

MASTER OF ENGINEERING A ROAD TO PROFESSIONAL DEVELOPMENT

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INTRODUCTION

The University of Minnesota Duluth offers Bachelor of Science degrees in Chemical, Civil, Electrical and Computer, Industrial, and Mechanical Engineering with a combined enrollment approaching 1000 students. In addition, Master of Science degrees in Electrical and Computer Engineering, Engineering Management, and a Master of Environmental Health and Safety program are also offered. To respond to our constituencies, the increasing regional need for professional development opportunities for engineer practitioners, and recognizing that there are potential changes in obtaining licensure requirements, UMD now offers a Professional Master of Engineering degree. The Professional Master Of Engineering degree emphasizes the practice of engineering in either the private or public sector. This new degree program, approved at the December 2009 Board of Regents Meeting, focuses on developing competencies in the areas of engineering design, problem solving, and practice beyond what can be achieved in earning a Bachelor of Science degree in a given engineering discipline.

An **MEng** graduate student is expected to have a focus and degree designation in one of the core UMD disciplines of Chemical Engineering, Civil Engineering, Electrical and Computer Engineering, Industrial Engineering, or Mechanical Engineering.

This paper provides some background in the development and implementation of this degree program and its expected impact on regional engineering education.

JUSTIFICATION

We are basically responding to a key portion of the UMD Mission Statement which reads, *“UMD serves northern Minnesota, the state, and the nation as a medium-sized comprehensive university dedicated to excellence in all of its programs and operations. As a university community in which knowledge is sought as well as taught, its faculty recognizes the importance of scholarship and service, the intrinsic value of research, and the significance of a primary commitment to quality instruction.....”* Our constituencies in the region also includes the Iron Range public and private sector employers. Our engineering graduates, public and private sector employers, and the professional societies have asked for expanded graduate engineering professional development opportunities.

A flexible, primarily coursework, **MEng** degree does:

- Provide an opportunity for student and engineering alumni professional development
- Address regional private and public sector needs for a graduate level technically-trained workforce
- Strengthen the regional economic base and attractiveness as a place to live and work for engineering professionals
- Offer post-baccalaureate engineering education opportunities to engineers employed on the Minnesota Iron “Range”
- Provide expanded opportunities for faculty in Chemical Engineering, Civil Engineering, Electrical and Computer Engineering, Industrial Engineering and Mechanical Engineering to engage in applied research and development activities with the private and public sectors
- Enhance UMD engineering faculty career development and retention.
- Expand opportunities for external research funding from the private and public sectors.

EXTERNAL FORCES

Another major driver in offering an MEng degree is recognizing that there are changes looming on the horizon with respect to professional engineering licensure and also related to this issue is the amount of mathematics, science, and discipline-specific technical courses that can be accommodated in a standard 4-year, 128-130 semester credit undergraduate engineering program. Stated in a National Academy of Engineering report ⁽¹⁾, *“It is evident that the exploding body of science and engineering knowledge cannot be accommodated within the context of the traditional four year baccalaureate degree”*.

The National Council of Examiners for Engineering and Surveying (NCEES), the National body responsible for the FE and PE examinations, have promulgated the following change in the “Model Law” when working with individual State engineering licensing boards ⁽²⁾. The change states,

“... that to sit for the PE exam a person must have either an MS from an EAC/ABET accredited program or equivalent, and 3 or more years of experience OR a BS from an EAC/ABET accredited program or equivalent, an additional 30 credit hours of acceptable coursework from approved course providers and 4 or more years of experience.”

The “Model Law” becomes effective in year 2020. Other requirements remain unchanged.

The Professional Societies have a mixed response to this NCEES “Model Law”. By far, the American Society of Civil Engineers (ASCE) is the strongest professional society supporting this “Model Law”. According to PS 465(Policy Statement 465)⁽³⁾,

“...the ASCE Book of Knowledge (BOK) will be fulfilled by means of formal education and experience—that is, a bachelor’s degree plus a master’s degree, or approximately 30 semester credits, and experience. Two common fulfillment paths were developed—one involving an accredited bachelor’s degree in civil engineering followed by a master’s degree, or approximately 30 semester credits of acceptable graduate-level or upper-level undergraduate courses, and the other

using an appropriate bachelor's degree followed by an accredited master's degree."

The official position of ASME is the one the ASME Board adopted April 24-25, 2008⁽⁴⁾, *"ASME General Position Statement on Mandatory Educational Requirements for Engineering Licensure," which expresses ASME's opposition to Master's or Equivalent. The position statement has been endorsed by eight other engineering organizations since its release: AIChE, ASHRAE, IESNA, IIE, ISA, SME, SNAME and TMS.*

The official position of the IEEE states,

"IEEE-USA neither supports nor opposes the National Council of Examiners for Engineering and Surveying (NCEES) decision to recommend that engineers who have successfully completed accredited baccalaureate-degree educational programs be required to take 30 additional hours of engineering education to become licensed, beginning in 2020. IEEE-USA recommends that NCEES work with ABET and concerned professional societies to ensure that the proposed additional education requirement is better defined, and to develop a clearly articulated process by which state licensing boards can ensure that individual applicants for licensure have met the requirement. Such actions will better serve the career needs of electrical engineers and the public need for an adequate supply of licensed professional engineers. IEEE-USA"

David L. Whitman, Ph.D., P.E., NCEES President, presented an overview of the current status of the "Model Law" at the ASEE Engineering Deans Institute, April 2010⁽⁶⁾. He is aware of the mixed responses and additional discussion is scheduled for the August NCEES meeting.

Even though the National professional societies provide a mixed message, we expect a significant number of graduates in the new UMD Civil Engineering program will want to pursue this BS + 30 option leading to eventual licensure. Career opportunities are severely limited for BS graduates who do not pass the Fundamentals of Engineering exam as the initial step leading to Professional Engineering licensure and it appears that licensure will require some type of a BS + 30. In a sense, we are being proactive in the development and offering of the **MEng** degree in response to these potential changes.

THE PROGRAM

Virtually all of the ASEE North Midwest Section member universities offer a variety of Master of Engineering, or similar degree monikers, with a focus on engineering or a specific discipline within engineering. In general, these programs focus on a strong emphasis towards the practice of engineering in industry, business, or government. In addition, these programs:

- Cater to a regional constituency
- Cater to place and time bound students
- Include minimal project or research components

- Have different admission requirements than a Master of Science degree program. Typically this includes undergraduate GPAs in the 2.5 to 3.0/4.0 range and consideration of post-baccalaureate professional experience
- Require a minimum of 30 post-baccalaureate semester credits

and are often, but not always, considered as a terminal degree, not directed toward continuation in a Ph. D. program.

The focus and content of the UMD **MEng** program is congruent with these characteristics. The requirements are similar to many other programs.

The UMD **MEng** degree program is primarily a coursework degree program, often referred to as a Plan C at the UMTC, with a minimum of three credits and a maximum of six credits allocated to a design project to be arranged between the Departmental Advisor and student. The 30 credits require a minimum of 14 credits at 5XXX or higher, and a cap of 6 credits on 4XXX courses. There is no requirement for a final exam above and beyond what is required in individual courses. Deviations from Table 1 must be agreed upon by the Departmental Advisor and student. The resultant Program of Study must then be approved by the Department, the SCSE **MEng** Director of Graduate Studies and forwarded to the UMD Office of Graduate Education for final approval.

Many classes are conveniently offered in the late afternoon or evening and many courses are offered by ITV or enhanced face-to-face at the Mesabi Range Community and Technical College in Virginia, MN as part of the Iron Range Graduate Engineering Education Program⁽⁷⁾.

Course Requirements	Semester Credits	Course Level
Major Plan Department: ChE, CE, ECE, ME (within MIE), IE (within MIE)	12 Minimum	5XXX or 8XXX***, Selected 4XXX courses*
Engineering Course Project within the Major Plan Department: ChE, CE, ECE, ME (within MIE), IE (within MIE)	3 to 6	5XXX to be arranged by the Departmental Advisor and student.
Other Engineering****	6 to 9	Selected 4XXX; 5XXX, 8XXX
Non Engineering**	3 Minimum	Graduate Courses-Approved Lists
TOTAL APPROVED CREDITS	30 Minimum	

TABLE 1 Master of Engineering Program

* Identical/similar courses taken as part of an undergraduate degree either at UMD or at another institution can not be repeated or applied as part of the **MEng** program. The Departmental Advisor and the SCSE Director of Graduate Studies will work with the student on this issue when setting up the Program of Study.

** Non-engineering courses would consist of courses approved for graduate credit by the Departments of Computer Science, Mathematics and Statistics, Physics, Chemistry, Geological Sciences, or Biology. Identical/similar courses taken as part of an undergraduate degree either at UMD or at another institution can not be repeated or applied as part of the **MEng** program.

The Departmental Advisor and the SCSE Director of Graduate Studies will work with the student on this issue when setting up the Program of Study.

**** In consultation with their Departmental Advisor, students may choose to include one or more 8XXX courses in their Program of Study. It should be noted that even though there are no requirements for 8XXX courses, **MEng** students who meet the course prerequisites for 8xxx courses in Electrical and Computer Engineering, Engineering Management, Geologic Sciences, and Computer Science will be encouraged to include these courses in their degree program.*

***** Courses selected in collaboration with the Departmental Advisor.*

All **MEng** Graduate Students will have a Departmental Advisor. Non-faculty, including members of the industrial community, are invited to collaborate and work with the student and Departmental Advisor.

Any project report or presentation requirement within the 3-6 credits of the engineering course project are at the option of the Departmental Advisor and Department.

Admission requires that an applicant has:

- Completed an undergraduate degree in an engineering program, or upon approval by the SCSE **MEng** Director of Graduate Studies, in a related discipline, e.g., computer science, physics, etc.
- Earned an undergraduate grade point average (GPA) of 3.00 (on a 4.0 scale) for admission. This preferred performance minimum of a 3.0*/4.0 GPA must be from an ABET accredited program or equivalent.
- Provided two letters of recommendation-academic and/or professional references

** Industrial experience and professional licensure will be considered for applicants with a grade point less than the preferred minimum*

In addition:

- For international applicants whose native language is not English, a TOEFL score preferred performance minimum is 213 on the computer based test.
- The GRE score is recommended but not required

SUMMARY

The University of Minnesota Duluth Swenson College of Science and Engineering (SCSE) now offers a **Professional Master Of Engineering** degree. The **MEng** addresses regional private and public sector needs as well as responds to external forces in the engineering profession. This degree program is designed to provide a strong emphasis toward the practice of engineering by focusing on the development of competencies in the areas of engineering design, problem solving, and practice beyond what can be achieved in earning a Bachelor of Science degree in a given discipline. An **MEng** graduate is required to specify a degree designation in one of the core UMD disciplines: Chemical Engineering, Civil Engineering, Electrical and Computer Engineering, Industrial Engineering, or Mechanical Engineering.

Additional information is available at <http://www.d.umn.edu/scse/degrees/MEng/index.html>

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 - The American Society of Civil Engineers (ASCE)-Duluth Section 3
 - Institute of Electrical and electronics Engineers (IEEE)-Arrowhead Section
 - Duluth Engineers Club
 - Minnesota Society of Professional Engineers-Arrowhead Chapter

REFERENCES

1. *Educating the Engineering of 2020, National Academy of Engineering 2005*
2. *Section 130.10.C.c, page 12 of NCEES Model Law.*” National Council of Examiners for Engineering and Surveying
3. Civil Engineering Body of Knowledge for the 21st Century Preparing the Civil Engineer for the Future Second Edition Copyright © 2008 by the American Society of Civil Engineers
4. <http://www.licensingthatworks.org/FAQs.cfm>
5. <http://www.ieeeusa.org/policy/positions/LicensureEducation1109.pdf>
6. <http://www.asee.org/conferences/edi/2010/upload/Whitman.pdf>
7. IRR Higher Education Committee (multiple meetings 2009 and 2010)

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Dr. Burns served as ECE Department Head at the University of Minnesota Duluth from 1998-2007 and was appointed an Associate Dean in the Swenson College of Science and Engineering and Jack Rowe Professor in the Department of Electrical and Computer Engineering, May 2007. His research interests include microelectronics processing, analog circuit design, sensors, and instrumentation. Dr. Burns teaches courses in semiconductors devices, and analog electronic circuit design. Prior to that coming to UMD, he was a Professor in the Electrical and Computer Engineering Department at Iowa State University. Professor Burns has twice received the National (IEEE) Outstanding Advisor Award for his work with the Iowa State University (ISU) IEEE student branch and received the ISU College of Engineering Superior Engineering Teacher Award. He is active in the ASEE, Senior Member of IEEE, and a registered Professional Engineer in Minnesota and Iowa. He received the B.S.E.E. (1967), the M.S.E.E. (1968), and the Ph.D. (1972) from the University of Wisconsin-Madison.