

**NEW GRADUATE DEGREE OR GRADUATE CERTIFICATE FORM D**

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

Date: 6/18/2008

ARUP K. MAJI

(Name of individual initiating Graduate Degree or Graduate Certificate)

CHAIR, CIVIL ENGINEERING, 2771757

(Title, position, telephone number)

amaji@unm.edu

(Email address)

CIVIL ENGINEERING

(Department/Division/Program)

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

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JUL 08 2008

RECORDS OFFICE

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.

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MAY 20 2009

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.

Graduate Office  
University of New Mexico

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

Proposed date to admit new students: Term FALL Year 2009

Required Signatures:

Department Chair	<u>[Signature]</u>	Date	<u>6/18/08</u>
College Curricula Committee	<u>[Signature]</u>	Date	<u>14 Oct 2008</u>
College or School Dean	<u>[Signature]</u>	Date	<u>14 Oct 2008</u>
Dean of Library Services	<u>[Signature]</u>	Date	<u>12/18/08</u>
Office of the Registrar—Catalog	<u>[Signature]</u>	Date	<u>11/19/08</u>
FS Graduate Committee	<u>[Signature]</u>	Date	<u>2/5/09</u>
Dean of Graduate Studies	<u>[Signature]</u>	Date	<u>30 March 2009</u>
FS Curricula Committee	<u>[Signature]</u>	Date	<u>3-5-09</u>
Office of the Provost	<u>[Signature]</u>	Date	
Faculty Senate	<u>[Signature]</u>	Date	<u>3/24/09</u>
Board of Regents	<u>[Signature]</u>	Date	<u>5/12/09</u>

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	_____

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Entered Catalog

For Registrar's Office ONLY:

Copies Mailed

## *1. Executive Summary*

The UNM Department of Civil Engineering wishes to implement a Master of Engineering (M.Eng.) degree to meet the needs of students and practitioners who seek an engineering practice-oriented degree distinct from the MS degree which requires a thesis. There is increasing recognition within the engineering profession of the need for additional academic training beyond that provided at the B.S. level. Local and national organizations and companies who hire civil engineers have recognized the limitations of the current B.S. degree in Civil Engineering. In particular, the profession is requesting that students be provided more exposure to engineering design and practice beyond that currently available to undergraduate students. This would specifically include additional training in the traditional studies of engineering science and design, along with expanded emphasis on communication skills (both written and oral) and engineering management. The profession believes that these skills can be learned more effectively through a combination of advanced practice-oriented courses rather than by working on a research project (thesis) as part of a traditional M.S. degree program. We believe that the proposed M.Eng degree would attract more part-time students to our department for their continuing professional education needs.

The proposed M.Eng. degree would have a different mix of classes than the M.S degree and would concentrate more on practice-oriented courses. While all of the classes currently in the graduate curriculum will be used to satisfy requirements for the new degree, additional practice-oriented courses in each discipline may be provided in the future if the M.Eng program grows. The M.Eng degree could be obtained within or combining any of the department's six focus areas, with an approved program of study. Just as is allowed for the M.S. degree, elective classes within the M.Eng degree could be a mix of theory and practice-oriented courses. An M.Eng. degree recipient could later pursue enrollment in a Ph.D. program if a sufficient number of theory and research classes were taken prior to admission to Ph.D. candidacy, and reasonable scores on the GRE were obtained.

Both of the department's Plan II options (project option and course-only option) will be eliminated once an M.Eng. degree has been implemented. Elimination of the Plan II options will provide one option requiring a thesis (current Plan I) and one professional practice option (M.Eng) for the Master's degree options of the Department. Hence, the M.Eng will help streamline the degree offerings of the department and provide prospective students with two distinct paths for their advanced degrees.



CIVIL ENGINEERING DEPARTMENT

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October 10, 2008

Memo To

The Provost and Vice President for Academic Affairs, University of New Mexico  
and  
The Dean of Graduate Studies, University of New Mexico

Subject: New Master of Engineering (M. Eng.) Degree in Civil Engineering

The School of Engineering Graduate Committee has approved the attached plan for starting the above-stated graduate degree program. The SOE faculty vote on 5/9/08 was unanimously in favor of this proposal. I am requesting your office for approval and subsequent action for its implementation.

The M. Eng. is to be a more practice-oriented degree than the current MS and no additional resources will be required for its implementation.

Sincerely,

Joseph Cecchi, Dean  
School of Engineering, UNM

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DEC 11 2008

Graduate Office  
University of New Mexico

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THE UNIVERSITY of  
NEW MEXICO

Office of the Vice Provost for Academic Affairs  
MSC05 3400  
1 University of New Mexico  
Albuquerque, NM 87131-0001  
505.277.2611

Date: 13 February 2008

To: Dean Joe Cecchi

From: Wynn Goering *Wynn*

Re: Master's Degree Proposals from the School of Engineering

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I have reviewed the three degree proposals submitted to the Office of the Provost last fall by the Departments of Mechanical Engineering, Civil Engineering, and Electrical and Computer Engineering of SOE. My sincere apologies for the slow response time: the fault is mine.

In my judgment the proposals are well-crafted and represent a thoughtful strategic response to state needs and potential student demand. I would be willing to endorse them and send them on through the approval process, with the following stipulations:

- ✓ 1. The first is a matter of protocol. We always require the dean's formal endorsement of new program proposals, inasmuch as you will be central to process of moving them through the multiple layers of university and state approvals. A brief letter and summary of the School's rationale for simultaneously submitting three new graduate degree proposals would be helpful.
- ✓ 2. Secondly, in the CE and ECE proposals, the sections in which "state support" is predicated on formula reimbursement for the credit hours generated do not reflect the current cash flow realities of the higher education funding formula at UNM. I would suggest that each proposal be rewritten along the lines of the presentation in the ECE proposal (p. 8), with the note that the linkage of credit hour production to formula reimbursement is "theoretical," and that the actual revenue generated for the university will depend on their enrollments at the time of any new "base year" calculations. Curt Porter or I would be happy to help with this if you'd like.

I appreciate the work you and your faculty have already put into these. We just want to make certain we have everything perfectly in order, before we embark on what has become an increasingly arduous graduate degree approval process.

Copy: Viola Florez  
Chuck Fledderman  
Curt Porter  
Arup K. Maji  
Juan C. Heinrich  
Chaouki Abdallah

To: Fran Wilkinson, Deputy Dean of University Libraries

From: Steven Harris, Director of Collections & Acquisitions Services



RE: Civil Engineering Curriculum Changes

Date: December 8, 2008

The Civil Engineering Department at UNM is undergoing minor curriculum changes that should not impact the Libraries greatly. Essentially, they plan to offer a M. Eng. as a non-thesis option, replacing the current M.S. non-thesis program. The subject matter of the degree will be largely the same, although some practical rather than theoretical courses may be added in the future. I believe that the University Libraries' collections already provide excellent coverage for this area. I recommend signing the Form D with no objections or suggestions.

Statement on how this new degree affects the existing MS in Civil Engineering

Both of the Plan II options (non-thesis) of the existing MS degree in Civil Engineering will be eliminated once an M.Eng. degree has been implemented. Elimination of the Plan II options will provide one option requiring a thesis (MS) and one professional practice option (MENG). Hence, the M.Eng will help streamline the degree offerings of the department and provide prospective students with two distinct paths for their advanced degrees.

## *2. Program Proposal*

# **Master Of Engineering Degree (M. Eng.) in Civil Engineering**

Department of Civil Engineering  
School of Engineering  
University of New Mexico

May 9, 2008

### *Principal Features*

- Emphasis on engineering practice including design and management
- Intended to be a professional degree distinct from the MS which requires a thesis.
- A total of 33 hours of academic coursework, with 2 additional hours of seminar
- A 15-hour core curriculum of practice-oriented classes
- A 6-hour block in engineering or project management
- A 3-hour design project for students who do not have an ABET, Inc.-accredited degree or at least two years of design experience.
- Replaces the Plan II options (both IIa and IIb) of the MS degree
- Administered by the Office of Graduate Studies (OGS)
- Entrance requirements:
  - B.S. in Civil Engineering or
  - B.S. in other engineering disciplines or in an approved Science plus remedial classes
  - 3.0 GPA in last two years of a BS program
  - Acceptable score on the GRE or passage of the FE exam
- Must pass a written preliminary examination and a final departmental exam covering the student's curriculum
- Must sit for the FE exam if such exam has not already been passed

## 1. Introduction

This is a proposal to develop and implement a Master of Engineering (M.Eng.) degree in Civil Engineering to meet the needs of students and practitioners who seek an engineering practice-oriented degree distinct from the MS degree which requires a thesis.

There is increasing recognition within the engineering profession of the need for additional academic training beyond that provided at the B.S. level. In New Mexico, the UNM Civil Engineering Department Advisory Board (CEDAB) has recognized the limitations of the current B.S. degree in Civil Engineering and encouraged the Department to improve the accessibility of its masters degree programs. In particular, the profession through the CEDAB is requesting that students be provided more exposure to engineering design and practice beyond that currently available to undergraduate students. This would specifically include additional training in the traditional studies of engineering science and design, along with expanded emphasis on communication skills (both written and oral) and engineering management. The profession believes that these skills can be learned more effectively through a combination of advanced practice-oriented courses rather than by working on a research project (thesis) as part of a traditional M.S. degree program.

In recent years, approximately 50% of the M.S. degrees in civil engineering at UNM have been awarded to part-time students. Many of these students might switch to the M.Eng. option if it were available. A more design/professional degree would attract more part-time students.

Students in the UNM School of Engineering may currently pursue a Master of Engineering in Manufacturing Engineering. These are interdisciplinary degrees, administered by the SOE, that allow specialization in hazardous waste management or radioactive management and in manufacturing engineering. Students must select an advisor and a home department within the SOE, and most students select either Civil Engineering or Chemical and Nuclear Engineering in these current M.Eng programs. In addition, M.Eng programs are being proposed by the Mechanical Engineering department and the Electrical and Computer Engineering department.

There are currently two degree plans leading to the M.S. degree at UNM in Civil Engineering. Plan I requires completion of a M.S. thesis. Plan II(a), as it is referenced in the CE department, allows students to do additional coursework and complete an M.S. project. This project is intended to demonstrate evidence of the student's ability to conduct high quality work with limited faculty supervision. In many cases, there is little distinction in the level of effort and quality of the final product between students' M.S. theses and M.S. projects. In the late 1990's, the CE faculty approved a coursework-only M.S. program in which students take additional coursework and a comprehensive M.S. examination in lieu of either the thesis or project. Technically, this is a variation of the Plan II M.S. program; we call this Plan II(b). The current Plan II(b) program does not satisfy the needs in the professional practice community because the plan is simply a course-only variant of the M.S degree. The M.Eng program will include more



practice-oriented classes than the Plan II(b) program, and it will emphasize 6-hours of coursework in engineering or project management.

Both of the Plan II options will be eliminated once an M.Eng. degree has been implemented. Elimination of the Plan II options will provide one option requiring a thesis and one professional practice option. Hence, the M.Eng will help streamline the degree offerings of the department and provide prospective students with two distinct paths for their advanced degrees.

The proposed M.Eng. degree would have a different mix of classes than the M.S degree and would concentrate more on practice-oriented courses. While all of classes currently in the graduate curriculum will be used to satisfy requirements for the new degree, additional practice-oriented courses in each discipline may be provided in the future if the M.Eng program grows. focus areas, with an approved program of study. Just as is allowed for the M.S. degree, elective classes within the M.Eng degree could be a mix of theory and practice-oriented courses. An M.Eng. degree recipient could later pursue enrollment in a Ph.D. program if a sufficient number of theory and research classes were taken prior to admission to Ph.D. candidacy, and reasonable scores on the GRE were obtained.

In the event a candidate for the M.Eng degree comes from a non-ABET, Inc. accredited program or a candidate who does not have at least two years of professional practice, a 3-hour design project will be required in the program. This design project will supplant one of the 3-unit elective courses taken for the degree.

## **2. Admission and Degree Requirements**

### **Admission**

Admission to the M.Eng. program will be based on five components: 1) completion of a B.S. degree in engineering or an approved science, 2) acceptable grade point average , 3) three letters of recommendation, 4) a letter of intent, and 5) an acceptable score on the GRE or passage of the FE exam . The academic requirements for admission are given in more detail, below.

#### B.S. Degree in Engineering or Science

Students admitted to the M.Eng. program must have an engineering or science degree. There are three ways this requirement can be met.

- B.S. Degree in Civil Engineering from an ABET, Inc.-accredited program - No remedial classes would be required for admission
- B.S. Degree in another field of engineering or from a non-ABET, Inc. accredited program - Remedial coursework may be required and will be determined by the CE Graduate Committee on a case-by-case basis depending on the student's background and his/her intended field of study. Students in this category who do not have at least

two years of practice-oriented experience will be required to take a 3-credit course in Project design (see Degree Requirements).

- B.S. Degree in a Science field - The following remedial courses will be required. In these courses a minimum cumulative GPA of 3.0, with no grade lower than a C, will be required.
  - Mathematics through ordinary differential equations (Math 316)
  - 1 class in college chemistry
  - 1 year of calculus-based college physics
  - CE 202 - Statics
  - CE 302 - Mechanics of Materials
  - ME 306 – Dynamics
  - CE 331 - Fluid Mechanics
  - CE 360 Soil Mechanics
  - Students intending to study in an area where this sequence of preparatory courses is not appropriate may substitute one preparatory course in engineering for one of the above courses. Permission to do so must be obtained from the CE faculty in the student's intended area of study. A member of that group will write a memo identifying the sequence to the CE Director of Graduate Programs that will be placed in the student's file.

#### GPA Requirements

Students must have a 3.0 GPA in the last 60 credit hours of undergraduate studies.

#### Letters of Recommendation

All applicants for the M.Eng. degree must submit at least three letters of recommendation.

#### Letter of Intent

All applicants must submit a letter of intent expressing the student's qualifications, professional goals, and intended area of concentration (e.g., structures, environmental, transportation, etc).

#### GRE or FE Exam

Applicants must submit a record of an acceptable score on the GRE, or show evidence of passage of the Fundamentals in Engineering (FE) exam.

#### Admission of Students Who Do Not Meet Minimum Requirements

Students who do not meet the GPA requirements may be granted admission after taking additional advanced-level engineering courses as a non-degree student to demonstrate their ability to conduct high quality work at the masters level. The specific courses to be taken and the required level of performance will be established by the CE Graduate Committee. The GPA requirement may be relaxed for students having significant relevant work experience or other exceptional credentials such as licensure as a professional engineer; this is the current policy for admission to the departments' graduate programs.

## **Degree Requirements**

Graduate study leading to the M.Eng. degree will be offered within or combining six concentration areas of civil engineering: construction engineering, environmental engineering, geotechnical engineering, structural engineering and material science, transportation engineering, and water resources-hydraulic engineering. Upon admission to the M.Eng. program, the student will select an area of concentration to begin their studies. This area can be changed at any time in consultation with the student's assigned advisor. The M.Eng. degree requirements will consist of:

- 33 credit hours of courses, plus 2 credit hours of CE 691 - Graduate Seminar
  - At least 15 credits of practice-oriented-content graduate level civil engineering classes shall constitute the student's core; the student shall select this core in consultation with their appointed advisor;
  - At least 12 elective credits of course work from within or outside the department which support the student's area of interest;
  - At least 6 credits of classes in program/project management; these classes can be taken in the Anderson School of Management or the Construction Engineering and Management programs within the Civil Engineering department.
  - A maximum of 12 credit hours can be taken under non-degree status
  - At least 18 units must be numbered 500 or higher
  - Not more than 15 credit hours can be taken from a single instructor
- For students who do not meet the entrance requirement for practice-oriented experience, 3-credits of CE 588 – Master's Project. This class will consist of an independent design project, to be conducted by the student, under the guidance of a faculty member in the student's chosen area of emphasis; this faculty mentor shall be a licensed professional engineer (PE). This course shall supplant one of the courses in the students elective classes.
- Minimum 3.0 overall GPA in the degree program.
- All candidates for the M.Eng. degree must pass two (2) departmental examinations in their chosen core curriculum. The first exam (preliminary) must be taken prior to submitting the student's Program of Studies. The exam should be taken as early as possible, typically after completion of 12 to 16 graduate credits. It is only after successful completion of this exam that a student can submit a Program of Studies for the M.Eng degree. The preliminary exam shall be a written exam. Successful completion of a final Departmental examination at the conclusion of all coursework, comprised of a written exam similar in content to the PE exam, is required. The examinations are to be administered by the CE Director of Graduate program based on input from a committee assembled at the beginning of each academic year.
  - All candidates must sit for the Fundamentals of Engineering (FE) exam, if they have not already passed this examination

A list of potential courses to make up the students core curriculum is listed below. These classes constitute those from the department which contain material which covers at least 50% practice-oriented or design-oriented content.

The list is organized by discipline, but students in the M.Eng program can select their core curriculum from any of the courses. Many of the courses listed below are not offered on an annual basis.

### **List of Potential Core Curriculum classes**

#### **Structural Engineering**

- CE 511 - Reinforced Concrete Design
- CE 524 – Structural Design in Metals
- CE 562 - Foundation Engineering I
- CE 503 - Composite Materials
- CE 506 - Prestressed Concrete
- CE 508 – Analysis and Design of Plates and Shells
- CE 518 – Theory of Structural Stability
- CE 520 – Introduction to Structural Dynamics
- CE 521 - Earthquake Engineering
- CE 598 – Selected Topics: Masonry and Timber Design (new class, Spring 2008)

#### **Water Resources, Hydraulics, and Environmental Engineering**

- CE 531 - Physical-Chemical, Water & Wastewater Treatment
- CE 532 – Advanced Physical-Chemical, Water & Wastewater Treatment
- CE 536 - Biological Wastewater Treatment
- CE 540 - Design of Hydraulic Systems
- CE 541 - Groundwater Engineering
- CE 542 – Intermediate Hydrology
- CE 544 - Water Resources Engineering
- CE 545 - Open Channel Hydraulics
- CE 547 - GIS in Water Resources

#### **Geotechnical Engineering**

- CE549 - Vadose Zone Hydrology
- CE 551x - Asphalt Materials and Mix Design
- CE 551x - Geo-environmental Engineering
- CE 561L - Advanced Soil Mechanics Lab
- CE 562 - Foundation Engineering I
- CE 563 - Earth Structures
- CE564 - Rock Mechanics
- CE 566 - Pavement Design
- CE 567 - Foundation Engineering II
- CE 568 - Soil Dynamics

### **Transportation Engineering**

CE 566 – Pavement Design  
CE 580 – Highway Traffic Design  
CE 582 – Highway and Traffic Engineering  
CE 551x - Asphalt Materials and Mix Design  
Any Construction Engineering Course

### **Construction Engineering**

CE 573 - Construction Law  
CE 574 – Principles of Written Construction Documents  
CE 575 – Construction Safety  
CE 577 – Project Controls  
CE 571 – Sustainable Design and Construction  
CE 598 – Selected Topics: Construction Methods and Equipment  
CE 598 – Selected Topics: Project Delivery Systems

All M.Eng students will be required to take 6 credit-hours of project management or engineering management classes. They may select from the list below or seek approval from their graduate committee for any substitutions to these.

### **Project and Engineering Management**

CE 455 – Engineering Project Management  
MGMT 501– Statistical Analysis for Management Decisions  
MGMT 502 – Accounting and Management Information Systems I  
MGMT 506 – Organizational Behavior and Diversity  
MGMT 508 – Ethical, Social, Political and Legal Environment  
MGMT 511 – Technology Commercialization and the Global Environment  
MGMT 520 – Operations Management  
CE 577 – Project Controls  
CE 598 – Selected Topics: Project Delivery Systems

### **3. Commission on Higher Education Proposal Guidelines**

#### **Purpose of the Program and Mission of the Proposing Institution**

The purpose of the M.Eng degree is to provide post-baccalaureate professional education in Civil Engineering. The M.Eng degree, in contrast to the M.S. degree, which includes a thesis, is a practice-oriented degree program, meant to augment the education received at the undergraduate level in civil engineering practice and design. Important courses that provide breadth and depth in professional specialties cannot be taken by students who wish to finish their BS programs in 4 years. Technology has expanded tremendously since the early 1900's, when engineering education started with 4-year programs.

Providing proper *professional* education is a key mission of the University. The University prides itself on offering comprehensive education programs at the undergraduate, graduate and *professional* levels. Strong professional education in engineering is also very critical for the economic development of our community, our state, and our region.

#### ***Justification for the Program***

##### **Need**

There is increasing recognition within the engineering profession of the need for additional academic training beyond that provided at the B.S. level. Indeed, the American Society of Civil Engineers (ASCE) concluded in 2001 that the current four-year bachelor's degree is becoming inadequate formal academic preparation for the practice of civil engineering at the professional level in the 21<sup>st</sup> century. In November 2001 the ASCE Board of Directors issues ASCE Policy 465 that "supports the concept of the master's degree or equivalent as a prerequisite for licensure and the practice of civil engineering at the professional level." In November 2003, ASCE moved to implement Policy 465 and formed a committee to make recommendations for implementation; this committee is called the Committee on Academic Prerequisites for Professional Practice. This same committee developed what they termed "a Body of Knowledge (BOK) for any aspiring engineer." The committee enlisted 10 academic institutions to help create the BOK for the design of bachelor's/master's degree tracks focused at professional practice. Policy 465 signifies that ASCE formally recognizes that young engineers must be better prepared for the future, both by taking more coursework in the principles of engineering and by expanding the curriculum to include more experience in the engineering practice-oriented process.

The need to provide practice-oriented education beyond the bachelors degree has been recognized in a number of recent studies on engineering education, e.g. the Board on Engineering Education (BEEd) study, *Engineering Education. Designing an Adaptive System*, 1995. In addition, the National Academy of Engineering, in their 2005 report *Educating the Engineer of 2020*, recognizes the difficulty of training and educating an engineer in 4 years and recommends that a masters degree be the first professional degree in engineering. Development of an M.Eng

now might prepare our department for such a possibility in the future. Appendix A provides a list of schools in our region and nationwide that have adopted an M.Eng degree.

### **Duplication**

Currently no institution in the state of New Mexico offers an M.Eng in Civil Engineering. A list of neighboring states which do provide this degree is provided in Appendix A. The School of Engineering at UNM currently offers an M.Eng degree in Manufacturing Engineering, and is considering two other M.Eng degrees (one in Mechanical Engineering and one in Electrical and Computer Engineering).

### **Inter-Institutional Collaboration and Cooperation**

Because of the professional need for the M.Eng degree programs, it can be expected that other institutions in the state that offer Civil Engineering programs may pursue such a degree. The M.Eng at UNM can serve as a model for other programs. Because the M.Eng requires support from the MS and PhD programs, only those institutions offering extensive graduate offerings in Civil Engineering taught by PEs will be prepared to offer an M.Eng degree in Civil Engineering.

### ***Clientele and Projected Enrollment***

#### **Clientele**

The primary clientele of the M.Eng in Civil Engineering program are B.S. graduates of CE programs who wish to extend their 4-year education to better prepare them for professional practice in industry or government. It is expected that about 50-60% of the students seeking to pursue a masters degree in Civil Engineering will elect the M.Eng degree; those electing this option will likely be those students already seeking the Plan II options.

Industry has a vested interest in an extended period of education for practicing professionals, because costs for on-the-job training are reduced for them. Another critical factor, for both industry and the engineer, is the extension of the professional lifetime that is possible with life-long education. Full-time students could complete most M.Eng degree programs in three academic semesters. This should be attractive to both industry and students.

The M.Eng degree may also attract individuals who do not have an undergraduate degree in Civil Engineering, or in any Engineering discipline. In these cases, the applicant will be accepted as a candidate for the degree only after they have completed a sufficient number of technical courses to satisfy ABET, Inc.-based requirements in Civil Engineering.

#### **Projected Enrollment**

In the spring semester 2008, the Department of Civil Engineering had 59 students in MSCE and MCM (Master of Construction Management) programs. Of this total, 1 student is taking a coursework only program in Plan II(b), 23 students are taking the Plan II(a) project program, 20 are pursuing a Plan I MS thesis program, and the remaining 15 students (mostly part-time MS) have not declared an option in their programs. Of these 59 students, we expect

about 5 of the undeclared students to select the M.Eng and about 10 of the 23 Option II project students to select the M.Eng, in the first year of the M.Eng program. Moreover, we are expecting approximately 3-4 new students in the first year to matriculate to UNM because of the availability of the M.Eng degree (anecdotal evidence in talking to prospective students). So, for the first year we expect about 20 students to enter the M.Eng program. In subsequent years we see more of the Plan II(b) students to matriculate to the M.Eng as we will be phasing out the Plan II(b) project program.

In September 2007, 76% of our domestic students were part-time students; many of them work at the engineering firms and government labs located in and around Albuquerque. The new M.Eng program will attract new students who did not previously consider post-bachelors education. We are estimating that the percentage of B.S. students going on to Masters programs increase from the current 13% to 25% of our undergraduates in the next 3 years. These assumptions are built into the enrollment projections listed below.

**M.Eng Projected New Enrollments (over current Plan I and Plan II enrollments)**

<b>2009</b>	<b>2009</b>	<b>2010</b>
4	6	8

**M.Eng Projected Enrollments-New Students, Undeclared and Option II conversions**

<b>2009</b>	<b>2009</b>	<b>2010</b>
16	20	26

The following assessment assumes that full-time students will take 24 credit-hours per year and part-time students will take 9 credit-hours per year. We are assuming a 30-70 % mix of part-time to full-time students for the M.Eng. This translates into the student-credit-hours estimated below.

**Expected total M.Eng enrollment and Student-Credit-Hours**

	<b>2008</b>	<b>2009</b>	<b>2010</b>
Enrollment	20	26	34
Student Credit Hours	270	354	456

***Institutional Readiness for the Program***

Because of UNM’s existing M.S. and PhD. programs in Civil Engineering, the institution is well prepared to offer an M.Eng program. The UNM Civil Engineering Department currently has 17 tenure track faculty positions and allows graduate specialization in six areas; construction engineering, environmental engineering, geotechnical engineering, structural engineering and material science, transportation engineering, and water resources-hydraulic engineering. Currently the CE Department offers the following degree programs:



- B.S. in Civil Engineering (130 credits)
- B.S. in Construction Engineering (130 credits)
- B.S. in Construction Management (129 credits)
- M.S. in Civil Engineering, Plan I (32 credits)
- M.S. in Civil Engineering, Plan II (a and b) (35 credits)
- Ph.D. in Engineering (36 units beyond the MS)

### **Teaching Faculty**

All of the CE faculty at UNM are licensed professional engineers in New Mexico or other jurisdictions and are therefore qualified to teach engineering practice-oriented classes as they currently do. The structure's faculty are planning to offer one new practice-oriented course, Timber and Masonry Design, in the spring semester 2008. Other new practice-oriented courses may be planned if significant new enrollments are realized in the future.

### **Library and Academic Support Resources**

No new classes will be needed to implement the M.Eng. degree requirements.

The libraries at UNM are more than sufficient to support the proposed M.Eng degree.

One asset for courses in design-and-practiced oriented subjects is the current suite of 400-level design courses offered to undergraduates as electives. The department currently offers 6 elective design courses to undergraduates; each student must take a minimum of two of these to satisfy BS degree requirements. Students in the M.Eng program could enroll in the 500-level versions of these courses that they have not previously taken and use them, along with others in their core curriculum, to satisfy their curriculum requirements.

### **External Oversight and Faculty Support**

The Civil Engineering Department's Advisory Board (CEDAB) has expressed a strong interest in the improvement of communication skills for CE graduates and incorporation of engineering management topics in the graduate curriculum. A letter from the CEDAB supporting our plan for the M.Eng degree is attached. The M.Eng requirements specify 6-credits in engineering or project management, where classes will be taken in the CE Construction Engineering and Management program or within the Anderson School of Management.

## ***Projected Costs of the Program***

### **New Cost for Program Start-Up**

- *Faculty*: no new faculty positions are to be required in the first 5 years.
- *Library*: no additional costs for the first 5 years.
- *Facilities, Equipment, Technological Resources*: No additional costs expected for the first 5 years

- *Graduate Assistants (GAs)*: No additional positions for the first 2 years. If projected enrollments are realized, then from 1-2 additional GAs may be required.
- *Laboratory Assistance*: After the second year there may be an increase in laboratory work associated with any new practice-oriented courses that may necessitate additional support from a laboratory technician. This additional support for the M.Eng is estimated at 15% (about \$6,000) commencing in the third year of the program. Such a technician is already supported in the department.
- *Administrative*: No additional costs for the first 2 years. If the enrollments increase as projected, then the department may need a 0.25 FTE administrative assistant support. It should be noted this new degree does not necessarily create new workload for UNM, but instead reflects a transfer of administrative work from the Office of Graduate Studies (OGS) as students are expected to switch from M.S. programs administered by OGS to M.Eng. programs administered by the OGS. The only additional workload would come from new students attracted to UNM by the new graduate program.
- *Supplies and Expenses*: Flyers and forms will be required to start up the program at an estimated cost of \$2,000 for the first year.

### **State Support for New Enrollments Only**

No additional support is required. The current total-cost rate per credit-hour for the Engineering-Graduate category is \$1293.45. Projections of student credit hour production support from state-provided I&G dollars, consistent with the credit-hour estimates from the new student enrollment figures (above), with a one year delay assumed are shown below.

<b>2008</b>	<b>2009</b>	<b>2010</b>	<b>2011</b>
0	\$5,174	\$7,761	\$10,348

### **Other Support**

National Engineering Associations, such as the National Academy of Engineering and the National ASCE organization, have adopted programs which enhance engineers education at the initial, practicing level. This new degree is consistent with the guidance and suggestions of these national professional organizations.

### ***Quality of the Program***

- The program will comply with UNM and CHE academic standards.
- A GPA of 3.0 is required for Graduation.
- Passage of a final comprehensive exam covering the practice-oriented core curriculum, administered by the department, is required for Graduation
- Candidates for the degree will be encouraged to sit for the Fundamentals in Engineering (FE) exam if they have not already passed this exam
- The B.S. degree will remain the sole CE accredited degree at the EAC *basic level*.

### ***Assessment of Operations and Impact***

The operation and impact of the program will be monitored at both the departmental and school or engineering levels. Administration of the program is addressed in Section 3.8. An exit questionnaire will be provided to all graduating students, and industrial and alumni surveys will be taken in order to assess the effectiveness of the new program.

### ***Administrative Responsibilities and Institutional Commitment***

The M.Eng. will be administered within the SOE. Admissions will be formally conducted by the SOE based upon recommendation by the CE Department. Advising will be conducted by a faculty advisor selected by the student and agreed to by the CE Graduate Advisor. The SOE will develop policies to deal with problems with academic performance, resolution of disputes with the department, and appeals procedures. Institutional commitment is indicated by the signatures on the University Form D.

## **4. Benefits to UNM and to the Engineering Profession**

Based on a survey of existing CE graduate students, approximately half of the current M.S. students will switch to the M.Eng. option. These students are primarily part-time students who are already employed as engineers and are pursuing a graduate degree to obtain additional knowledge, expertise, and qualifications to further their professional development. Discussion with current graduate students and with practicing engineers in New Mexico suggest that a practice oriented M.Eng. degree will immediately generate an additional two to five graduate students per year who are not interested in the thesis option for the MS degree. It will also significantly shorten the time required to complete a masters degree by eliminating the requirement that a student conduct a research project (thesis).

As noted previously, the American Society of Civil Engineers has recommended that the profession adopt a Body of Knowledge (BOK) plan to be implemented in integrated bachelor's/master's programs to prepare an engineer for licensure as a professional engineer. Initiation of the M.Eng. degree at UNM would be consistent with this recommendation. The vast majority of Civil Engineering graduates become licensed Professional Engineers. The M.Eng degree will assist the long-term goals of many practicing civil engineers.

The Civil Engineering Department has no plans to seek accreditation of the M.Eng. program at the ABET-Inc/EAC *advanced level*. However, this degree will serve the engineering community by enabling students to receive additional practice oriented training in their chosen field. It will also allow UNM to develop experience with advanced, integrated, practice oriented training which may facilitate a smooth transition to an accredited five year program at some point in the future.

## Appendix A

Listed below are schools in states bordering New Mexico that have instituted M.Eng type degrees:

<i>School</i>	<i>Comments</i>
<b>Arizona State University</b>	Master of Science in Engineering (MSE) degree
<b>University of Colorado</b>	Master of Engineering (M.Eng) degree, 30 semester hours
<b>Texas A&amp;M University</b>	Master of Engineering (ME) degree, 36 semester hours
<b>Utah State University</b>	Master of Engineering (ME) degree, 30 semester hours

Four universities that currently have the most extensive M.Eng degree programs are:

**Cornell University** (one of the first schools to introduce the practice oriented M.Eng degree)  
**University of Louisville** (M.Eng ABET, Inc. accredited degree, viewed as the first professional degree in engineering)  
**Rensselaer Polytechnic Institute** (M.Eng, viewed as a degree for practicing professionals)  
**Massachusetts Institute of Technology; M.Eng in Civil and Environmental Engineering** (M.Eng, viewed as a professional degree)

Additionally, in Civil Engineering, at least 3 universities offered M.Eng type degrees for over 3 decades for purposes primarily of offering advanced design-and-practice oriented courses to large cohorts of engineers wishing to enter professional practice:

**Stanford University** (Engr., viewed as a post-masters, practicing degree)  
**Rice University** (M.Eng., ABET, Inc. accredited degree for practicing professionals)  
**University of Southern California** (Engr., viewed as a post masters, practicing degree)

In the Peterson's 2003 listing of Graduate Programs in Engineering and Applied Science, the M.Eng degree was listed for 31 out of a total of 110 Engineering and Applied Sciences programs.

### ***3. Catalog Description***

The Master of Engineering (M.Eng.) degree meets the needs of students and practitioners who seek a practice-oriented engineering degree. The Engineering profession is requesting that students be provided more exposure to engineering design and practice beyond those currently available to undergraduate students. This would specifically include additional training in the traditional studies of engineering science and design, along with expanded emphasis on communication skills (both written and oral) and engineering management.

The M.Eng. degree requirements will consist of:

- 33 credit hours of courses, plus 2 credit hours of CE 691 - Graduate Seminar
  - At least 15 credits of practice-oriented-content graduate level civil engineering classes shall constitute the student's core.
  - At least 12 elective credits of course work from within or outside the department which support the student's area of interest;
  - At least 6 credits of classes in program/project management.
  - A maximum of 12 credit hours can be taken under non-degree status
  - At least 18 units must be numbered 500 or higher
  - Not more than 15 credit hours can be taken from a single instructor

Other entrance and program requirements are provided in the department's manual for graduate studies.

#### **4. Graduate Program Projected Cost**

##### **New Cost for Program Start-Up**

- *Faculty*: no new faculty positions are to be required in the first 5 years.
- *Library*: no additional costs for the first 5 years.
- *Facilities, Equipment, Technological Resources*: No additional costs expected for the first 5 years
- *Graduate Assistants (GAs)*: No additional positions for the first 2 years. If projected enrollments are realized, then from 1-2 additional GAs may be required.
- *Laboratory Assistance*: After the second year there may be an increase in laboratory work associated with any new practice-oriented courses that may necessitate additional support from a laboratory technician. This additional support for the M.Eng is estimated at 15% (about \$6,000) commencing in the third year of the program. Such a technician is already supported in the department.
- *Administrative*: No additional costs for the first 2 years. If the enrollments increase as projected, then the department may need a 0.25 FTE administrative assistant support. It should be noted this new degree does not necessarily create new workload for UNM, but instead reflects a transfer of administrative work from the Office of Graduate Studies (OGS) as students are expected to switch from M.S. programs administered by OGS to M.Eng. programs administered by the OGS. The only additional workload would come from new students attracted to UNM by the new graduate program.
- *Supplies and Expenses*: Flyers and forms will be required to start up the program at an estimated cost of \$2,000 for the first year.

##### **State Support for New Enrollments Only**

No additional support is required. The current total-cost rate per credit-hour for the Engineering-Graduate category is \$1293.45. Projections of student credit hour production support from state-provided I&G dollars, consistent with the credit-hour estimates from the new student enrollment figures (above), with a one year delay assumed are shown below.

<b>2008</b>	<b>2009</b>	<b>2010</b>	<b>2011</b>
0	\$5,174	\$7,761	\$10,348

##### **Other Support**

National Engineering Associations, such as the National Academy of Engineering and the National ASCE organization, have adopted programs which enhance engineers education at the initial, practicing level. This new degree is consistent with the guidance and suggestions of these national professional organizations.

## ***5. Library Impact Statement***

No new classes will be needed to implement the M.Eng. degree requirements.

The libraries at UNM are more than sufficient to support the proposed M.Eng degree.

One asset for courses in design-and-practiced oriented subjects is the current suite of 400-level design courses offered to undergraduates as electives. The department currently offers 6 elective design courses to undergraduates; each student must take a minimum of two of these to satisfy BS degree requirements. Students in the M.Eng program could enroll in the 500-level versions of these courses that they have not previously taken and use them, along with others in their core curriculum, to satisfy their curriculum requirements.

# Proposal

## **Master Of Engineering Degree (M. Eng.) in Civil Engineering**

Department of Civil Engineering  
School of Engineering  
University of New Mexico

February 2, 2009

### *Principal Features*

- Emphasis on engineering practice including design and management
- Intended to be a professional degree, distinct from the MS which requires a thesis.
- Does not require any new classes to be developed by the Department
- A total of 33 hours of academic coursework, with 2 additional hours of seminar
- A 15-hour core curriculum of practice-oriented classes
- A 6-hour block in engineering or project management
- A 3-hour design project for students who do not have an ABET, Inc.-accredited degree or at least two years of design experience.
- Replaces the Plan II options (both IIa and IIb) of the MS degree
- Administered by the Office of Graduate Studies (OGS)
- Entrance requirements:
  - B.S. in Civil Engineering or
  - B.S. in other engineering disciplines or in an approved Science plus remedial classes
  - 3.0 GPA in last two years of a BS program
  - Acceptable score on the GRE or passage of the FE exam
- Must pass a written preliminary examination and a final departmental exam covering the student's curriculum
- Must sit for the FE exam if such exam has not already been passed



## 1. Introduction

This is a proposal to develop and implement a Master of Engineering (M.Eng.) degree in Civil Engineering to meet the needs of students and practitioners who seek an engineering practice-oriented degree distinct from the MS degree which requires a thesis.

There is increasing recognition within the engineering profession of the need for additional academic training beyond that provided at the B.S. level. In New Mexico, the UNM Civil Engineering Department Advisory Board (CEDAB) has recognized the limitations of the current B.S. degree in Civil Engineering and encouraged the Department to improve the accessibility of its masters degree programs. In particular, the profession through the CEDAB is requesting that students be provided more exposure to engineering design and practice beyond that currently available to undergraduate students. This would specifically include additional training in the traditional studies of engineering science and design, along with expanded emphasis on communication skills (both written and oral) and engineering management. The profession believes that these skills can be learned more effectively through a combination of advanced practice-oriented courses rather than by working on a research project (thesis) as part of a traditional M.S. degree program.

In recent years, approximately 50% of the M.S. degrees in civil engineering at UNM have been awarded to part-time students. Many of these students might switch to the M.Eng. option if it were available. A more design/professional-practice focused degree would attract more part-time students.

Students in the UNM School of Engineering may currently pursue a Master of Engineering in Manufacturing Engineering. This is an interdisciplinary degree, administered by the SOE, that allows specialization in manufacturing engineering. In addition, M.Eng programs are being proposed by the faculty within Mechanical Engineering department and the Electrical and Computer Engineering department.

There are currently two degree plans leading to the M.S. degree at UNM in Civil Engineering. Plan I requires completion of a M.S. thesis. Plan II(a), as it is referenced in the CE department, allows students to do additional coursework and complete an M.S. project. This project is intended to demonstrate evidence of the student's ability to conduct high quality work with limited faculty supervision. In many cases, there is little distinction in the level of effort and quality of the final product between students' M.S. theses and M.S. projects. In the late 1990's, the CE faculty approved a coursework-only M.S. program in which students take additional coursework and a comprehensive M.S. examination in lieu of either the thesis or project. Technically, this is a variation of the Plan II M.S. program; we call this Plan II(b). The current Plan II(b) program does not satisfy the needs in the professional practice community because the plan is simply a course-only variant of the M.S degree. The M.Eng program will place more emphasis on practice-oriented classes than the Plan II(b) program, and it will emphasize 6-hours of coursework in engineering management or project management.

Both of the Plan II options will be eliminated once an M.Eng. degree has been implemented. Elimination of the Plan II options will provide one option requiring a thesis and one professional practice option. Hence, the M.Eng will help streamline the degree offerings of the department and provide prospective students with two distinct paths for their advanced degrees.

The proposed M.Eng. degree would have a different mix of classes than the M.S degree and would concentrate more on practice-oriented courses. Hence, it is not an entirely new program in the sense of a new set of courses. Rather, the M.Eng will be comprised of a different mix of classes drawing from the existing MS and PhD offerings. While all classes currently in the civil engineering graduate curriculum will be used to satisfy requirements for the new degree, additional practice-oriented courses in each discipline may be provided in the future if the M.Eng program grows. The M.Eng degree could be obtained within, or combining, any of the department's six concentration areas, with an approved program of study. Just as is allowed for the M.S. degree, elective classes within the M.Eng degree could be a mix of theory and practice-oriented courses. The distinction between the M.Eng and MS will be that the former degree will emphasize more of our practice-oriented courses while the latter degree will emphasize more of our research-or-theory oriented courses. An M.Eng. degree recipient could later pursue enrollment in a Ph.D. program if a sufficient number of theory and research classes were taken prior to admission to Ph.D. candidacy, and reasonable scores on the GRE were obtained.

In the event a candidate for the M.Eng degree comes from a non-ABET, Inc. accredited program or a candidate who does not have at least two years of professional practice, a 3-hour design project will be required in their program of studies. This design project will supplant one of the 3-unit elective courses taken for the degree.

## **2. Admission and Degree Requirements**

### **Admission**

Admission to the M.Eng. program will be based on five components: 1) completion of a B.S. degree in engineering or an approved science, 2) acceptable grade point average, 3) three letters of recommendation, 4) a letter of intent, and 5) an acceptable score on the GRE or passage of the FE exam. The academic requirements for admission are given in more detail, below.

#### B.S. Degree in Engineering or Science

Students admitted to the M.Eng. program must have an engineering or science degree. There are three ways this requirement can be met.

- B.S. Degree in Civil Engineering from an ABET, Inc.-accredited program - No remedial classes would be required for admission
- B.S. Degree in another field of engineering or from a non-ABET, Inc. accredited program - Remedial coursework may be required and will be determined by the CE Graduate Committee on a case-by-case basis depending on the student's background

and his/her intended field of study. Students in this category who do not have at least two years of practice-oriented experience will be required to take a 3-credit course in Project design (see Degree Requirements).

- B.S. Degree in a Science field - The following remedial courses will be required. In these courses a minimum cumulative GPA of 3.0, with no grade lower than a C, will be required.
  - Mathematics through ordinary differential equations (Math 316)
  - 1 class in college chemistry
  - 1 year of calculus-based college physics
  - CE 202 - Statics
  - CE 302 - Mechanics of Materials
  - ME 306 – Dynamics
  - CE 331 - Fluid Mechanics
  - CE 360 Soil Mechanics
  - Students intending to study in an area where this sequence of preparatory courses is not appropriate may substitute one preparatory course in engineering for one of the above courses. Permission to do so must be obtained from the CE faculty in the student's intended area of study. A member of that group will write a memo identifying the sequence to the CE Director of Graduate Programs that will be placed in the student's file.

#### GPA Requirements

Students must have a 3.0 GPA in the last 60 credit hours of undergraduate studies.

#### Letters of Recommendation

All applicants for the M.Eng. degree must submit at least three letters of recommendation.

#### Letter of Intent

All applicants must submit a letter of intent expressing the student's qualifications, professional goals, and intended area of concentration (e.g., structures, environmental, transportation, etc).

#### GRE or FE Exam

Applicants must submit a record of an acceptable score on the GRE, or show evidence of passage of the Fundamentals in Engineering (FE) exam.

#### Admission of Students Who Do Not Meet Minimum Requirements

Students who do not meet the GPA requirements may be granted admission after taking additional advanced-level engineering courses as a non-degree student to demonstrate their ability to conduct high quality work at the masters level. The specific courses to be taken and the required level of performance will be established by the CE Graduate Committee. The GPA requirement may be relaxed for students having significant relevant work experience or other

exceptional credentials such as licensure as a professional engineer; this is the current policy for admission to the departments' graduate programs.

## **Degree Requirements**

Graduate study leading to the M.Eng. degree will be offered within or combining six concentration areas of civil engineering: construction engineering, environmental engineering, geotechnical engineering, structural engineering and material science, transportation engineering, and water resources-hydraulic engineering. Upon admission to the M.Eng. program, the student will select an area of concentration to begin their studies. This area can be changed at any time in consultation with the student's assigned advisor. The M.Eng. degree requirements will consist of:

- 33 credit hours of courses, plus 2 credit hours of CE 691 - Graduate Seminar
  - At least 15 credits of practice-oriented-content graduate level civil engineering classes shall constitute the student's core; the student shall select this core in consultation with their appointed advisor;
  - At least 12 elective credits of course work from within or outside the department which support the student's area of interest;
  - At least 6 credits of classes in program/project management; these classes can be taken in the Anderson School of Management or the Construction Engineering and Management programs within the Civil Engineering department.
  - A maximum of 12 credit hours can be taken under non-degree status
  - At least 18 units must be numbered 500 or higher
  - Not more than 15 credit hours can be taken from a single instructor
- For students who do not meet the entrance requirement for practice-oriented experience, 3-credits of CE 588 – Civil Engineering Project. This class will consist of an independent design project, to be conducted by the student, under the guidance of a faculty member in the student's chosen area of emphasis; this faculty mentor shall be a licensed professional engineer (PE). This course shall supplant one of the courses in the students elective classes.
- Minimum 3.0 overall GPA in the degree program.
- All candidates for the M.Eng. degree must pass two (2) departmental examinations in their chosen core curriculum. The first exam (preliminary) must be taken prior to submitting the student's Program of Studies. The exam should be taken as early as possible, typically after completion of 12 to 16 graduate credits. It is only after successful completion of this exam that a student can submit a Program of Studies for the M.Eng degree. The preliminary exam shall be a written exam. Successful completion of a final Departmental examination at the conclusion of all coursework, comprised of a written exam similar in content to the PE exam, is required. The examinations are to be administered by the CE Director of Graduate program based on input from a committee assembled at the beginning of each academic year.
  - All candidates must sit for the Fundamentals of Engineering (FE) exam, if they have not already passed this examination

A list of potential courses to make up the students core curriculum is listed below. These classes constitute those currently offered by the department which contain material which covers at least 50% practice-oriented or design-oriented content.

The list is organized by discipline, but students in the M.Eng program can select their core curriculum from any of the courses. Many of the courses listed below are not offered on an annual basis, but they are currently part of our curricula offerings.

### **List of Potential Core Curriculum classes**

#### **Structural Engineering**

- CE 511 - Reinforced Concrete Design
- CE 524 - Steel Design
- CE 562 - Foundation Engineering
- CE 503 - Composite Materials
- CE 506 - Pre-stressed Concrete Design
- CE 508 – Analysis and Design of Plates and Shells
- CE 518 - Structural Stability
- CE 520 - Structural Dynamics
- CE 521 - Earthquake Engineering
- CE 598 - Masonry and Timber Design (new class, Spring 2008)

#### **Water Resources, Hydraulics, and Environmental Engineering**

- CE 531 - Physical-Chemical, Water & Wastewater Treatment I
- CE 532 - Physical-Chemical, Water & Wastewater Treatment II
- CE 536 - Biological Wastewater Treatment
- CE 540 - Design of Hydraulic Systems
- CE 541 - Groundwater Engineering
- CE 542 – Intermediate Hydrology
- CE 544 - Water Resources Engineering
- CE 545 - Open Channel Hydraulics
- CE 546 - Hydraulic Structures
- CE 547 - GIS Applications in Water Resources

#### **Geotechnical Engineering**

- CE549 - Vadose zone hydrology
- CE 551x - Asphalt Materials and Mix Design
- CE 551x - Geo-environmental Engineering
- CE 561 - Advanced soil mechanics lab
- CE 562 - Foundation Engineering I
- CE 563 - Earth Structures
- CE564 - Rock Mechanics
- CE 566 - Structural Pavement Design

CE 567 - Foundation Engineering II  
CE 568 - Soil Dynamics

**Transportation Engineering**

CE 566 – Pavement Design  
CE 580 – Highway Traffic Design  
CE 582 – Highway and Traffic Engineering  
CE 551x - Asphalt Materials and Mix Design  
Any Construction Engineering Course

**Construction Engineering**

CE 573 - Construction Law  
CE 574 – Principles of Construction Documents  
CE 575 – Construction Safety  
CE 577 – Project Controls  
CE 57x – Sustainable Design and Construction  
CE 598 – Construction Methods and Equipment  
CE 598 – Project Delivery Systems

All M.Eng students will be required to take 6 credit-hours of project management or engineering management classes. They may select from the list below or seek approval from their graduate committee for any substitutions to these.

**Project and Engineering Management**

CE/ME 455 – Engineering Project Management  
MGMT 501, 502, 506, 508, 511, 520  
MGMT 520 – Operations Management  
CE 577 – Project Controls  
CE 598 – Project Delivery Systems

### **3. Commission on Higher Education Proposal Guidelines**

#### **Purpose of the Program and Mission of the Proposing Institution**

The purpose of the M.Eng degree is to provide post-baccalaureate professional education in Civil Engineering. The M.Eng degree, in contrast to the M.S. degree which includes a thesis, is a practice-oriented degree program, meant to augment the education received at the undergraduate level in civil engineering practice and design. Important courses that provide breadth and depth in professional specialties cannot be taken by students who wish to finish their BS programs in 4 years. Technology has expanded tremendously since the early 1900's, when engineering education started with 4-year programs.

Providing proper *professional* education is a key mission of the University. The University prides itself on offering comprehensive education programs at the undergraduate, graduate and *professional* levels. Strong professional education in engineering is also very critical for the economic development of our community, our state, and our region.

#### ***Justification for the Program***

##### **Need**

There is increasing recognition within the engineering profession of the need for additional academic training beyond that provided at the B.S. level. Indeed, the American Society of Civil Engineers (ASCE) concluded in 2001 that the current four-year bachelor's degree is becoming inadequate formal academic preparation for the practice of civil engineering at the professional level in the 21<sup>st</sup> century. In November 2001 the ASCE Board of Directors issues ASCE Policy 465 that "supports the concept of the master's degree or equivalent as a prerequisite for licensure and the practice of civil engineering at the professional level." In November 2003, ASCE moved to implement Policy 465 and formed a committee to make recommendations for implementation; this committee is called the Committee on Academic Prerequisites for Professional Practice. This same committee developed what they termed "a Body of Knowledge (BOK) for any aspiring engineer." The committee enlisted 10 academic institutions to help create the BOK for the design of bachelor's/master's degree tracks focused at professional practice. Policy 465 signifies that ASCE formally recognizes that young engineers must be better prepared for the future, both by taking more coursework in the principles of engineering and by expanding the curriculum to include more experience in the engineering practice-oriented process.

The need to provide practice-oriented professional education beyond the bachelors degree has been recognized in a number of recent studies on engineering education, e.g. the Board on Engineering Education (BEEEd) study, *Engineering Education. Designing an Adaptive System*, 1995. In addition, the National Academy of Engineering, in their 2005 report *Educating the Engineer of 2020*, recognizes the difficulty of training and educating an engineer in 4 years and recommends that a masters degree be the first professional degree in engineering. Development

of an M.Eng now might prepare our department for such a possibility in the future. Appendix A provides a list of schools in our region and nationwide which have adopted an M.Eng degree.

### **Duplication**

Currently no institution in the state of New Mexico offers an M.Eng in Civil Engineering. A list of neighboring states which do provide this degree is provided in Appendix A. The School of Engineering at UNM currently offers an M.Eng degree in Manufacturing Engineering, and is considering two other M.Eng degrees (one in Mechanical Engineering and one in Electrical and Computer Engineering).

### **Inter-Institutional Collaboration and Cooperation**

Because of the professional need for the M.Eng degree programs, it can be expected that other institutions in the state that offer Civil Engineering programs may pursue such a degree. The M.Eng at UNM can serve as a model for other programs. Because the M.Eng will draw from the same curriculum offerings that support the MS and PhD programs, only those institutions offering graduate classes in Civil Engineering taught by PEs will be prepared to offer an M.Eng degree in Civil Engineering.

### ***Clientele and Projected Enrollment***

#### **Clientele**

The primary clientele of the M.Eng in Civil Engineering program are B.S. graduates of CE programs who wish to extend their 4-year education to better prepare them for professional practice in industry or government. It is expected that about 50-60% of the students seeking to pursue a masters degree in Civil Engineering will elect the M.Eng degree; those electing this option will likely be those students already seeking the Plan II options.

Industry has a vested interest in an extended period of education for practicing professionals, because costs for on-the-job training are reduced for them. Another critical factor, for both industry and the engineer, is the extension of the professional lifetime that is possible with life-long education. Full-time students could complete most M.Eng degree programs in three academic semesters. This should be attractive to both industry and students.

The M.Eng degree may also attract individuals who do not have an undergraduate degree in Civil Engineering, or in any Engineering discipline. In these cases, the applicant will be accepted as a candidate for the degree only after they have completed a sufficient number of technical courses to satisfy ABET, Inc.-based requirements in Civil Engineering.

#### **Projected Enrollment**

In the spring semester 2008, the Department of Civil Engineering had 59 students in MSCE and MCM (Master of Construction Management) programs. Of this total, 1 student is taking a coursework only program in Plan II(b), 23 students are taking the Plan II(a) project program, 20 are pursuing a Plan I MS thesis program, and the remaining 15 students (mostly part-time MS) have not declared an option in their programs. Of these 59 students, we expect



about 5 of the undeclared students to select the M.Eng and about 10 of the 23 Option II project students to select the M.Eng, in the first year of the M.Eng program. So, for the first year we expect about 20 students to enter the M.Eng program from the current cohort of MS students. In subsequent years we expect more of the Plan II(b) students to matriculate to the M.Eng as we will be phasing out the Plan II(b) project program.

In September 2007, 76% of our domestic students were part-time students; many of them work at the engineering firms and government labs located in and around Albuquerque. The new M.Eng program may attract new students who did not previously consider post-bachelors education.

### **M.Eng Projected Enrollments-New Students, Undeclared and Option II conversions**

<b>2009</b>	<b>2009</b>	<b>2010</b>
16	20	26

### ***Institutional Readiness for the Program***

Because of UNM's existing M.S. and PhD. programs in Civil Engineering, the institution is well prepared to offer an M.Eng program. The UNM Civil Engineering Department currently has 17 tenure track faculty positions and allows graduate specialization in six areas; construction engineering, environmental engineering, geotechnical engineering, structural engineering and material science, transportation engineering, and water resources-hydraulic engineering. Currently the CE Department offers the following degree programs:

- B.S. in Civil Engineering (130 credits)
- B.S. in Construction Engineering (130 credits)
- B.S. in Construction Management (129 credits)
- M.S. in Civil Engineering, Plan I (32 credits)
- M.S. in Civil Engineering, Plan II (a and b) (35 credits)
- Ph.D. in Engineering (36 units beyond the MS)

### **Teaching Faculty**

All of the CE faculty at UNM are licensed professional engineers in New Mexico or other jurisdictions and are therefore qualified to teach engineering practice-oriented classes as they currently do. The structure's faculty developed one new practice-oriented course, Timber and Masonry Design, in the spring semester 2008. Other new practice-oriented courses may be planned if significant new enrollments are realized in the future.

### **Library and Academic Support Resources**

No new classes will be needed to implement the M.Eng. degree requirements.

The libraries at UNM are more than sufficient to support the proposed M.Eng degree.

One asset for courses in design-and-practiced oriented subjects is the current suite of 400-level design courses offered to undergraduates as electives. The department currently offers 6 elective design courses to undergraduates; each student must take a minimum of two of these to satisfy BS degree requirements. Students in the M.Eng program could enroll in the 500-level versions of these courses that they have not previously taken and use them, along with others in their core curriculum, to satisfy their curriculum requirements.

### **External Oversight and Faculty Support**

The Civil Engineering Department's Advisory Board (CEDAB) has expressed a strong interest in the improvement of communication skills for CE graduates and incorporation of engineering management topics in the graduate curriculum. A letter from the CEDAB supporting our plan for the M.Eng degree is attached. The M.Eng requirements specify 6-credits in engineering or project management, where classes will be taken in the CE Construction Engineering and Management program or within the Anderson School of Management.

### ***Projected Costs of the Program***

The expected cost of starting up the M.Eng program will be minimal (see estimates below) because the program will draw upon the existing curriculum and faculty for the MS and PhD programs. To reiterate, the M. Eng degree (design/professional practice) is a different mix of classes from the MS (research) degree.

### **New Cost for Program Start-Up**

- *Faculty*: no new faculty positions are to be required in the first 5 years.
- *Library*: no additional costs for the first 5 years.
- *Facilities, Equipment, Technological Resources*: No additional costs expected for the first 5 years
- *Graduate Assistants (GAs)*: No additional positions for the first 5 years.
- *Laboratory Assistance*: After the third year there may be an increase in laboratory work associated with any increased enrollments that may necessitate additional support from a laboratory technician. This additional support for the M.Eng is estimated at 15% (about \$6,000) commencing in the fourth year of the program. Such a technician is already supported in the department.
- *Administrative*: No additional costs for the first 3 years. If the enrollments increase as projected, then the department may need a 0.25 FTE administrative assistant support. It should be noted this new degree does not necessarily create new workload for UNM, but instead reflects a transfer of administrative work from the Office of Graduate Studies (OGS) as students are expected to switch from M.S. programs administered by OGS to M.Eng. programs administered by the OGS. The only additional workload would come from new students attracted to UNM by the new graduate program.
- *Supplies and Expenses*: Flyers and forms will be required to start up the program at an estimated cost of \$2,000 for the first year.

### **Other Support**

National Engineering Associations, such as the National Academy of Engineering and the National ASCE organization, have adopted programs that enhance engineering education at the initial, practicing level. This new degree is consistent with the guidance and suggestions of these national professional organizations.

### ***Quality of the Program***

- The program will comply with UNM and CHE academic standards.
- A GPA of 3.0 is required for Graduation.
- Passage of a final comprehensive exam covering the practice-oriented core curriculum, administered by the department, is required for Graduation
- Candidates for the degree will be encouraged to sit for the Fundamentals in Engineering (FE) exam if they have not already passed this exam
- The B.S. degree will remain the sole CE accredited degree at the EAC *basic level*.

### ***Assessment of Operations and Impact***

The operation and impact of the program will be monitored at both the departmental and school or engineering levels. Administration of the program is addressed above. An exit questionnaire will be provided to all graduating students, and industrial and alumni surveys will be taken in order to assess the effectiveness of the new degree.

### ***Administrative Responsibilities and Institutional Commitment***

The M.Eng. will be administered within the SOE. Admissions will be formally conducted by the SOE based upon recommendation by the CE Department. Advising will be conducted by a faculty advisor selected by the student and agreed to by the CE Graduate Advisor. The SOE will develop policies to deal with problems with academic performance, resolution of disputes with the department, and appeals procedures. Institutional commitment is indicated by the signatures on the University Form D.

## **4. Benefits to UNM and to the Engineering Profession**

Based on a survey of existing CE graduate students, approximately half of the current M.S. students will switch to the M.Eng. option. These students are primarily part-time students who are already employed as engineers and are pursuing a graduate degree to obtain additional knowledge, expertise, and qualifications to further their professional development. Discussion with current graduate students and with practicing engineers in New Mexico suggests that a

practice oriented M.Eng. degree will likely generate additional graduate students who are not interested in the thesis option for the MS degree. It will also significantly shorten the time required to complete a master's degree by eliminating the requirement that a student conduct a research project (thesis).

As noted previously, the American Society of Civil Engineers has recommended that the profession adopt a Body of Knowledge (BOK) plan to be implemented in integrated bachelor's/master's programs to prepare an engineer for licensure as a professional engineer. Initiation of the M.Eng. degree at UNM would be consistent with this recommendation. The vast majority of Civil Engineering graduates become licensed Professional Engineers. The M.Eng degree will assist the long-term goals of many practicing civil engineers.

The Civil Engineering Department has no plans to seek accreditation of the M.Eng. program at the ABET-Inc/EAC *advanced level*. However, this degree will serve the engineering community by enabling students to receive additional practice oriented training in their chosen field. It will also allow UNM to develop experience with advanced, integrated, practice oriented training which may facilitate a smooth transition to an accredited five year program at some point in the future.

## Appendix A

Listed below are schools in states bordering New Mexico that have instituted M.Eng type degrees:

<u>School</u>	<u>Comments</u>
<b>Arizona State University</b>	Master of Science in Engineering (MSE) degree
<b>University of Colorado</b>	Master of Engineering (M.Eng) degree, 30 semester hours
<b>Texas A&amp;M University</b>	Master of Engineering (ME) degree, 36 semester hours
<b>Utah State University</b>	Master of Engineering (ME) degree, 30 semester hours

Four universities that currently have the most extensive M.Eng degree programs are:

**Cornell University** (one of the first schools to introduce the practice oriented M.Eng degree)  
**University of Louisville** (M.Eng ABET, Inc. accredited degree, viewed as the first professional degree in engineering)  
**Rensselaer Polytechnic Institute** (M.Eng, viewed as a degree for practicing professionals)  
**Massachusetts Institute of Technology; M.Eng in Civil and Environmental Engineering** (M.Eng, viewed as a professional degree)

Additionally, in Civil Engineering, at least 3 universities offered M.Eng type degrees for over 3 decades for purposes primarily of offering advanced design-and-practice oriented courses to large cohorts of engineers wishing to enter professional practice:

**Stanford University** (Engr., viewed as a post-masters, practicing degree)  
**Rice University** (M.Eng., ABET, Inc. accredited degree for practicing professionals)  
**University of Southern California** (Engr., viewed as a post masters, practicing degree)

In the Peterson's 2003 listing of Graduate Programs in Engineering and Applied Science, the M.Eng degree was listed for 31 out of a total of 110 Engineering and Applied Sciences programs.