

MASTERS OF ENGINEERING IN MECHANICAL ENGINEERING

Department of Aerospace and Mechanical Engineering University of Notre Dame

1.) PROGRAM GOALS AND OBJECTIVES:

In response to the ever changing challenges in graduate education, the Department of Aerospace and Mechanical Engineering proposes the development and implementation of a Master of Engineering in Mechanical Engineering (MEME) degree. This program is intended to prepare participating students for leadership roles in the guidance and direction of technological innovation in industry.

This program will focus on many aspects of the development of an engineered product or process. It is this emphasis on product and process that will bring to the student a truly multidisciplinary perspective which is required in order to understand how technology can be effectively applied in satisfying societal needs and solving its problems. With the ever increasing importance of science and technology in today's society, it is imperative that the leaders in industry and government be prepared not only to understand the potential of the technology but they must also understand how to best integrate new and existing technology into society. The engineer's role in society is to develop tools, products and processes.

Within the past 50 years many of these tools, products or processes have become much more complex and their influence on society more far-reaching. It is more apparent than ever that today's technological developments are the result of the efforts of many individuals, working together on complex multidisciplinary programs, often in multi-national groups. Technology has helped create a world community and now academia is faced with the challenge of educating tomorrow's leaders to cope with this explosion in the complexity and influence of technology.

This emerging role of the 21st century engineer will, more than ever, require effective communication and information-management skills and the ability to deal with collaborative project development in multi-national environments. Engineers must understand how business practice and societal needs influence technological development, and be prepared for a career of technical evolution and constant change.

Since the focus of this proposed program will be on the development of products and processes, the inherent multidisciplinary nature of each will serve to provide the desired program breadth. It is proposed that students find a faculty advisor and jointly formulate a research/design project. These projects can be either individual research projects or team based design projects. These projects are often done in collaboration with an industrial organization. Therefore, there will not be a specific technology area to which the projects will be limited. As one would expect, the projects will be driven by the backgrounds and experiences of the participating faculty, student and industrial partners.

At this time a number of focus areas are being considered and each will be evaluated to select those most appropriate for the first phases of this effort. These have been developed based upon the experience of participating faculty. They include:

- autonomous electro-mechanical systems
- vision based control of electro-mechanical systems
- advanced rapid-prototyping and rapid-production manufacturing processes.

Other potential research/design projects may include biomedical design projects or micro-electrical mechanical systems (MEMS) devices designed for flow control to name just a few.

2.) PROGRAM STRUCTURE:

The proposed MEME program is intended to be a one year academic program. Two semesters are primarily devoted to coursework and project planning and the following summer term is used for the individual or team-based project. During the first two semesters the students will build upon their undergraduate experiences by taking 8 courses. These include a core of four courses from within the AME Department, and then selected courses in the College of Business related to design, manufacturing and management; the remaining courses would be electives dictated by the technical focus of the project and approved by the faculty advisor. It should be noted that no new courses are required to implement the MEME program.

As part of this educational program we propose to invite industrial partners to campus. These visits are intended to provide both the industrial visitor and the program participants with better perspectives on the contributions of each and to enhance communication between both sectors. It is planned that visitors will provide seminars and assist in the selection of projects and evaluation of progress for individual project teams. Similarly one factor which will bear strongly upon the selection of industrial partners is the identification of those organizations which will support the concept of encouraging their employees to consider participation in this program as well as providing on-site, extended “intern” experiences for the student participants.

3.) CONFIGURATION AND REQUIREMENTS

The Master of Engineering in Mechanical Engineering (MEME) is a one-year professional masters degree program that allows students to develop a high level of competence in engineering design, manufacturing and business practice. Practicing engineers can participate in this program on a part time basis. This program provides students exposure to an engineering research project, which typically includes design and analysis. This option requires students to find a faculty advisor and jointly formulate a research/design project. These projects can be either individual research projects or team based design projects. Research projects are often done in collaboration with an industrial organization. Students are required to write and defend a research report at the end of their study. A minimum of 30 credits of technical coursework are required, including a maximum of 6 credits of directed studies with their advisor. The program has a great deal of flexibility, allowing students to tailor a program of study to their individual needs and interests.

A) The MEME Design and Manufacturing Core. At the core of the MEME program is a four course sequence of design and manufacturing courses. These courses are as follows:

Statistical Quality Methods	AME 50561	(3 credits)
Finite Element Methods for Structural Analysis	AME 50541	(3 credits)
Engineering Analysis of Manufacturing Systems	AME 50542	(3 credits)
Optimum Design of Mechanical Elements	AME 60661	(3 credits)

Students who have already taken one of the design and manufacturing core courses at Notre Dame or an equivalent course at another university should petition the graduate studies committee to substitute an engineering elective in place of a core requirement.

B) The MEME Business Elective. MBA Course Requirements. To satisfy degree requirements for the MEME program, students must take a minimum of three credits of MBA courses. MEME students may take up to a total of six credits of MBA courses. MBA courses are offered as one, two, three or four credit classes. MEME students can take courses from the following selection of MBA courses, if the MBA program has open seats (see MBA office for waiver form) and the professor gives his/her permission.

Manufacturing Management Courses:

Strategic Cost Analysis	ACCT XXXXX	(2 credits)
New Products Marketing	MARK 70450	(2 credits)
Negotiation	MGT 70430	(2 credits)
International Manufacturing	MGT XXXXX	(2 credits)
Supply Chain Management	MGT XXXXX	(2 credits)
Spreadsheet Decision Modeling	MGT XXXXX	(2 credits)
Technology and Business	MGT XXXXX	(2 credits)

Consulting Courses:

Project Management	MGT 60750	(2 credits)
Innovation	MGT 70420	(2 credits)
Innovation Seminar	MGT 70425	(2 credits)
Organizational Consulting	MGT 70490	(2 credits)

Operations Courses:

Strategic Cost Analysis	ACCT XXXXX	(2 credits)
Negotiation	MGT 70430	(2 credits)

Operations Courses (continued):

Supply Chain Management	MGT XXXXX	(2 credits)
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Technology and Business	MGT XXXXX	(2 credits)
Information Technology Courses:		
Strategic Cost Analysis	ACCT XXXXX	(2 credits)
Negotiation	MGT 70430	(2 credits)
Organizational Consulting	MGT 70490	(2 credits)
Business Intelligence	MGT XXXXX	(2 credits)
Spreadsheet Decision Modeling	MGT XXXXX	(2 credits)
Technology and Business	MGT XXXXX	(2 credits)
eBusiness Technology	MGT XXXXX	(2 credits)

Note: These courses are offered as MBA only courses. Students enrolled in the MEME program must obtain a waiver from the College of Business and the permission of the instructor to participate in these Management courses.

C) The MEME General Electives. Students participating in the MEME program are required to complete a minimum of 30 credits of course work, including a maximum of 6 credits of directed studies with their advisor. The program is designed to provide participants with increased engineering knowledge. General electives for MEME students must be 60000 level courses offered in the College of Engineering. Exceptions to this requirement must be approved by the Graduate Studies committee.

D) Research Project - Team Based Design Project (directed studies). Full time students participating in the MEME program will enroll in one credit of directed studies with their advisor (Advanced MEME Project – AME 67663) during the fall semester to begin the planning of their research/design project with their advisor. In the spring semester students will enroll for one credit of directed studies (Advanced MEME Project – AME 67663) and begin their research project. The research project will be completed in the summer session, in which the student will enroll in four credits of directed studies (Advanced MEME Project – 67663). Part time students must complete six credits of directed studies (Advanced MEME Project – AME 67663) during their course of study.

E) Example Project. A project will be initiated once a product/process area has been identified by the faculty advisor and student. These projects may involve teams of students and faculty as well as industry partners. As an example, consider a project based upon the development and fabrication of a new fused-deposition rapid-prototyping machine for manufacturing geometrically complex, chopped-fiber polymer composite structural components. This project would involve faculty with specialized expertise in materials/materials processing, electro-mechanical design, controls, and computer science. They would be responsible for addressing the technological/scientific issues associated with the project along with a multitude of other issues such as defining customer requirements, product marketing, patent evaluation, fabrication/production planning and disposal or recycling of the product.

F) Peer Programs. Many leading universities, for instance Northwestern University, Cornell University and Michigan, are currently offering professional master of engineering degrees. The design of the MEME has borrowed ideas from these programs.

G) MEME Typical Course Sequence:

<u>Fall Semester</u>	(13 Credits)		
Statistical Quality Methods		AME 50561	(3 credits)
Engineering Analysis of Manufacturing Systems		AME 50542	(3 credits)
Advanced MEME Project		AME 67663	(1 credit)
TWO ELECTIVES			(6 credits)
<u>Spring Semester</u>	(13 Credits)		
Finite Elements in Eng.		AME 50541	(3 credits)
Optimum Design		AME 60661	(3 credits)
Advanced MEME Project		AME 67663	(1 credit)
TWO ELECTIVES			(6 credits)
<u>Summer Session (~June 22- August 7)</u>	(4 Credits)		
Advanced MEME Project		AME 67663	(4 credits)
TOTAL CREDITS			30 credits

4.) APPLICANT POOL

The MEME program is designed to meet the needs of Notre Dame engineering undergraduates and undergraduates from other Universities who want to have an educational experience in product/process development before starting a career in industry. The program is also well suited for engineers currently working in industry that wish to expand their educational background. The program is flexible and will accommodate both part time and full time students.

We envision a program that will initially start with mostly industrial part time students. However, our goal is to expand the program to have at least half the students be full time. Our target enrollment is approximately 20 students per year.

Another group of students who will likely find this program to be attractive are the GEM (National Consortium for Graduate Degrees for Minorities in Engineering and Science, Inc.) students. (Incidentally the GEM National Headquarters are located in South Bend, IN) Typically these students are supported by an industrial organization for a master's degree. The product realization aspect of this degree would be attractive to the GEM sponsors.

5.) ADMISSION TO THE MEME

Admission to the MEME program will follow normal graduate student application procedures. This calls for an application to be made to the Graduate School of the University of Notre Dame. The application is to specify that that the student intends to pursue the MEME. Students are recommended for admission to the Graduate School by the Graduate Studies Committee of the Aerospace and Mechanical Engineering Department. Admission to the MEME is completely separate from admission to the M.S. or Ph.D. programs in Aerospace and Mechanical Engineering.

6.) DEGREE REQUIREMENTS and MEME EXAMINATION

- i) Every degree candidate must pass the examinations of all the courses that are taken as part of the student's MEME plan of study.
- ii) Degree candidates must have a minimum cumulative GPA of 3.0 in their 24 credits of course work. This excludes the 6 credits of directed studies Advanced MEME Project - AME 67663.
- iii) A degree candidate in the MEME program must complete a meaningful research/design project under the supervision of the advisor. Degree candidates must prepare a research/design project report. To be accepted, the report must be approved by at least two readers from the faculty of the Aerospace and Mechanical Engineering Department. The advisor can not serve as one of the readers.
- iv) Degree candidates must make an oral presentation of their research findings to a committee consisting of the two readers and the faculty advisor. The MEME examination begins with a twenty minute presentation of the research/design project findings by the candidate. After the presentation, the faculty advisor calls for questions from members of the committee. After the examination, the faculty advisor may excuse the candidate and call for discussion followed by a vote of committee members. A candidate passes upon either the unanimous consent or the consent of all except one member.

7.) RESOURCES

Students enrolled in the MEME program will be required to pay tuition and will not receive a stipend. Therefore the program will not draw funds away from our Ph.D. program. There will be resources required for the projects (individual or team-based).

The faculty members supporting the project or an industrial sponsor will provide these funds. A number of AME faculty have expressed interest in supporting the MEME program. They view this program as a means to augment their funded research in design, manufacturing and robotics.

8.) INDUSTRY SUPPORT

Students who have participated in the program on a part time basis include employees from Honeywell (formerly AlliedSignal), Bayer, Biomet Inc and Tyler Refrigeration. This program is very attractive to part time industry employees who want additional engineering and business training.

APPENDIX A