative Committee, comprised of the Dean, Associate Deans and SOE Department Chairs, reviewed and voted on its top Special Projects priorities, and selected Biomedical Engineering as the top priority for the School.

Hence, I am delighted to articulate the following commitments of the School of Engineering to the proposed new graduate program:

1. Given the recent commitment of $208,000 of additional I&G funding per year to the School of Engineering to administer the Biomedical Engineering Program, the School is committed to using this money towards the administration, staffing and Associated Faculty as necessary. The school will also seek synergy with other programs and departments to leverage personnel and resources.

2. The School of Engineering will provide space for the offices of the Director and Program Manager.

3. The School of Engineering Dean's office will determine the appropriate programmatic and fiscal oversight of the program.

Given the importance of this new program in advancing the economic interests of the State of New Mexico, and the strategic objectives of the University, I am fully committed to ensuring that this program succeeds.

The University of New Mexico · MSC01 1140 · 1 University of New Mexico · Albuquerque, NM 87131-0001 · Phone 505.277.5521 · Fax 505.277.1422 · www.soe.unm.edu
Centennial Engineering Center, Suite 3071

Appendix E. Curricula vitae of the course instructors

1. Curriculum vitae of Assistant Professor Heather Canavan
2. Curriculum vitae of Assistant Professor Eva Chi
3. Curriculum vitae of Assistant Professor Elizabeth Dirk
4. Curriculum vitae of Research Professor Evan Evans
5. Curriculum vitae of Research Professor James P. Freyer
6. Curriculum vitae of Associate Professor Stephen W. Graves
7. Curriculum vitae of Assistant Professor Stephen Koch
8. Curriculum vitae of Research Professor Scott S. Sibbett
9. Curriculum vitae of Professor David G. Whitten

Appendix F.
Projected program budget in response to possible cost containment efforts*

		% budget cut		
		0%	3%	8%
Income	I&G	$ 207,000	$ 200,790	$ 190,440
Expenses	Salaries	203,580	197,275	186,878
	Office supplies	1,009	980	1,027
	Equipment rental	1,545	1,500	1,500
	Business food	1,030	1,000	1,000
	Banner tax	36	35	35
	Total expenses	207,201	200,790	190,440
Income minus expenses		-201	0	0

*Budget cuts of 3% or 8% are not expected to compromise the successful launch and long-term vitality of the proposed new program.

HEATHER E. CANAVAN, PH.D.

Assistant Professor
Center for Biomedical Engineering (CBME)
Department of Chemical and Nuclear Engineering
University of New Mexico — Tel: 505-277-8026
Centennial Engineering Center, Rm. 2059 — Fax: 505-277-5433
Albuquerque, NM 87131-1141 — Email: canavan@unm.edu

EDUCATION

The George Washington University
Doctor of Philosophy: Physical Chemistry — May 2002
Advisor: David E. Ramaker

The George Washington University
Master of Philosophy: Physical Chemistry — January 2000

University of California Santa Barbara
Bachelor of Arts: Biology — December 1996

ACADEMIC APPOINTMENTS

University of New Mexico, Albuquerque NM

Assistant Professor, Department of Chemical and Nuclear Engineering — 2005-present

University of Washington, Seattle WA, Laboratory of Dr. David Castner

Senior Postdoctoral Fellow, Departments of Chemical and Bioengineering — 2002-2005
National ESCA and Surface Analysis Center for Biomedical Problems (NESAC/BIO)

PROFESSIONAL EXPERIENCE

Los Alamos National Laboratory, Los Alamos, NM

Chemist, Chemistry Science and Technology Division — 1994-1997

Los Alamos National Laboratory, Los Alamos, NM

Staff Research Assistant, Chemistry Science and Technology Division — 1991-1994

COURSES TAUGHT

Chemical Engineering Thermodynamics (ChNE 302)	Spring 2006-present
Advanced Chemical Engineering Thermodynamics (ChNE 542)	Fall 2005 - 2009
Biomolecular Engineering (ChNE 361)	Fall 2006-2009
Undergraduate Senior Seminar (ChNE 471)	Fall 2005; Fall 2010
Biomaterials Engineering (ChNE 499/515)	Fall 2010

AWARDS

Harrison Faculty Excellence Award	2009
Apple Polisher Award, recognition from Chi Omega sorority members for outstanding contribution to higher education	2008
Untenured Faculty Award, 3M Corporation	2006
Dorothy M. and Earl S. Hoffman Scholarship, AVS	1999
Benjamin D. Van Evera Memorial Teaching Prize, George Washington University	1998

CURRENT RESEARCH

Study of temperature-dependent behavior of poly(*N*-isopropyl acrylamide) (pNIPAM), a "smart polymer" used to detach cells as contiguous sheets, by surface analytical and biological techniques. Characterization of the behavior of the ECM secreted from mammalian cells cultured on pNIPAM-treated surfaces as well as the cell sheets. Development of cell-based sensors and engineered tissues from cell sheets obtained from smart polymer surfaces.

http://www-chne.unm.edu/testche/faculty/canavan/lab%20site/research.htm

SERVICE

Director, Biomaterials Engineering Outreach Program	2006-2007
Volunteer/presenter, Biomaterials Engineering Outreach Program	2006-present
Faculty Advisor, UNM Student Chapter of the Biomedical Engineering Society	2005-present
Member, ChNE Undergraduate Student Curriculum Development Committee	2005-present
Member, ChNE Graduate Student Recruitment Committee	2005-2008
Member, ChNE Graduate Student Qualifications Exam Committee	2008
Member, School of Engineering Dean's Search Committee	2009
Member, ChNE Faculty Search Committee	2006, 2007
Member-at-large, NM Chapter of the American Vacuum Society (AVS)	2006-2008
Member-at-large, AVS BioInterfaces Division	2006-present
Manuscript Reviewer: *Surface and Interface Analysis, Langmuir, Plasma Processes and Polymers, Biomaterials, Advanced Materials, Biomacromolecules, Journal of the American Ceramic Society*	2005-present
Grant Proposal Reviewer: National Science Foundation, Irish Health Research Board	2005-present
Contributor, UNM Higher Learning Commission site visit	2009
Participating Mentor, UNM Initiatives for Minority Student Development (IMSD), UNM Post baccalaureate Research and Education Program (PREP), UNM Cross-disciplinary Optics Research and Education (CORE) IGERT, and REU programs	2005-present

MEMBERSHIPS

American Chemical Society (ACS)	American Institute of Chemical Engineers (AIChE)
American Society for Engineering Education (ASEE)	American Vacuum Society (AVS)
Society for Biomaterials (SFB)	Biomedical Engineering Society (BMES)

SELECTED PUBLICATIONS (of 15 refereed publications, 5 in preparation, 2 submitted/accepted, 1 chapter, 12 non-refereed publications, 15 with undergraduates)

†Indicates undergraduate researcher.

Articles in Preparation

1. Reed, J.A.; Lucero, A.E.; Love, S.; Hughes, C.; CANAVAN, H.E.; "Thermoresponsive film deposition: Comparing Deposition Methods for Mammalian Cell Applications," in preparation for submission to *Langmuir*.
2. Reed, J.A.; Shah, R.; Angelini, T.; Weitz, D.W.; CANAVAN, H.E.; "Uncovering the Extracellular Matrix with Thermoresponsive Microgels," in preparation for submission to *Advanced Materials*.

3. Lucero, A.E.; Reed, J.A.; Cooperstein, M.;† CANAVAN, H.E.; "Fabrication and Characterization of Thermoresponsive Films Deposited by an RF Plasma Reactor," in preparation for submission to *Plasma Processes and Polymers*.

Articles Submitted, Accepted, or In Press

1. Reed, J.A.; Lucero, A.E.; Hu, S.;† Ista, L.K.; Bore, M.; López, G.P.; CANAVAN, H.E.; "A Low-cost, Rapid Deposition Method for 'Smart' Films: Applications in Mammalian Cell Release," *ACS Applied Materials & Interfaces*, in press.

Articles Published

1. Cooperstein, M.;† CANAVAN, H.E.; "Applications and Uses of Biological Cell Detachment from pNIPAM," ," cover art and Feature Article of *Langmuir*, **26** (11), (2010).
2. Chang, M.S.; Stohlman, J.; Molnar, P.; Natarajan, A.; CANAVAN, H.E.; Teliska, M.; Krauthamer, V.; Hickman, J.J.; "Altered Calcium Dynamics in Cardiac Cells Grown on Silane-Modified Surfaces," *Biomaterials*, **31** (4), 602-607 (2010).
3. Mendez, S.; Andrzejewski, B.P.; CANAVAN, H.E.; Keller, D.J.; McCoy, J.D.; López, G.P.; and Curro, J.G.; "Modeling the Force-vs-Distance Profiles of Terminally Anchored Poly(*N*-isopropyl acrylamide) with Self-Consistent Field Theory," *Langmuir*, **25** (18), 10624-10632 (2009).
4. Reed, J.A.; Lucero, A.E.; Cooperstein, M.;† CANAVAN, H.E.; "The Effects of Cell Culture Parameters on Cell Release Kinetics from pNIPAM," *Journal of Applied Biomaterials & Biomechanics*, **6** (2), 81-88 (2008).
5. CANAVAN, H.E.; Stanton, M.; Lopez, K.; Grubin, C.; Graham, D.J., " 'Finger Kits': An Interactive Demonstration of Biomaterials and Engineering for Elementary School Students," *Chemical Engineering Education*, **42** (3), 125-131 (2008).
6. CANAVAN, H.E.; Cheng, X.; Graham, D.J.; Ratner, B.D.; and Castner, D.G., "Comparison of Native Extracellular Matrix with Adsorbed Protein Films using Mass Spectrometry," cover art of *Langmuir*, **23** (1), 50-56 (2007).
7. CANAVAN, H.E.; Cheng, X.; Graham, D.J.; Castner, D.G.; and Ratner, B.D., "A Plasma-deposited Surface for Cell Sheet Engineering: Advantages over Mechanical Dissociation of Cells," *Plasma Processes and Polymers*, **3** (6-7), 516–523, (2006).
8. Cheng, X.; CANAVAN, H.E.; Castner, D.G.; and Ratner, B.D., "Protein Interaction with Plasma Polymerized *N*-Isopropyl Acrylamide," *Biointerphases*, **1** (1), 61-72 (2006).
9. CANAVAN, H.E.; Cheng, X.; Graham, D.J.; Ratner, B.D.; and Castner, D.G., "Cell Sheet Detachment Affects the Extracellular Matrix: A Surface Science Study Comparing Thermal Lift-off, Enzymatic and Mechanical Methods," *Journal of Biomedical Materials Research*, **75A** (1), 1-13 (2005).
10. Cheng, X.; CANAVAN, H.E.; Stein, M.J.; Hull, J.R.; Hull, J.R.; Kweskin, S.J.; Wagner, M.S.; Somorjai, G.A.; Castner, D.G.; and Ratner, B.D., "Surface Chemical and Mechanical Properties of Plasma Polymerized *N*-isopropylacrylamide," *Langmuir*, **21** (17) 7833-7841 (2005).
11. Lee, C.Y.; CANAVAN, H.E.; Gamble, L.J.; and Castner, D.G., "XPS and ToF-SIMS Characterization of Thiolated Single-stranded DNA Oligomers Self-assembled onto Gold Surfaces," *Langmuir*, **21** (11) 5134-5141 (2005).
12. CANAVAN, H.E.; Cheng, X.; Graham, D.J.; Ratner, B.D.; and Castner, D.G., "Surface Characterization of the Extracellular Matrix upon Cell Detachment from a Thermoresponsive Polymer," cover article of *Langmuir*, **21** (5), 1949-1955 (2005).
13. May, C.J.;† CANAVAN, H.E.; and Castner, D.G., "Quantitative XPS and ToF-SIMS Characterization of the Components in DNA Microarrays," *Analytical Chemistry*, **76** (4), 1114-1122 (2004).
14. Barker, S.L.R.; Tarlov, M.J.; CANAVAN, H.; Hickman, J.J.; and Locascio, L.E, "Plastic Microfluidic Devices Modified with Polyelectrolyte Multilayers," *Analytical Chemistry*, **72** (20), 4899-4903 (2000).
15. Goldstein, S.J.; Slemmons, A.K.; and CANAVAN, H.E., "Energy Dispersive X-Ray Fluorescence Methods for Environmental Characterization of Soils," *Environmental Science and Technology*, **30** (7) 2318-2321 (1996).

SELECTED PRESENTATIONS (of 16 invited, 62 contributed, 18 with undergraduates). †Indicates undergraduate researcher.

1. CANAVAN, H.E.; "Assessment of Thermoresponsive Films for Mammalian Cell Release," presented at the NSF UNM/Harvard University PREM Workshop on Cell & Tissue Biomaterial Interactions, June 25, 2009.
2. CANAVAN, H.E. "Use of "Smart" Materials and Cell Sheet Engineering to Characterize Buried Biological Interfaces: Scientific and Engineering Applications," presented at the Harvard University Department of Engineering and Applied Sciences Summer Symposium, August 5, 2008.
3. Canavan, H.E. "'Smart' Polymers and Biological Cells: Current Research on the Buried Biological Interface and its Future Applications, presented at the 3M Corporation Untenured Faculty Award Winners' Meeting, June 19-20, 2007.
4. CANAVAN, H.E. "Characterization of Cells and the Buried Biological Interface using Surface Science Techniques," presented at "Biomaterials from 2D to 3D to Larger than Life" Symposium, Ka'anapali Beach, Maui, December 14-17, 2006.

Contributed Talks

1. Reed, J.A.; Lucero, A.E.; CANAVAN, H.E.; "Effect of Deposition Methods on Cell-releasing Properties of a Thermoresponsive Polymer," presented at the American Institute of Chemical Engineers Annual Meeting, Nashville TN, November 8-13, 2009.
2. Reed, J.A.; Shah, R.; Angelini, T.; Weitz, D.W.; CANAVAN, H.E.; "Uncovering the Extracellular Matrix with Thermoresponsive Microgels," presented at the 55th International Symposium of the American Vacuum Society, San Jose, CA, November 8-13, 2009, 1st place for best student poster.
3. Wilde, K.N.; Corbitt, T.S.; Ding, L.; Whitten, D.G.; CANAVAN, H.E.; "Assessing the Cytotoxicity of Cationic Conjugated Polyelectrolyte Biocides," presented at the NSF UNM/Harvard University PREM Workshop on Cell & Tissue Biomaterial Interactions, June 25, 2009.
4. Pawlikowski, L.; CANAVAN, H.E.; "Development of a Cell-based 'Smart' Microfluidic Sensor," presented at the NSF UNM/Harvard University PREM Workshop on Cell & Tissue Biomaterial Interactions, June 25, 2009.
5. Lucero, A.E.; CANAVAN, H.E.; "Optimizing an RF Plasma Reactor for Biocompatible "Smart" Surfaces," presented at the American Institute of Chemical Engineers Annual Meeting, Philadelphia, PA, November 16-21, 2008.
6. Fulghum, J.E.; Artyushkova, K.; Lucero, A.E.; CANAVAN, H.E. "Use of Multivariate Analysis Techniques to Predict Cellular Response to Plasma Polymerized pNIPAM," presented at the 54th International Symposium of the American Vacuum Society, Boston, MA, October 19-24, 2008.
7. Reed, J.A.; Bore, M.; Ista, L.K.; López, G.P.; CANAVAN, H.E.; "Solution Deposited Poly(*N*-isopropyl acrylamide) Films Optimized for Mammalian Cell Release," presented at the 54th International Symposium of the American Vacuum Society, Boston, MA, October 19-24, 2008, 2nd place for best student poster.
8. CANAVAN, H.E.; Candelaria, S.L.;† Reed, J.A.; Lucero, A.E.; Wilde, K.N.; Liu, X.P.; Gallagher-Gonzales, K.M. "Scientific and Bioengineering Applications of a Plasma Polymerized Thermoresponsive Surface," presented at the 3M Corporation Untenured Faculty Award Winners' Meeting, June 19-20, 2008.
9. CANAVAN, H.E.; Candelaria, S.L.;† Reed, J.A.; Lucero, A.E.; Wilde, K.N.; Joe, R.; Tapia, P.; Werner-Washburne, M.; "Use of a Thermoresponsive Substrate to Separate Cell Populations," presented at the 8th World Biomaterial Congress, Amsterdam, the Netherlands, May 28 – June 1, 2008.
10. Lucero, A.E.; CANAVAN, H.E.; "Optimizing Thermoresponsive pNIPAM Films using an RF Plasma Reactor," presented at the AAAS/SWARM Symposium, Albuquerque, NM, April 11, 2008, honorable mention for best student poster.
11. Mendez, S.; Andrzejewski, B.; Keller, D.H.; CANAVAN, H.E.; Lopez, G.P.; Curro, J.G.; and McCoy, J.D.; "Modeling Force versus Distance Profiles of Terminally Anchored Poly(N-isopropylacrlamide) with Self-Consistent Field Theory," presented at the 53rd International Symposium of the American Vacuum Society, Seattle, WA, October 15-19, 2007.