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GENERAL INFORMATION

MILWAUKEE SCHOOL OF ENGINEERING
ACADEMIC CALENDAR 2006-2008

Fall Quarter (11 Weeks)	**2006**	**2007**
Labor Day	Monday, Sept. 4	Monday, Sept. 3
Classes Begin 8 a.m.	Tuesday, Sept. 5	Tuesday, Sept. 4
End of Fall Quarter 5 p.m.	Saturday, Nov. 18	Saturday, Nov. 17
Commencement Exercises	Saturday, Nov. 18	Saturday, Nov. 17

Winter Quarter (11 Weeks)	**2006-07**	**2007-08**
Registration	Nov. 1 - Nov. 22	Oct. 31 - Nov. 21
Thanksgiving Day	Thursday, Nov. 23	Thursday, Nov. 22
Classes Begin 8 a.m.	Monday, Nov. 27	Monday, Nov. 26
Christmas Recess Begins 10 p.m.	Saturday, Dec. 23	Saturday, Dec. 22
Classes Resume 8 a.m.	Monday, Jan. 8	Monday, Jan. 7
End of Winter Quarter 5 p.m.	Saturday, Feb. 24	Saturday, Feb. 23
Commencement Exercises	Saturday, Feb. 24	Saturday. Feb. 23

Spring Quarter (11 Weeks)	**2007**	**2008**
Registration	Feb. 7 - March 2	Feb. 6 - Feb. 29
Classes Begin 8 a.m.	Monday, March 5	Monday, March 3
Spring Break Begins 10 p.m.	Thursday, April 5	Thursday, March 20
Classes Resume 8 a.m.	Monday, April 16	Monday, March 31
End of Spring Quarter 5 p.m.	Saturday, May 26	Saturday, May 24
Commencement Exercises	Saturday, May 26	Saturday, May 24

Summer Quarter

The schedule of classes may vary during the summer term. A variety of attendance options are offered from 6- to 11- week sessions. Contact the Registrar's Office at (414) 277-7215 to receive a *Timetable of Classes* and further information.

All new students will be notified concerning registration dates.

Vision Statement

MSOE will always be at the forefront of professional education with emphasis on both theory and technology, coupled with intensive laboratories and career practice.

Mission Statement

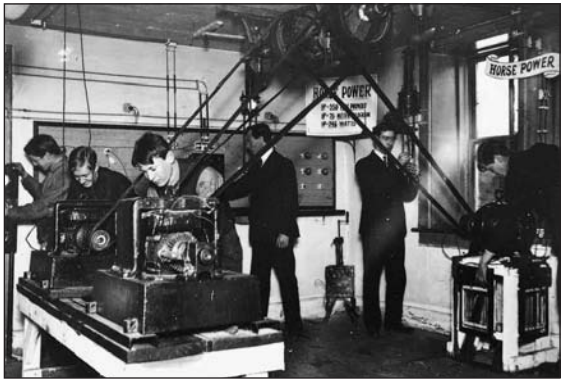
MSOE provides a sustained interactive educational climate for students to become well-rounded,technologically experienced graduates and highly productive professionals and leaders.

Institutional Principles

The fundamental beliefs of Milwaukee School of Engineering are the following:

- The focus is on the individual student.
- Lifelong learning is essential for success.
- Dedicated faculty with relevant, up-to-date experience are the heart of our teaching process.
- Scientific and mathematical reasoning and processes are essential.
- Applied research and evolving and interdisciplinary technologies are vital in exploiting opportunities.
- The development of communication skills is needed to function effectively.
- The student experience is strengthened by interaction with the business, industry and health care fields.
- The development of leadership and entrepreneurial characteristics is essential.
- Students, faculty, staff and volunteers all share the responsibility of learning.
- Strong personal values are necessary for success.
- The alumni strengthen the institution through their counsel, encouragement and support.
- Freedom with responsibility is the foundation of free enterprise.
- There is strength in diversity.
- Global awareness must be reflected in all activities.
- Initiation and acceptance of change is required to anticipate and capitalize on opportunities.

History



At the turn of the century, American industry began a period of rapid expansion. This accelerated the use of electrical and mechanical power. As a result, new occupations emerged in technical fields. Engineers and technicians with knowledge and skill were badly needed, but few people were available who had a combination of technical training and formal education. Industry's need spurred the development of progressive programs of technical education.

In this context, Oscar Werwath organized the School of Engineering of Milwaukee in 1903. Werwath was a practicing engineer who was a graduate of European technical universities. He was the first to plan an American engineering educational institution based on an applications-oriented curriculum. Milwaukee industries were vitally interested in this kind of training and called on Werwath to provide education and training for their employees. From the beginning, leaders of business and industry cooperated in the university's development, and a close relationship was established that has continued throughout MSOE's history. These early supporters realized that their future depended on educational institutions that could prepare men and women to fill the newly created engineering and managerial positions.

For more than a century, MSOE has had many memorable moments, creating a rich tradition of educational excellence that has positioned MSOE as a leader among today's universities.

Location

MSOE has a small university atmosphere within an exciting city environment. The 15-acre, user friendly campus is located in a historic downtown district, just blocks from beautiful Lake Michigan. Called The Genuine American City, Milwaukee boasts 60 miles of lakeshore, 15,000 acres of parkland and hundreds of miles of bike trails, a vibrant fine arts and cultural community, major and minor league sports, a brisk live-music scene, and is famous for its more than 50 annual festivals. The city is also a business, technological and industrial center where employment opportunities abound.

MSOE also offers select undergraduate and graduate course work in Appleton, Wis., and other sites throughout the state.

Graduate Degree Programs

MSOE offers seven master of science degree programs:

- Cardiovascular Studies (MSCS)
- Engineering (MSE)
- Engineering Management (MSEM)
- Environmental Engineering (MSEV)
- Medical Informatics (MSMI)*
- Perfusion (MSP)
- Structural Engineering (MSST)

*Offered jointly with Medical College of Wisconsin.

Class sizes tend to be small, averaging eight students per class.

Questions about any of the graduate programs offered by MSOE may be directed to the individual program directors (see the particular graduate program description within this Catalog for name and phone number of program director), or the Enrollment Management Department at (414) 277-6763 or (800) 332-6763.

All of these programs are explained in detail in later sections of this Catalog.

Undergraduate Degree Programs

MSOE's undergraduate degree programs are described in a separate publication, the Undergraduate Academic Catalog. To view the Undergraduate Academic Catalog go to www.msoe.edu/admiss/catalog.shtml or contact the Enrollment Management Department at (414) 277-6763 or (800) 332-6763.

Accreditation

MSOE is accredited by the Higher Learning Commission of the North Central Association of Colleges and Schools (NCA, 30 N. LaSalle St., Suite 2400, Chicago, IL 60602-2504, (312) 263-0456).

The Master of Science in Perfusion program is accredited by the Commission on Accreditation of Allied Health Education Programs (www.caahep.org) upon the recommendation of the Accreditation Committee on Perfusion Education (Commission on Accreditation of Allied Health Education Programs 1361 Park Street, Clearwater, FL 33756, 727-210-2350).

The Academic Year

The official academic calendar of MSOE is published in the front of this Catalog. The academic year is divided into three 11-week quarters, September through May. Courses are also offered during the summer.

Affiliations

MSOE holds institutional membership in the Wisconsin Association of Independent Colleges and Universities, the American Society for Engineering Education, the American Medical Informatics Association, the College Entrance Examination Board, the College Scholarship Service Assembly, the National Collegiate Athletic Association – Division III, the Council for the Advancement and Support of Education, Associated Schools of Construction, the College Board and the American Association of Colleges of Nursing.

MSOE is also a member of the Metropolitan Milwaukee Association of Commerce, the Greater Milwaukee Convention and Visitors Bureau, and the Better Business Bureau of Greater Milwaukee.

Location Options

Milwaukee Campus

With the exception of some of the classes in the MSMI program, all graduate programs are offered on MSOE's main campus, located on Milwaukee's east side. The MSMI program is offered jointly by MSOE and the Medical College of Wisconsin, and courses are offered at both sites. The MSOE campus is convenient to the interstate system.

Southeastern Wisconsin

For the MSEM program, in addition to MSOE's main campus, courses are offered in several locations in southeastern Wisconsin, including Kenosha and Brookfield/Waukesha.

Fox Valley Region

Courses leading to the MSEM degree are offered in the Appleton, Wis. area. Students may obtain admission information by calling the MSOE Enrollment Management Department at (800) 332-6763.

On-site Company Locations

On-site offerings are feasible for companies with 10 or more employees who share a common educational need. In some cases, students not necessarily employed by a particular company are permitted to enroll in courses on-site at the company. For more information regarding on-site offerings, contact the Enrollment Management Department at (414) 277-6763.

Internet Courses

Graduate courses have been offered via the Internet. Questions regarding the specifics of access, requirements and use should be directed to the faculty member or department chair for a course listed in the Timetable of Classes as an Internet offering.

The Business Excellence Consortium

The Business Excellence Consortium (BEC) assists individuals and organizations in their journey toward World Competitive Status through assessment, training and implementation. The BEC is an interactive partner that measures its success on your improvement results.

We seek out the best of the best in industry expertise, operating in their selected fields, and deploy these experts within a framework of collaborative effort. The result is targeted directed training and implementation that generates timely and predictable success within our members' organization.

The BEC is an active player by taking customer feedback and analyzing market trends to determine the next generation of problem solving tools needed to ensure our member companies future successes.

In addition, the BEC acts as a conduit to the MSOE institutional operations to ensure that the graduates your firm hires are equipped with skills, knowledge and wisdom that is relevant to your needs.

The BEC offers both certificate-level and certification-level training at three differing levels of training:

Seminars: Seminars are offered to provide the opportunity for practicing professionals to stay abreast of cutting-edge technologies, current applications and techniques. Continuing Education Units are awarded to seminar attendees. Seminars are offered in formats ranging from four-hour workshops to two-day symposiums.

Certificate: Certificate-level training is conducted to provide the best means to transfer knowledge to the participants. Participants are tested upon completion of the program to demonstrate their understanding and knowledge of the material. Some certificates are eligible for academic credit.

Certification: Certification level goes beyond the transferring of knowledge. Participants are required to pass the required certificate tests but also must demonstrate their ability to use the knowledge they have gained, thus demonstrating a mastery of the knowledge they have learned. Participants are evaluated on their use of the knowledge gained. Some certifications are eligible for either graduate or undergraduate credit.

Graduate Credit for BEC Offerings: Certain BEC courses and projects are eligible for graduate credits toward the Master of Science in Engineering Management (MSEM) degree. For information on which courses apply, see the document on BEC courses for academic credit, available at http://www.msoe.edu/business/credit_for_bec_courses.pdf. To receive academic credit, a student must be accepted into the MSEM program. BEC credit is considered transfer credit, for which no letter grade is given, and is subject to the nine credit limit on total transfer credit. An MSEM student who has successfully completed one of the qualifying BEC courses or projects and who wishes graduate academic credit should write the MSEM program director requesting credit.

Customized On-Site Courses

While certain courses and training session are held on the MSOE campus, most training sessions are held at a company site for the participant's convenience and the ability to apply the training to their own environment and situation.

SERVICES AND RESOURCES FOR GRADUATE STUDENTS

Research Facilities

The ***Applied Technology Center™ (ATC)*** is the research arm of the university. It serves as a technology transfer catalyst among academia, business and industry and government agencies. The close association between MSOE and the business and industrial community has long been one of its strengths; applied research serves as a renewable resource in this linkage.

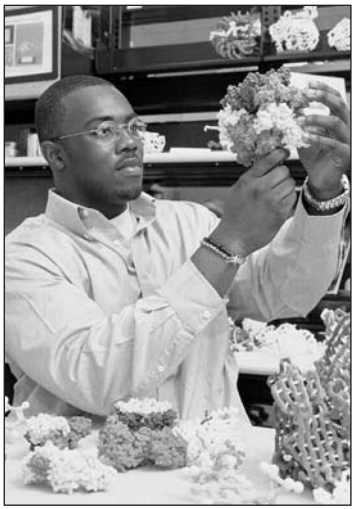
- Environmental Engineering Projects
- Electrical and Computer Programs
- High Speed Video and Motion Analysis
- Engineering Research Center for Compact and Efficient Fluid Power*
- NanoEngineering Laboratory
- Photonics and Applied Optics Center
- Construction Science and Engineering Center
- Electrical and Computer Programs
- High Speed Video and Motion Analysis

The Rapid Prototyping Center (RPC) is a joint effort of industry, government and MSOE that is dedicated to the application of proven technologies to novel challenges. MSOE is the only university that has a laboratory devoted to all five commercially-available rapid prototyping systems — stereolithography (SLA), laminated object manufacturing (LOM), selective laser sintering (SLS), fused

** In conjunction with the University of Minnesota, Purdue University, University of Illinois, Georgia Tech, Vanderbilt, North Carolina A&T.*

deposition modeling (FDM), Z-Corp processing. A rapid scanning system has recently been acquired which allows the automatic preparation of 3D data bases from laser scanning of any object, thereby making it possible to reproduce the object using RP systems. Rapid Prototyping historically has been a tool for reducing product development cycle times. The RPC continues to advance the state-of-the-art in this area, using computer-based manufacturing techniques and complementary processes to reduce the time and cost of industrial products ranging from functional models to full-scale production.

Established in 1991, the Rapid Prototyping Consortium continues MSOE's tradition of building strong ties to business and industry. The Consortium includes industrial companies and educational institutions that cooperate in understanding the Consortium's vitality and success in a high level of industrial parts design and fabrication activity. Companies that take advantage of the facilities and expertise within the Consortium become stronger and more competitive. Member companies include or have included Johnson & Johnson, Harley-Davidson, Bombardier Recreational Products, Snap-On, Northeast Wisconsin Technical College, Master Lock, Kohler, Waukesha Engine, The IDEX Companies, Pentair, J.W. Speaker, KOSS, Gardner-Denver Inc., Ecolab, Trane Co., Oshkosh Truck, Rockwell Automation, HUSCO International and Alticor.



The RPC also is extending the use of rapid prototyping through research projects as diverse as biomolecular and biomedical modeling, architectural modeling and manufacturing tooling. Rapid Prototyping Research is involved in several biomolecular technology development programs including nanomagnetics, liquid crystals and digital manufacturing. There is significant activity in novel internally-structured solid objects and advanced high resolution metal casting processes.

In 1999, an undergraduate student and MSOE professor gained national recognition after using rapid prototyping to provide a pivotal link for law enforcement agencies in helping identify a murder victim. It was the first known use of rapid prototyping for facial reconstruction by forensic experts.

The ***Center for BioMolecular Modeling*** creates unique physical models of molecular structures using rapid prototyping technologies. The center works with research scientists to create custom models of the proteins whose structures they are investigating. The center also works closely with educators at both the secondary and post-secondary levels to create innovative products that make the molecular world real for students. The center is unique in the world, bringing together the disciplines of engineering, structural biology and computer visualization.

Fluid Power Institute (FPI)™, one of the first centers of its kind in the country, remains a pioneer in motion control and fluid power education. Through its state-of-the-art facilities it conducts a variety of performance, endurance, and environmental evaluations of components and systems. FPI also performs component and system design, modeling and simulation, contamination and reliability analyses, system integration and prototyping, and develops and delivers various education programs. A $5 million endowment from the estate of Otto J. Maha provides resources to ensure continued advancement of fluid power education.

FPI uses an interdisciplinary workforce comprised of faculty and staff from various academic departments, and undergraduate and graduate students, to conduct fluid power, motion control and related industry projects. FPI's approach uses mechanical, electrical, computer and software engineering along with MSOE's Rapid Prototyping Center. MSOE is a member of the National Fluid Power Association and supports the activities of the Fluid Power Society and the Fluid Power Educational Foundation. It has expanded into electrohydraulic interface studies and currently has active programs in fluid power systems design, applications of fluid power to manufacturing, computerized fluid dynamics (CFD), electromagnetic actuators and sensors, component evaluation, and filtration and contamination testing.

Contracts for U.S. Marine vehicle reliability improvements were won by the Fluid Power InstituteTM. The agreement is valued at $1 million/year with options up to five years. The initial contracts were awarded for hydraulic system design review, analysis, and reliability improvements on two vehicles ABV (Assault Breacher Vehicle) and JAB (Joint Assault Bridge).

Engineering Research Center for Compact and Efficient Fluid Power has been formally established through a multimillion dollar National Science Foundation award with strong support by the National Fluid Power Association. Each year, two graduate and two undergraduate students will be supported in addition to an REU student and a high school teacher. Strong interaction with our Rapid Prototyping Center and the new NanoEngineering Laboratory are anticipated.

MSOE is one of seven universities nationwide that is part of this research center for fluid power. MSOE's involvement in the center will amplify its already significant work in fluid power, applying new technologies to the field. The lead university is the University of Minnesota. MSOE was chosen to be a part of this center because of its 40-plus year history in fluid power education and research, through its Fluid Power Institute. MSOE will integrate new technologies such as rapid prototyping, sensors, nanotechnology and tribology plus contamination analysis in fluid power to advance understanding of these areas, then help take them to the marketplace.

NanoEngineering Laboratory. Research and education at the nano-scale is becoming more critical each year as research and development focuses on nano-scale phenomena, ultrafine structures and interfaces between matter. Atomic Force Microscopy ("AFM") allows the force between a small tip and a chosen sample surface to be measured with atomic-scale resolution. Initially lateral forces between the tip and the sample can also be measured to better understand the origins of friction at the molecular scale. Other types of AFM surface measurement models include: plastic deformations, electrical conductivity and thermal conductivity. All these capabilities make the AFM an indispensable tool for characterization and manipulation in all areas of the emerging field of technology called nanotechnology. Leveraging the state-of-the-art AFM capabilities, research will be conducted in the areas of wear reduction and surface enhancement. Other areas include Solid Freeform Fabrication (SFF) of metal matrix composites and numerous projects for biological and industrial applications (e.g., MEMS).

Photonics and Applied Optics Center comprises the Undergraduate Applied Optics Laboratory, the Photonics and Sensors Laboratory and use of the Rapid Prototyping Center's Laser Engraving Laboratory. All of the center's laboratories are in an extremely low-vibration site that allows performance of the most sensitive optical projects and experiments. The center includes six 4-by-8 foot optical tables and a collection of optical instruments and apparatus that includes picowatt optical power meters, computer-controlled monochromators and a broad array of

optical sources including an optical time-domain reflectometer. Recent projects associated with the center include consulting for several of America's largest corporations involving lasers, LEDs, sensor applications and optical fabrication.

The ***Construction Science and Engineering Center*** promotes innovation in the building design and construction industries by conducting applied research in structural materials and systems as well as construction methods. The center's laboratory has approximately 2,100 square feet of floor space and a clear height of 36 feet. There is a large door for truck access and an overhead crane with two 5-ton trolleys. Specialized and adaptable structural testing systems, including a two-channel digitally controlled system, can produce loads from 50 to 500,000 pounds on specimens up to 24 feet tall. The lab has multiple computerized data acquisition capabilities and an extensive array of transducers for measuring force, displacement, and strain. Academic course activities in this laboratory ensure that MSOE graduates understand the physical realities of structural behavior and construction.

Electrical and Computer Programs include projects in which the primary technologies are software, computer hardware and electronic or electrical systems. Specialty areas include magnetic actuators and sensors as well as their use in electrohydraulic systems. Selected capabilities to create, simulate, breadboard, analyze, and test electrical or software-based solutions to real-world requirements are available.

The ***High Speed Video and Motion Analysis*** system has the ability to digitally capture — and immediately play back — events in the 1,000- to 12,000-frames-per-second range, enabling the user to analyze situations otherwise impossible with conventional video or the eye. Since the system is portable, it can be taken to any point of interest. Powerful motion analysis software can be used to track and graph up to nine points in the visual field. Projects for industry and aerospace engineering have been conducted.

Types of Projects within the ATC™

Interdisciplinary capabilities provide a major advantage and can span fields such as engineering, science, business, computers and technical communication. Faculty, staff and students who undertake applied research projects represent all aspects of the university's curricula — architectural, biomedical, computer, industrial, software, electrical and mechanical engineering and technology, plus construction management, nursing, mathematics, physics and chemistry, business and technical communication. The research projects involve expertise in a variety of areas, such as CAD-CAM, plan layout, environmental engineering, finite element stress/thermal/fluid dynamic analysis, materials, product and process design, wind tunnel testing, and many others. ATC research assistantships involve both undergraduate and graduate students working on capstone projects and internships.

Modes of interaction include directly funded projects, consultation, federally funded Small Business Innovation Research (SBIR) and Small Business Technology

Transfer Research (STTR) grants, consortia work, technology licensing and subcontracts. Applied research is done by staff and faculty with industrial experience — often with research assistants and student and class projects in engineering and business disciplines — coordinated with company and faculty advisors. Student internships provide part-time or summer employment and future employment opportunities for students. Referrals serve as an initial contact point for networking with others to optimize expertise and facilities for technology transfer.

The Applied Technology Center undertakes more than 250 company-sponsored projects annually supporting business, industry and governmental sectors with design, development and evaluation of products, processes, and manufacturing systems. Staff can construct and evaluate prototypes and assist in providing technology transfer, helping to fulfill the global objectives of applying engineering talents for the betterment of life for all people.

Research Assistantships

MSOE offers a limited number of graduate research assistantships for research with the ATC. Selection is based upon available funds, project personnel requirements and student qualification. February 1 is the application deadline for an assistantship that is awarded for the subsequent Fall Quarter. Assistantships may be available at other times of the year, based on additional funding and program activity.

Graduate research assistants are assigned to the ATC. All assistantship candidates must be accepted for graduate study by MSOE. Open Graduate research positions can be viewed online at www.msoe.edu/hr/student_employment/findajob.shtml under "current job openings." You may also submit a letter of interest detailing areas of expertise along with a current resume to the following address: Dean of Applied Research, 1025 North Broadway, Milwaukee, WI 53202-3109, USA. Allow at least 60 days for processing the application once all materials are received.

Position Obligations and Benefits: This is a 12-month appointment, renewable for subsequent years based on continued availability of funding, the student's work performance and academic progress. Students will normally receive both of the following awards:

- ***Research Assistantship:*** Student typically will be assigned a specified number of hours of research and ATC project work per week over 12 months.
- ***Tuition Scholarship:*** Student must take at least six credits of course work per academic quarter (summers optional), leading to the M.S. degree in two-to-three years. Tuition will be waived in proportion to the fraction of full-time employment for courses needed for the degree, providing they meet graduate degree program requirements. Each tuition scholarship award will be made based on a student's academic record, potential to succeed in the program and related work experience.

No other (outside) employment is allowed. To be eligible for the research assistantship, applicants must be enrolled as graduate students at MSOE by virtue of course work or continuous enrollment. No teaching or classroom-related work will normally be expected of research assistants. Occasionally, a graduate student will assist in running a laboratory.

Students must maintain satisfactory graduate student academic standing to retain their position.

Research with Human Participants

The ***Institutional Review Board (IRB)*** is an administrative body established to protect the rights and well being of human participants recruited to participate in research activities. MSOE complies with requirements set forth in Title 45, Part 46 of the Code of Federal Regulations (45 CFR 46), known as the "Common Rule," regardless of the source of project funding.

All students, staff and faculty at MSOE planning on conducting research involving human participants must submit and IRB protocol for review and approval by the MSOE Institutional Review Board. Review and approval must be completed before research has begun. The review ensures the research plan adequately has protected the rights and well being of human participants. If the investigator is a student, the research must be performed under the supervision of an MSOE faculty or staff member who by his or her signature assumes responsibility for the conduct of that research with respect to the proper safeguards of the rights of the participants.

Research is defined (45 CFR 46.102(d)) as "a systematic investigation, including methodology, development, testing and evaluation, designed to develop or contribute to generalize knowledge." This definition includes formal investigations from which the results will be publicly disseminated, pilot projects, exploratory research and research undertaken by students for purposes of classroom work, independent study, project work or thesis.

Human Participant is defined (45 CFR 46.102(f)) as "a living individual about whom an investigator conducting research obtains data through intervention or interaction with the individual, or identifiable private information." Intervention generally includes both physical procedures by which one gathers data and manipulations of the subject or subject's environment. Private information includes information about behavior that occurs in a context in which the subject can reasonably expect that no recording is taking place or information the subject has provided for a specific purpose can reasonably expect will not be made public.

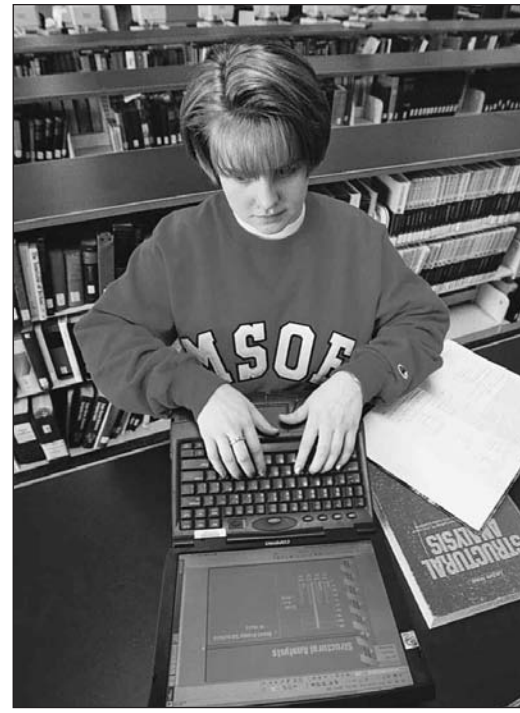
IRB protocol packets are available on-line at http://www.msoe.edu/vpacad/documents/irb.pdf or in the Applied Research and Grants office, S-149. Contact Ann Bloor, Director of Research Administration, at (414) 277-7237 for more information or assistance in writing the protocol.

Library Resources

The Walter Schroeder Library is a service-oriented facility committed to serving the research, study and other information needs of MSOE's students, faculty and staff. Housing more than 48,000 print volumes in support of the university's specialized curricula, the library features a collection that consists of books, magazines, journals, newspapers, standards, senior design projects, microfiche, videos and other media programs. The library's catalog, Horizon, can be accessed via the Web at http://garrett.msoe.edu. The library additionally catalogs and houses master's theses and capstone reports completed in graduate programs at MSOE.

In addition to its specialized collection, the library provides a number of services and resources for members of the MSOE community. An extensive array of online databases is available on the library's Web site at http://www.msoe.edu/library. Online databases particularly helpful to graduate students include the ABI/Inform business and management database, Applied Science & Technology, Ei Compendex Engineering database, FirstSearch, Environmental Sciences & Pollution Management database, Medline database, the IEEE Computer Society Digital Library and the IEEE Xplore database. Many of these databases provide the

full text of articles published in leading journals and magazines: more than 19,000 e-journals are available to students through full-text databases and online subscriptions. The library also provides electronic books through such resources as the Books24x7 e-book database. More than 15,000 e-books are available to students through the library's e-book databases. All Web-based databases are remotely accessible for members of the MSOE community.



Library services particularly helpful for graduate students include interlibrary loan and document delivery, database training, online reference help, and extensive research and documentation help. The library belongs to a number of resource sharing consortia that enable it to obtain materials from other libraries from around the world. Lists of graduate capstone and thesis work are compiled regularly by the librarians and made available on the library's Web site at http://www.msoe.edu/library/library_resources.shtml. The library additionally is responsible for maintaining and providing support for the documentation and style format guidelines that are employed in MSOE's graduate programs. The guidelines are available at the library's Web site at http://www.msoe.edu/library/grad_student_doc_standards.shtml. The librarians also regularly maintain web-based tutorials that guide graduate students through the research process. The tutorials are available on the library's Web site at http://www.msoe.edu/library/class_tutorials.shtml .

Audiovisual equipment and materials are available through the Audiovisual Center in the library, which also houses the unique and valuable "MSOE MMAC Business and Management Video Collection." Group study rooms, photocopiers, Internet research desktop computers, scanners, networked laser printers and the Gene Carter Desktop Media MacIntosh Computer Laboratory also are available in the library.

Computer and Communication Services Department

The Computer and Communication Services Department (CCSD) is responsible for the planning, development, maintenance and administration of the university's computing resources. CCSD is comprised of two main branches: the academic, dealing with educational functions, and the administrative, dealing with such things as student records, financial aid and telecommunications.

Students are assigned their own computer accounts while attending MSOE. These accounts enable students to send and receive Internet and local e-mail, access other Internet applications, and use of PC network and systems applications. Students may also have a personal Web page, which is hosted by an MSOE Web server.

The Help Desk is located in room S-301. Call (414) 277-7288, or fax (414) 277-7495 or (414) 277-7508.

Placement Services

The Placement Office staff provides placement assistance to undergraduate students, graduate students and alumni. Services include job listings, reference library, Career Net Web site, career and job search videos and graduate school information. The Placement Office also can assist in providing salary information, resume and cover letter assistance, developing a job search strategy and improving interview skills.

The Placement Office staff coordinates the university's internship program, sponsors the Annual Career Fair and hosts employers who come to campus to conduct employment interviews. Part-time and summer job listings also are available.

Academic Year Hours

Monday-Friday 8 a.m. – 4:30 p.m.

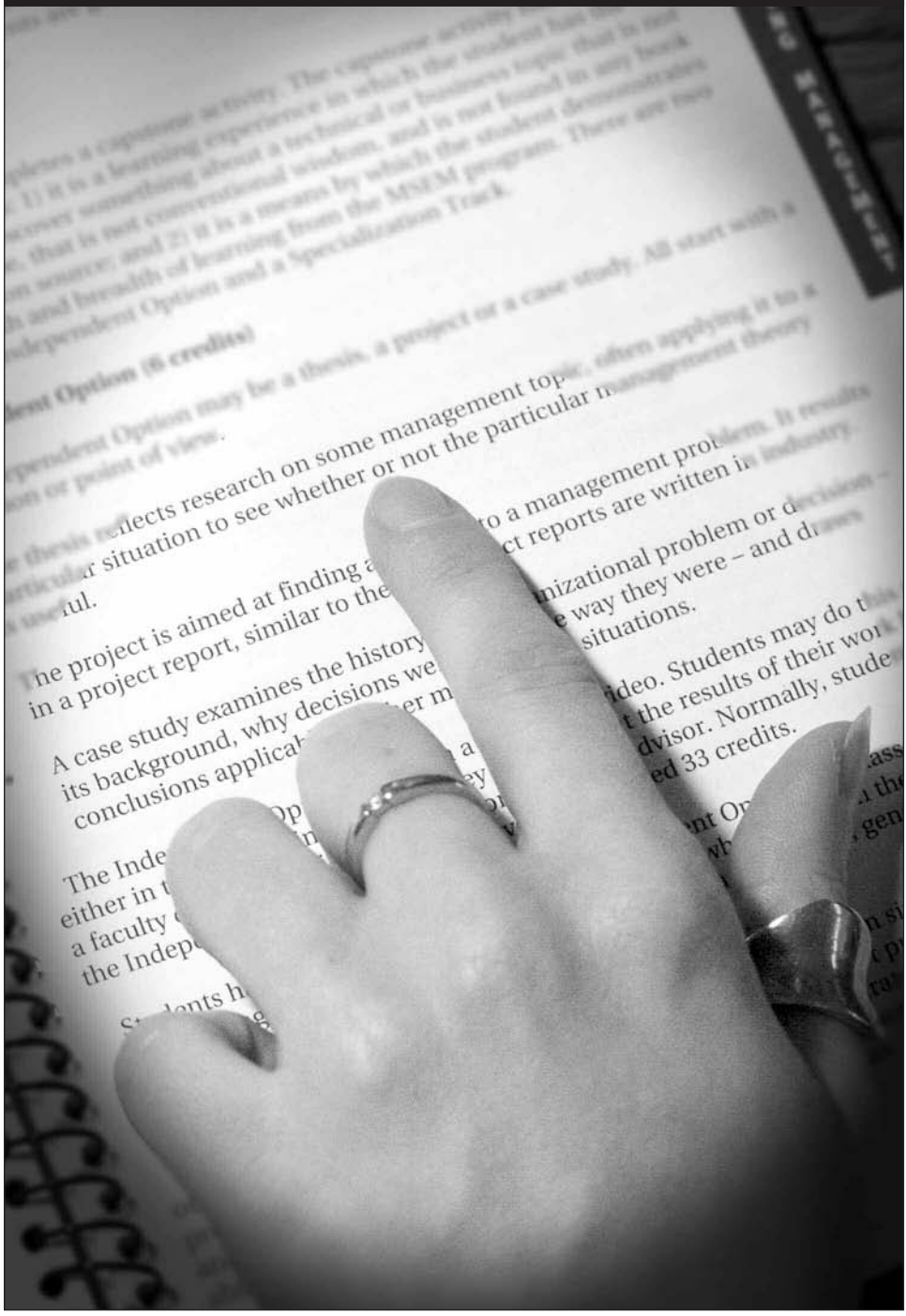
Graduate Student Housing

MSOE operates three residence halls located in the middle of campus just a block ot two from classrooms and laboratories. These facilities offer quiet floors, suites and a full-service food operation. Although undergraduate students comprise the largest segment of the resident population, the residence halls do offer an on-campus option to the graduate student. The Housing Department can provide more information on what is available and how personal needs might be accommodated.

Renting off-campus housing from one of the many independently owned rental units near the university provides an alternative.

B

GRADUATE ADMISSION REQUIREMENTS



GENERAL REQUIREMENTS

Admission materials may be obtained from the Enrollment Management Department at (414) 277-6763 or (800) 332-6763. The address is listed later in this *Catalog* under "Application Procedures."

General requirements for all graduate programs at MSOE include the following (also see specific program requirements):

1) Completed application and fee. An online application may be submitted at: http://www.msoe.edu/admiss/app_selector.shtml.
2) Completion of a baccalaureate degree in a discipline appropriate for the graduate program to which the applicant seeks admission (see "Program-Specific Requirements" section).
3) Official transcripts sent directly from all colleges and/or universities previously attended. A fee will be assessed for the translation of each transcript that is in a language other than English.
4) An academic record that indicates potential achievement in graduate studies. See program specific requirements pertaining to grade point average (GPA) and the need for standardized examinations, such as the Graduate Record Examination (GRE).
5) For applicants whose native language is not English, language proficiency must be demonstrated by one of the following methods:
    a. Submit an official transcript indicating receipt of a baccalaureate or graduate degree from a United States college/university or other institution where the language of instruction is English.
    b. Submit an official test score from the Test of English as a Foreign Language (TOEFL) with a minimum score of 213 on the computer-based test or 550 on the paper-based test.
    c. Submit proof of satisfactory completion of Level 109 of intensive English study at any English as a Second Language (ESL) Center in the United States.
6) If a student is a permanent resident of the U.S., then a copy of a permanent resident's card is a requirement for admission.
7) International student applicants who will require immigration documents issued by MSOE must submit a certified bank statement or notarized MSOE Financial Certificate, detailing the availability of finances for the first year of study (including tuition and living expenses). If transferring from another institution that has issued immigration documents, an MSOE Transfer Form must also be submitted.

Master of Science in Cardiovascular Studies (MSCS)

1) Applicants must have earned a bachelor of science degree in an appropriate discipline with an undergraduate GPA of at least 2.80 (on a 4.00 scale).
2) equired undergraduate course work must include at least one course in human physiology (or anatomy and physiology) and one class in calculus. Recommended course work includes biochemistry, physics and statistics.
3) GRE general test scores having percentiles that average 50 percent or better.
4) Three letters of recommendation, two of which must be from faculty members who can judge the applicant's academic abilities.

Master of Science in Engineering (MSE)

1) A bachelor of science degree in engineering, engineering technology, or a closely related area.
2) Specific course requirements include one year of calculus, two courses in physics, one course in each of the following: structured programming, differential equations and chemistry. Additionally, one course in each of the following engineering topics is required: statics, dynamics, thermodynamics, circuit analysis, and digital logic & microprocessors. It is expected that the applicant has earned a letter grade of "C" or better in each of these required undergraduate courses.
3) Test scores from the GRE general test if an applicant's undergraduate GPA is less than 3.00 (on a 4.00 scale). Test scores must be submitted prior to regular acceptance into the MSE program. Applicants are expected to submit scores that indicate potential for success in the MSE program, including scores from the "Quantitative" test section that is in the upper 50 percentile of those tested.
4) Prior to registering for any classes, the accepted applicant is required to speak with the MSE program director, either by phone or in person, to plan a course of study.

Master of Science in Engineering Management (MSEM)

1) A baccalaureate degree in engineering, engineering technology, science, business, management or a related area.
2) At least three years of professional, full-time work experience in engineering or management. This requirement may be waived for applicants who will be working full-time in such a position while attending the program.
3) Computer literacy, knowledge of word processing and spreadsheet software, and a personal computer (laptop recommended) with a modem and private Internet access.
4) Two letters of recommendation. If employed, at least one of the letters should be from the applicant's employer or manager.
5) Test scores from the GMAT or GRE if the applicant's undergraduate GPA was below 2.80 (on a 4.00 scale). Test scores must be submitted prior to regular acceptance into the MSEM program. Applicants are expected to submit scores that indicate potential for success in the MSEM program.
6) Completion of an advisory briefing within the first year of enrollment is highly recommended. The briefing may be completed in either a group session or individual conference, either by phone or in person, with the MSEM program director.

Master of Science in Environmental Engineering (MSEV)

1) A bachelor of science degree in architectural, chemical, civil or mechanical engineering, or a closely related area.
2) Specific course requirements include one year of calculus, two courses in physics, two courses in chemistry, and one course in each of the following: statistics, differential equations, fluid mechanics and thermodynamics. A "C" or better must have been earned in each of these required courses.

   Most students entering the program who hold a bachelor of science degree in a traditional engineering field from an ABET-accredited institution are expected to have the required undergraduate courses. Students who hold an engineering degree but lack some of these courses, or students who hold other technical degrees, may need to complete deficient undergraduate course work in order to meet all the admission requirements. These students may be permitted to begin course work on a conditional basis, and are generally expected to complete all such requirements within one year. Such admission decisions are made on a case-by-case basis.
3) Test scores from the GRE general test if an applicant's undergraduate GPA is less than 3.00 (on a 4.00 scale). Test scores must be submitted prior to regular acceptance into the MSEV program. Applicants are expected to submit scores that indicate potential for success in the MSEV program.
4) Two letters of recommendation.
5) Prior to registering for any classes, the accepted applicant is required to meet with the MSEV program director, either by phone or in person, to plan a course of study.

Master of Science in Medical Informatics (MSMI)

1) Minimum undergraduate degree GPA of 3.00 (on a 4.00 scale).
2) GRE or GMAT general test scores having percentiles that average 60 percent or better, or a Medical College Admission Test (MCAT) average of nine on the individual scores. (This requirement is waived for individuals with a graduate degree.)
3) Transcripts should show proof of undergraduate course work in college algebra, introduction to statistics, introduction to computers, computer programming and medical terminology.
4) If your native language is not English, a score of 580 or better must be achieved on the Test of English as a Foreign Language (TOEFL). There are additional application filing requirements for international students.
5) Prior to registering for any classes, the accepted applicant is required to speak with the MSMI program director, either by phone or in person, to plan a course of study.*
6) Three letters of recommendation. If employed, at least one of the letters should be from the applicant's employer or manager.
7) A personal essay stating why the applicant wishes to pursue this degree.

**Please note that applications are evaluated in their entirety. If applicants are deficient in one or more areas, they still are encouraged to apply and we may be able to recommend ways to complete the prerequisites and requirements.*

Master of Science in Perfusion (MSP)

Academic Requirements:

1) Applicants must have earned a bachelor of science degree in an appropriate discipline with an undergraduate GPA of at least 2.80 (on a 4.00 scale).
2) Required undergraduate course work must include at least one course in human physiology (or anatomy and physiology) and one class in calculus. Recommended course work includes biochemistry, physics and statistics.
3) GRE general test scores having percentiles that average 50 percent or better.
4) Three letters of recommendation, two of which must be from faculty members who can judge the applicant's academic abilities.

Clinical Requirements:

1) Applicant must have observed at least two clinical cases under the direction of a Certified Clinical Perfusionist prior to acceptance. The clinical program director may be able to help schedule these if necessary.
2) Successful completion of a personal interview with the academic and clinical program directors.

Master of Science in Structural Engineering (MSST)

1) A bachelor of science degree in an architectural, civil, or structural engineering program, or a closely related degree.
2) Specific undergraduate course requirements include indeterminate structural analysis, structural steel design, reinforced concrete design and soil mechanics. Applicants who hold an engineering degree, but lack some of the specific course requirements, or applicants who hold closely related degrees, may need to complete deficient undergraduate course work. Applicants may be permitted to begin course work on a probationary status. Such decisions are made on a case-by-case basis.
3) Test scores from the GRE general test may be required from applicants whose undergraduate GPA is less than 2.80 (on a 4.00 scale). In such cases, test scores must be submitted prior to regular acceptance into the Master of Science in Structural Engineering program. Applicants may be permitted to begin course work as nonmatriculated students if the test scores have not been submitted by the time of initial enrollment. Applicants are expected to submit scores that indicate potential for success in the program.
4) Two letters of recommendation. If employed, at least one of the letters should be from the applicant's employer or manager.
5) A personal essay stating why the applicant wishes to pursue this degree.
6) Prior to registering for any classes, the accepted applicant is required to speak with the program director, either by phone or in person, to plan a course of study.

TYPES OF ACCEPTANCE

Full Acceptance

A student who has satisfied all requirements for admission will achieve full acceptance.

Probationary Acceptance

Probationary acceptance is used in cases where (a) there are academic deficiencies that need to be fulfilled, or (b) there is some uncertainty in the applicant's ability to succeed in the program, such as marginal undergraduate performance, and it is therefore appropriate to carefully monitor the applicant's performance. The probationary status ends when the conditions stated on the probationary acceptance letter have been met; for example, completion of two terms with at least a "B" average. Until full acceptance, probationary students may have restrictions imposed on the graduate courses they are permitted to take. Students on probation must consult quarterly with their respective graduate program director prior to registering for the next quarter's classes.

Nondegree Status

Nondegree status is available for those who wish to take graduate courses but not pursue a degree. Applicants should submit a graduate application marked "Nondegree," an application fee and an official transcript showing receipt of a bachelor's degree. Nondegree students are expected to meet the same requirements that are expected of regular graduate students in the courses they take, receiving grades and graduate credit for courses completed.

Students who are under the nondegree status may apply for official acceptance at any time. Credits earned while under the nondegree status will be reviewed to determine if they will be counted toward satisfying program requirements. Not more than three courses (nine credits) taken as a nondegree student are transferable to a degree program.

Nonmatriculated Student Status

Applicants who do not yet have a completed application to a program may be eligible to register for one term as a nonmatriculated student The nonmatriculated student status allows a student to begin course work without being accepted into an academic program, but does require approval of the program director whose program is offering the course. Students should contact the Enrollment Management Department to inquire about eligibility.

Registration as a nonmatriculated student is no guarantee of subsequent acceptance into a graduate program. Registration as a nonmatriculated student allows the student to take only one term's course work. Subsequent registrations are expected to be under full or probationary acceptance status.

INTERNATIONAL STUDENT APPLICANTS

Nonimmigrant international students holding the F-1 visa are required to take a course load of at least nine credit hours as a condition of their visa. The student must document that he or she has sufficient funds for tuition, fees and living expenses. Additional funds must be available for dependents.

MSOE has a very limited number of research assistantships and does not provide other financial aid or scholarships for nonimmigrants, nor does it employ teaching assistants.

The United States Citizenship and Immigration Service (USCIS – formerly INS, Immigration and Naturalization Services) does not permit off-campus employment of F-1 visa students during their first year of school under any circumstances. Permission to work part time (up to 20 hours per week) after the first year can be granted only by the Bureau of U.S. Citizenship and Immigration Services (BCIS), and only after application based on a verifiable change in financial circumstances that would make it impossible to continue in school without income from part-time employment.

Prior to the release of the Immigration Form I-20, a deposit of $100 is required of all accepted international applicants who are not sponsored by a corporation or their government. The deposit is refundable if the student does not enter the United States on a F-1 visa obtained by using the I-20 form issued by MSOE. If the student enters the United States by using MSOE's I-20 form, but does not enter MSOE, no refund is made, and MSOE is obligated to report this occurrence within 30 days after the expected date of enrollment.

International students should have a firm and demonstrable command of both written and spoken English. Language proficiency must be demonstrated by achieving a composite score of 550 (213 computer-based) or higher on the Test of English as a Foreign language (TOEFL). Admission to the master's degree program in medical informatics requires a minimum TOEFL score of 580 (237 computer-based). International graduate student applicants should submit all application materials at least 90 days prior to the start of the academic term in which they wish to enroll.

APPLICATION PROCEDURES

Applicants should submit an application, official copies of all undergraduate and graduate course work (transcripts), letters of recommendation, application fee and appropriate test scores to the following address:

Graduate Admission
Enrollment Management Department
Milwaukee School of Engineering
1025 North Broadway
Milwaukee, WI 53202-3109
USA

The application and letters of recommendation may be submitted online at www.msoe.edu/grad/resources.shtml. Any questions may be directed to (800) 332-6763.

Upon receipt of all materials, application files are reviewed by the appropriate program director. Students will be promptly notified of their acceptance status. International graduate student applicants should refer to the previous section for additional information.

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ACADEMIC REGULATIONS AND POLICIES

REGISTRATION

All new students are required to register in person prior to the start of the academic quarter. Students should check the Timetable of Classes (http://www.msoe.edu/registrar/registration.shtml) for that quarter or contact the Enrollment Management Department for specific dates and times to register. During registration, a student's curriculum is reviewed, courses are selected, and parking permits and student identification cards are issued. Please note that all programs (except the MSEM program) require that the student confer with the program director to choose an appropriate program of study prior to registering.

Current students may register in person, by mail, by fax, or on the web. Registration forms are sent to students about a month before the start of each quarter. Tuition payment is required as outlined in the "Graduate Tuition" section of this Catalog.

MSOE reserves the right to revise admission rules, rules regarding the granting of degrees, tuition and fees, and any other regulations affecting its students at any time. MSOE will exercise the normal means of communication announcing revisions. MSOE also reserves the right to exclude, at any time, any student whose conduct or academic standing is regarded as undesirable.

STUDENT FINANCIAL SERVICES

MSOE's Student Financial Services Office is available to assist graduate students in obtaining financial aid, exploring alternative loan products and coordination of individualized payment plans. We encourage all students to visit our Web site at www.msoe.edu/finaid for more detailed information. If you have any questions or want further information, feel free to contact Student Financial Services at (800) 778-7223 or finaid@msoe.edu. (MSOE reserves the right to revise tuition, fees and policies at any time. MSOE will exercise the normal means of communication announcing revisions.).

How to Apply for Aid

Apply for a PIN (Personal Identification Number) from the U.S. Department of Education (ED). This process can be completed online at www.pin.ed.gov. The PIN is used as your electronic signature when applying for aid.

Once you have your PIN, you can apply for aid by completing the Free Application for Federal Student Aid (FAFSA). You may do so online at www.fafsa.ed.gov. If you wish to apply via a paper application, feel free to contact our office.

Eligibility

Admitted graduate students who are not in default or owe a repayment on any federal aid program are eligible for need-based and non need-based federal student loans. A student must be enrolled in a minimum of three graduate credits per quarter to be eligible for student loans, and deferment of student loans.

Please note the BEC courses are not eligible for financial aid. Further note that non-degree and non-matriculated students are not eligible for financial aid.

Graduate Tuition 2006-2007

Per Credit Hour $526

Perfusion Full Time .....$7605 per term

Application Fee.....$30

Graduation Fee $75

Directed Study (per credit hour) $823

Audit Fee .....75% of normal tuition for the course

Continuation Fee (GC-899) $100

At the time of this printing, 2007-2008 tuition and fees were not yet determined. Please contact Student Financial Services for the most recent tuition and fee rates or visit our web site at http://www.msoe.edu/campus/tuitfees.shtml.

PAYMENT POLICIES

Due Dates

Charges are due and payable by Monday of the third week of classes. Students who have settled in full all obligations to MSOE will be issued earned certificates, diplomas and transcripts, and will be permitted to register for the subsequent term. A student must have a zero balance to register for the next quarter.

If payment is not received by Monday of the third week, a late payment fee may accrue at a rate of 12 percent A.P.R (1 percent per month) until paid. Students whose financial aid has not transferred to their student account as of Monday of the third week because they have not completed their financial aid, have not yet applied for financial aid, or have applied for financial aid late may be charged a late payment fee on the entire outstanding balance. Students that are sponsored by a company, Chapter 31, DVR, or a Foreign Embassy who have their letter of authorization on file in the Student Accounts Office by Monday of the third week will not be charged a late payment fee on those charges covered by a company or agency.

If a student does not make payments when due, MSOE reserves the right to require full payment of the subsequent quarter before the student can register for that quarter.

Agency or Employer Sponsorship of Students

To allow flexibility for students sponsored by a company or agency, the following is possible: If the company/agency will allow MSOE to invoice them for the student's education with no contingencies, a letter of authorization from the company or agency must be on file in the Student Accounts Office or must accompany the registration form. The letter of authorization must state exactly what expenses will be covered (i.e. which classes, costs, fees, books, etc.). MSOE must have the letter at the time of the student's registration.

Financial Aid Disbursement

All processed financial aid will transfer to your student account during the second week of the term and on a rolling basis from that time forward.

Credit Balance Refund Checks

If you have more financial aid disburse to your account than charges on your account you will have a credit balance. Credit balance refund checks will be processed after all financial aid has been disbursed to your account and will be mailed to your local address. Please allow 10 days after a credit balance is created for credit balance refund checks to be processed.

Book Purchase Policy

Students are able to charge their book purchases, made at the MSOE Bookstore,

to their MSOE student account and will be billed for those charges on their next monthly invoice. In order to do this, students must present their MSOE student ID to the bookstore when purchasing their text books. You are able to charge your books to your student account during the two weeks before the term begins through the first Friday of the term. (Please note that you must wait at least 24 hours after you have registered before you can charge your books this way). Students can only charge books and supplies to their account; students cannot charge MSOE apparel or souvenirs to their account.

Student Invoices

All registered students are mailed a paper invoice before the term begins. If you register after the first batch of invoices has been mailed, you will receive a paper invoice in the mail during week three of the term. These invoices are mailed to the legal/home/permanent address you have on record with the Registrar's Office. If you wish to have it mailed to a different, address, you must contact us at payments@msoe.edu or 414-277-7130.

Please remember that you can always view your statement online at my.msoe.edu and you are responsible for all charges regardless of whether or not you receive a paper invoice in the mail. Charges are not updated online until week two of the term.

Outside Resources Reporting Requirements

If you receive financial aid or receive financial support from other agencies, you are required by federal regulations to report the amount of support you receive from those agencies to the Student Financial Services Office. Examples of such resources include monies received from the Department of Vocational Rehabilitation (DVR), the Trade Adjustment Act (TAA), the Veterans Affairs office (VA), National Guard, private scholarships and employer tuition reimbursement.

Late Registration

A $45 late registration fee is due and payable at the time of late registration. Late registration is defined as registering during week one of the term.

Audited and Other Noncredit Courses

Payment in full is required with registration.

Returned Check Fee

Checks received in payment of tuition and fees or cashed at the MSOE Bookstore, which are returned by the bank "Non Sufficient Funds", "Payment Stopped", or "Account Closed" will result in a charge of an additional $30.00 NSF check handling fee. If two (2) checks are returned from the bank, the student will lose their check writing privileges in the bookstore and their student account will be annotated to require all future payments to be in cash, cashier's check, money order, or credit card.

Dual Degree Program Charges

Duel degree programs offer the ability to complete both a bachelor's and a master's degree in five years. These students should complete their Free Application for Federal Student Aid as an undergraduate student.

Full-time students accepted into the Master of Science in Environmental Engineering or Master of Science in Structural Engineering duel degree programs are charged full-time undergraduate tuition rates and receive undergraduate financial aid for their fourth year, even though they may be taking graduate courses (If a student enrolls in more than 19 credits, they will be charged the graduate per-

credit rate for any credits above 19).

During their fifth year, students enrolled in an approved dual degree program will be charged the standard per credit charge based on the type and number of credits for which they enroll. They will still receive undergraduate financial aid for their fifth year because they have not yet graduated with a bachelor's degree.

MSOE scholarships and grants are not available to sixth year students; therefore if a student in an approved dual degree program must enroll for a sixth year, it is recommended that they graduate with their bachelor's degree after the fifth year so as to be eligible for graduate level Stafford loans in their sixth year.

Refund Policies

Tuition refunds will be based on the date of official withdrawal. The official withdrawal date is the date that the completed form is received by the Registrar's Office. Tuition refunds will be authorized only for withdrawals approved by the Registrar's Office.

Tuition Refund Schedule for Financial Aid Recipients

- A Financial Aid Recipient is defined as any student who has been awarded Financial Aid (Federal, State, or Institutional) by the Financial Aid Office.
- **No tuition refund will be made for Financial Aid recipients who drop individual courses after 4:00 p.m. on Friday of the first week of the quarter.**
- Tuition refunds will only be granted to Financial Aid recipients who officially withdraw from **ALL** courses according to the following schedule:

  Prior to the start of the quarter .....100% Tuition Refund
  During the first week of the quarter .....100% Tuition Refund
  During the second week of the quarter .....80% Tuition Refund
  During the third week of the quarter .....40% Tuition Refund
  During the fourth week of the quarter .....20% Tuition Refund
  After the fourth week of quarter .....NO REFUND

Return of Title IV Funds Policy

- If a recipient of Title IV aid officially withdraws from all classes before completing 60 percent of the quarter, MSOE is required by law to calculate whether a portion of the student's federal financial aid must be returned to the federal government.
- The amount of federal aid the student keeps is in direct proportion to the length of time the student remained enrolled during the quarter. The amount of aid earned is determined by dividing the number of days completed in the quarter by the total number of days in the quarter.
- Any funds not earned will be returned in the following order:

  1. Unsubsidized Stafford Loan
  2. Subsidized Stafford Loan
  3. Federal Perkins Loan
  4. Federal PLUS Loan
  5. Federal Pell Grant
  6. Federal Supplemental Educational Opportunity Grant
  7. Other Title IV Aid

- If a student withdraws before completing 60 percent of the quarter, the student may owe a repayment to the school. A bill will be sent to the student for any balance due as a result of returning financial aid funds.
- Please contact the Student Financial Services Office before withdrawing to determine what aid will be returned and what you may owe MSOE.

Tuition Refund Schedule for Students NOT Receiving Financial Aid

- This refund schedule is for 11 week classes; for shorter classes please contact the Student Account Office.
- Tuition refunds will be made for students not receiving financial aid who officially withdraw from one or more courses according to the following schedule:

Prior to the start of the quarter .....100% Tuition Refund
During the first week of the quarter .....100% Tuition Refund
During the second week of the quarter.....80% Tuition Refund
During the third week of the quarter .....40% Tuition Refund
During the fourth week of the quarter .....20% Tuition Refund
After the fourth week of quarter .....NO REFUND

GRADING

Graduate students are expected to earn at least a "B" grade in all course work attempted. Graduate students are not allowed to repeat a class for which a letter grade has been earned unless given permission by the program director. If a graduate course is repeated, then both grades will count toward the student's cumulative GPA. With the exception of Medical Informatics, MSOE uses the following grading system for graduate level courses:

Letter Grade	Numerical Equivalent	Interpretation
A	4.00	Excellent
AB	3.50	Above Expectations
B	3.00	Meets Expectations
BC	2.50	Below Expectations
C	2.00	Minimally Acceptable for Graduate credit
F	0	Failure
W	0	Withdrawal
P	0	Pass
NR	0	No grade reported
PIP	0	Project in Progress
S	0	Satisfactory

For those courses in the Master of Science in Medical Informatics program (i.e., courses with the MI-prefix), MSOE uses the following grading system:

Letter Grade	Numerical Equivalent	Interpretation
A	4.00	Excellent
A-	3.70	Significantly Above Expectations
B+	3.30	Somewhat Above Expectations
B	3.00	Meets Expectations
B-	2.70	Somewhat Below Expectations
C+	2.30	Below Expectations
C	2.00	Significantly Below Expectations
C-	1.70	Minimally Acceptable for Graduate Credit
F	0	Failure
W	0	Withdrawal
P	0	Pass
NR	0	No grade reported
PIP	0	Project in Progress
S	0	Satisfactory

Letter grades of A-F that are received for graduate courses completed at MSOE are included in the calculation of the average. To receive the degree, the student must attain a 3.00 cumulative GPA.

A letter grade followed by an asterisk is a temporary grade indicating incomplete work. The letter preceding the asterisk indicates the grade the student will receive if the work is not completed. An incomplete grade is given at the discretion of the instructor. It is the responsibility of the student to make arrangements within the first two weeks of the following quarter (not including summer) to complete the course. The student must submit the required work to complete the course within the time deadline set by the instructor, but this may not be later than the end of this same quarter. If the student has not completed all work for the course after this period of time, the asterisk will be dropped and the temporary letter grade will become the permanent grade.

Students who are unable to complete course work due to business travel, health or other factors are urged to either arrange with the instructor for an incomplete grade or officially drop the course. Otherwise, an “F” grade may be assigned for the course.

See the *Timetable of Classes* for information on drop dates.

ACADEMIC PROGRESS REQUIREMENTS

MSOE expects all students to complete their academic objectives as outlined under the "Grade Point Requirement" and the "Maximum Time Period" sections that follow. In addition, students are expected to follow the prescribed sequence of courses for the degree program selected, observing all course prerequisites and corequisites.

Grade Point Requirement

A student is expected to maintain a cumulative GPA of at least 3.00 in any graduate program. The cumulative GPA is calculated on the basis of all graduate courses completed or attempted at MSOE with final grades to which grade points are assigned. This would exclude, for example, a project course graded on a pass/fail basis when a pass (P) grade is earned. The cumulative GPA will include courses completed at the Medical College of Wisconsin (MCW) for students in the MSMI program. The cumulative GPA will be recorded on grade reports and on the student's permanent record each quarter. A student also is expected to maintain a program GPA of at least 3.00, calculated on the basis of all MSOE graduate courses applicable toward the degree being pursued (including those at MCW for students in the MSMI program).

A student whose cumulative GPA falls below 3.00 in any given quarter will be placed on academic probation. Each graduate-level program may impose restrictions on registration privileges for students on academic probation.

A student whose cumulative GPA falls below the minimum given in the table below, where "N" is the number of graduate credits over which the GPA is based, will be subject to academic termination.

N = Number of Graduate Course Credits for Cumulative GPA	Minimum Cumulative GPA
5 or less	2.00
Between 6 and 20, inclusive	2.30 + (1/30)N
21 or more	3.00

Individual graduate programs may impose additional requirements (for example, a minimum program GPA) that, if not met, would also cause a student to be subject to academic termination.

Grade Appeals and Termination From a Graduate Program

A student who receives a letter grade of "F" in a graduate class may be subject to enrollment termination.

A student who wishes to dispute any grade, including a grade of "F," in any graduate class must appeal first to the faculty member assigning the grade. The decision of the faculty member may be appealed to the department chairperson responsible for that course. The department chairperson will notify the graduate program director for the course and for the student that a grade appeal has been filed. The decision of the department chairperson may be appealed to the vice president of academics. The decision of the vice president of academics in the grade dispute matter is considered final.

A student who has been terminated from a graduate program due to academic difficulty may appeal the termination decision to the Graduate Student Advancement Subcommittee of the Graduate Programs Council. The student must submit a written petition to the Registrar's Office, addressed to the Graduate Student Advancement Subcommittee of the Graduate Programs Council. The decision of the Graduate Student Advancement Subcommittee of the Graduate Programs Council will be final.

Maximum Time Period

A student in the MSCS, MSE, MSEM, MSEV or MSST has a maximum of seven years from his/her initial enrollment in a graduate course to complete all degree requirements. A student in the MSMI program has a maximum of five years to complete all degree requirements. A student in the MSP program is expected to complete the program's requirements at the end of the six consecutive quarters of enrollment, including summer, of his/her initial matriculation and has a maximum of two years to complete all degree requirements. Any student failing to complete all degree requirements within the deadlines described should consult with his/her program director and request a time extension (described below).

Time Extensions

Students having a valid reason for being unable to meet deadlines established by MSOE for completion of the graduate degree programs (see above for specific time limits) may appeal in writing to the program director for an extension of time of up to one year. The decision of the program director may be appealed to the Graduate Programs Council. An appeal for an extension of more than one year must be approved by the GPC's Graduate Student Advancement Subcommittee.

The request for an extension must explain why the deadline was not or will not be met and propose substitute deadlines.

If the GPC Graduate Student Advancement Subcommittee grants a time extension, the subcommittee will outline academic requirements the student must meet prior to graduation.

DIRECTED STUDY ENROLLMENT

In the event that a student is unable to schedule a specific course, he/she may be eligible to register for the directed study program. This program provides one-on one instruction with an MSOE faculty member. Generally, permission for such registration is granted only if the course is essential to the student's program of study and if he/she is registered for his/her last quarter before graduation or is within nine credits of graduation. Permission will be granted subject to the availability of appropriate faculty. A student seeking this registration may obtain the proper form from the Registrar's Office. Students must contact the appropriate program director for approval.

POLICY ON STUDENT INTEGRITY

As an institution of higher learning, MSOE is committed above all to the educational development of its students as responsible and principled human beings, and is an institution accountable in this regard to all whom it serves and by whom it is scrutinized. MSOE has a priority interest in promoting personal integrity and in ensuring the authenticity of its graduates' credentials.

The university is similarly mindful that both the professions and business and industry have, for a long time, been concerned with the ethical, no less than the professional, practice of their members and employees. It follows, therefore, that students of MSOE – preparing for professional careers and leadership roles that are founded on responsibility and trust – must observe and be guided by the highest standards of personal integrity both in and out of the classroom.

The expectations of the university with respect to academic and classroom integrity are reflected in, but not limited to, the following guidelines:

1) The student must recognize that even a poorly developed piece of work that represents his or her best efforts is far more worthwhile than the most outstanding piece of work taken from someone else.
2) Assignments prepared outside of class must include appropriate documentation of all borrowed ideas and expressions. The absence of such documentation constitutes "plagiarism," which is the knowing or negligent use of the ideas, expressions or work of another with intent to pass such materials off as one's own.
3) The student should consistently prepare for examinations so as to reduce temptation toward dishonesty.
4) A student may not share examination answers with others for the purpose of cheating, nor should he or she, through carelessness, give them an opportunity to obtain the same.
5) The student should know that a person of integrity will not support, encourage or protect others who are involved in academic dishonesty in any way, and will furthermore attempt to dissuade another student from engaging in dishonest acts.

The institutional policy that follows includes prescribed procedures for the assigning of penalties by instructors in instances of academic dishonesty as well as procedures for student appeals of such actions. A student who in any way acts dishonestly in class assignments or examinations or who submits a plagiarized or unoriginal work to an instructor shall be subject to sanctions up to and including an "F" grade for the assignment, examination and/or the course at the discretion of the instructor of the course. The numerical value of the "F" will be assigned by the instructor. If the instructor assigns an "F" for the course, the student will not be allowed to drop the course. If the instructor assigns an "F" for academic dishonesty, the student has the right to appeal following established procedures. Upon recommendation of the instructor or at his own initiation, the vice president of academics may decide that repeated or extremely serious acts of dishonesty may be grounds for more severe disciplinary action up to and including student expulsion.

The student will be notified by the faculty member either within three academic working days of the faculty member's awareness of the problem or at the next class session attended by the student. The faculty member will notify the student using the form designed for notification. A copy of this notice will be sent to the department chairperson and the vice president of academics. The vice president of academics will retain all such reports in a permanent file.

The procedure outlined in steps 1-7 below will be used if a student wishes to appeal a faculty member's judgment that academic dishonesty has occurred.

1) The student will have three academic working days after delivery of the written notification to initiate an appeal to the chairperson of the department in which the faculty member serves. The student will be deemed to have waived his/her right to appeal unless he/she files the appeal with the department chairperson within these three academic working days. The statement of appeal must specify each denial of the faculty member's decision and the substance of the contentions upon which the student intends to rely in his/her appeal. Filing notices of appeal in accordance with these provisions shall not suspend the operations of the sanction previously declared in the case by the faculty member. The student will remain in class during the entire appeal process.
2) The department chairperson will have three academic working days in which to review the appeal. The sole purpose of the department chairperson's review is to determine if sufficient evidence exists that the student was engaged in academic dishonesty. The chairperson must inform the student and faculty member of his/her judgment within those three academic working days.
3) The student or faculty member may further appeal to the vice president of academics within three academic working days.
4) The vice president of academics shall convene an academic review board to hear the student's appeal within a reasonable time (if possible, within three academic working days of the appeal). The academic review board shall be made up of two department chairpersons selected by the vice president of academics, and one faculty member selected by the vice president of academics and agreed upon by the person initiating the appeal. The vice president of academics will be a nonvoting chairperson. The faculty member assigning the penalty and his/her department chairperson may not be on the board.
5) The sole purpose of the academic review board is to determine if sufficient evidence exists that the student was cheating. The academic review board shall render its decision after all sufficient evidence has been presented, but in a time period not to exceed three academic working days from the commencement of its proceedings. The decision of the academic review board in appeal cases is final and cannot be further appealed under procedures established herein.
6) All appeals established by this procedure must be in writing.
7) The student may bring a representative to any meeting established under this procedure. The faculty member also may have representation at any meeting.If a student wishes to appeal the penalty, such an appeal must be in writing and must follow the procedure on graduate "Grade Appeals" and "Termination from a Graduate Program" appearing elsewhere in this Catalog.

CONTINUOUS REGISTRATION

Graduate students are required to be continuously registered until graduation after initiation of the master's project, thesis or other capstone activity. Students who initiated the master's project, thesis or other capstone activity and are not registered for three or more graduate credits in a quarter must register for GC-899 and pay the Continuation Fee associated with this course. Registration in the GC-899 will appear on the students transcript as a no credit course with no effect on the student's GPA. Students in the Master of Science in Perfusion program are required to be continuously registered for four quarters per academic year after initiation of the master's thesis. Students in other programs are not required to be registered for the summer program.

ACADEMIC ADVISING

Each degree program at MSOE has a designated program director who acts as mentor and academic counselor for all students in that program. Incoming students are provided with a catalog and program outline. For those students who meet all of the graduate admission requirements, the program outline identifies all required courses and the exact credit breakdown related to electives.

Most of the graduate programs require new students to meet with the program director prior to registering for the first course to ensure that the new students understand the curriculum and future scheduling procedures. Students are encouraged to call the program director or faculty advisor whenever they have questions on the program. In subsequent quarters, students whose cumulative grade point average falls below a specified minimum (normally 3.00) will be required to consult with the program director prior to registration.

The program director, designated faculty advisors, department chairpersons and the registrar work together to ensure that students in a particular degree program make satisfactory progress without violating prerequisites. Any attempt by students to schedule substitute courses not required or allowed may be questioned at the time of registration and will, in general, not satisfy the program requirements.

It is recommended that students with a designated advisor meet with him/her during each Spring Quarter to review their current academic program. At that time, they may discuss with the advisor a provisional study program for the next academic year.

PREREQUISITE POLICY

The student is responsible for ensuring that he or she has successfully completed all prerequisites before taking a course. If any prerequisites have not been successfully completed by the start of the course, the student is required to drop the course. Students in violation of this prerequisite policy are subject to removal from the course. The student will be allowed to continue in the course only if a prerequisite waiver is approved by the appropriate program director. Prerequisites are listed in the course description section of the academic catalog.

STUDENT ATTENDANCE POLICY

MSOE expects all graduate students to attend regularly and promptly all lectures, laboratories and other sessions of courses for which they are registered.

Graduate students are expected to attend and contribute to all class sessions. However, the faculty recognizes that business travel or other factors may force students to miss some classes. Students should notify their instructor as early as possible if they will be forced to miss a class, and they should make arrangements to make up any missed work. Unexcused absences may result in a lowering of the grade or being dropped from the course.

ADDING/DROPPING COURSES AND CHANGING SECTIONS

If a change of schedule is necessary, this may be done in the Registrar's Office before 4:30 p.m. on Friday of the first week of classes. **Students may neither add a course nor change sections after 4:30 p.m. on Friday of the first week.** This policy also must be followed by students taking courses available on a credit/noncredit basis who want to change from credit to noncredit status or from noncredit to credit status.

A student may drop a course and receive a grade of "W" after the first week and **before 6 p.m. on Monday of the eighth week of classes.** Drop forms are available in the Registrar's Office or at www.msoe.edu/registrar/forms.shtml. These must be completed, properly signed and received by the Registrar's Office before the deadline for dropping courses. Tuition refunds will be based on the date the completed form is received by the Registrar's Office, not on the date of last class attendance.

All students are responsible for their academic schedule. Students should not rely on instructors to drop them for nonattendance.

Students enrolled at off-campus locations are required to meet the same deadlines. Forms may be sent via facsimile to the Registrar's Office. For more information, call the Registrar's Office at (414) 277-7215.

WITHDRAWAL FROM ALL CLASSES

Students who wish to drop all classes must complete a withdrawal form, which is available in the Registrar's Office or at www.msoe.edu/registrar/forms.shtml. **This must be done before 4:30 p.m., on Friday of the 10th week of classes.** Tuition refunds will be based on the date of official withdrawal, NOT on the date of last class attendance. The official withdrawal date is the date that the completed form is received by the Registrar's Office. Should a student fail to meet the withdrawal deadline, he/she will be responsible for tuition for all scheduled classes and will receive final grades in all of them.

Students enrolled at off-campus locations are required to meet the same deadlines. Forms may be sent via facsimile to the Registrar's Office. For more information, contact the Registrar's Office at (414) 277-7215.

TRANSFER OF GRADUATE CREDIT

A maximum of nine credit hours (or three MSOE courses, whichever is less), of approved graduate work taken at another institution may be transferred with the consent of the appropriate program director. A course completed at another institution must meet the following conditions to be accepted for credit: (1) it was taken for graduate credit; (2) a grade of "B" or better was earned; and (3) It was taken not earlier than five years prior to the first course in the program.

If transfer credit is granted, the grades earned in those courses will not be counted in the MSOE grade point average.

Transfer of graduate credit for a non-elective course.

Transfer credit will be granted for a non-elective course in a program only if the course content of the non-elective course was met in the proposed transfer course.

Applicants should send a letter to the program director identifying the course(s) they wish to transfer and the MSOE course(s) for which they propose to substitute. The letter also should contain any catalog course descriptions and course syllabi for the proposed transfer courses to assist the program director in assigning transfer credit.

If transfer credit is approved by the program director, it will be indicated on the transcript as "TR" next to the course number for which transfer credit was granted.

Transfer of an elective course.

Elective courses may be of one of two types:

1) Restricted elective – such as a technical elective

2) Non-restricted or "free elective"

Transfer credit granted for restricted electives will follow the policies footnoted on the official curriculum track of the student's program.

Any graduate course meeting the conditions for acceptable graduate credit, and that have relevance to the program, will be allowed to transfer for a non-restricted elective. The decision of relevance will be made by the program director.

Transfer credit approved to take the place of an elective course will be indicated on the transcript with a "TR" designation. The course title will indicate the subject matter of the transferred course and will be determined by the program director. The course number will be indicated as EL1 for non-restricted electives and EL1R for restricted electives.

PROCEDURE FOR CHANGING GRADUATE PROGRAM

A student wishing to change from one graduate program of study to another must submit a new application for admission, obtained from the Enrollment Management Department. New letters of recommendation will be required, and the student will be subject to any other application requirements for the program to which the student is applying. If the student's new application is accepted, the student's previously completed course work will be evaluated for transfer into the new program (see "Transfer of Graduate Credit" section). Only those courses taken subsequent to acceptance into the new program will be counted in the student's cumulative GPA.

PETITION FOR RE-ADMISSION TO A GRADUATE PROGRAM

A graduate student who has not been enrolled in a graduate program for over seven years must petition for re-admission to continue in the program. Students who have been enrolled in a program within the previous seven years do not have to petition for re-admission to that program. However, these students are advised to contact the Program Director to determine if a time extension, or other action, will be necessary.

The petition process for re-admission to a graduate program is as follows:

- The Enrollment Management Department is to direct inquiries concerning readmission to a graduate program to the Program Director.
- The student is to submit a petition for re-admission to the Program Director. The petition for re-admission is to consist of:
  - updated personal information (i.e. contact info, etc, which may be supplied by filling out a new application form),
  - a written appeal stating the reasons for the student's absence from the program and why the student believes future success in the program is likely,
  - letters of recommendation as required by the program, and
  - an official MSOE transcript showing previous work completed.
- The Program Director is to evaluate the petition using current program admission standards to determine if the student should be re-admitted. The student's previous work in the graduate program should be weighed by the Program Director to determine if the student should be fully re-admitted, re-admitted on a probationary basis or not re-admitted.
- If the Program Director determines the student should not be re-admitted, the Program Director will notify the student in writing. A copy of the letter shall be forwarded to the Office of the Registrar and added to the student's permanent file. The student may appeal the decision of the Program Director to Graduate Programs Council Graduate Student Advancement Subcommittee by submitting the students' petition for re-admission to the Graduate Programs Council Graduate Student Advancement Subcommittee. The procedure for this appeal is available from the program director.

AWARDING OF TWO MASTER'S DEGREES (MSE AND MSEM)

A student may pursue both the MSE and MSEM either concurrently or separately.

For students pursuing both degrees, up to six credits may be shared between the MSE and MSEM programs as follows:

1) Students may use one three-credit MSE course to satisfy three of the elective credits in the MSEM program.
2) Students my use one three credit MSEM course to satisfy the three elective credits in the MSE program.

AUDITING A CLASS

To audit a course, a student must be accepted by MSOE as a regular or nondegree graduate student. The student must have an appropriate background in the course subject area. At the completion of the audit, no letter grade is issued and no graduate credit is awarded. A notation is made on the student's transcript of successful/unsuccessful audit based upon the course requirements. The tuition rate for audit of graduate level course work is specified in the Timetable of Classes for any given quarter.

UNDERGRADUATE/GRADUATE COURSES

Courses whose numbers start with "5" are generally open both to undergraduate and graduate students. The instructor will typically give additional assignments to the graduate students.

Undergraduate/Graduate courses have a double designation. Students taking them for graduate credit register under the 500-level designation. Those taking them for undergraduate credit, including graduate students fulfilling prerequisite requirements, register under a 400-level designation. Graduate tuition is charged for such courses having the 500-level designation.

Undergraduates who meet the grade point requirements for graduate study may enroll in 500-level courses and receive graduate credit, so long as they have not already taken the equivalent undergraduate course.

Receiving Graduate Credit for an Undergraduate Course

MSOE recognizes that on occasion a graduate student having a free elective in his/her graduate program may wish to enroll in an undergraduate course that contains subject matter of particular interest to the student, and to receive graduate credit for so doing. MSOE also recognizes that graduate students need to be held to a higher academic standard than do undergraduate students. The following policy shall therefore be in effect regarding graduate students wishing to receive graduate credit for attending an undergraduate course:

In the quarter preceding the one in which the undergraduate class is offered, the graduate student shall contact his/her graduate program director and request a graduate independent study form. The student shall then contact the instructor of the undergraduate course in question, and will explain his/her desire to obtain graduate credit for the course. The graduate student will ask the instructor if he/she is willing to assign and grade an additional project or projects to supplement the standard undergraduate course materials, in order to raise the level of the course to that of a graduate offering. The student also will request permission to attend the lecture and/or lab portions of the course, along with its undergraduate enrollees. If the instructor and the department chair of the department offering the course so agree, then the student will ask the instructor to complete the independent study form, which stipulates all requirements for completing the course for graduate credit. The student should submit the original, signed, independent study form to the registrar. The student will then register for the course just as he/she would for any graduate independent study course. Upon completion of all stipulated requirements, the instructor will award the student a grade for the course, and the student will receive graduate credit for that course.

The above procedure will not apply to courses that already carry an undergraduate/ graduate (U/G) designation. Such courses may be taken for graduate credit simply by registering for the appropriate course number, as discussed above.

Students wising to transfer in course work from another institution for graduate credit may only do so if the course work carries a U/G or G designation, as stated in that institution's official catalog.

FULL-TIME STATUS

MSOE graduate students are classified as enrolled full time if they are registered for nine or more graduate credit hours as of the close of business on Friday of the first week of the quarter.

GRADUATION REQUIREMENTS

Degrees are conferred at the end of the Fall, Winter, Spring and Summer Quarter. Attendance at the appropriate Commencement Exercises is required for all master's degree candidates.

Students must indicate to the Registrar's Office their intention to graduate as stated in the "Graduation Procedures" section that follows. Candidates for graduation must have completed or be enrolled in all courses required for graduation.

Master's Degree Requirements

1) Satisfactory completion of all courses prescribed for the particular area of study in which the degree is to be granted.
2) A cumulative grade point average of 3.00 or higher in graduate course work that is applicable toward the degree being granted.
3) Completion of all prescribed courses while at MSOE, except where permission is granted by the program director to transfer a maximum of nine graduate credits or three courses, whichever is less, into the graduate program.
4) Satisfactory completion of a master's thesis, oral presentation or other projects when prescribed, for the specific degree being sought.
5) Attendance and participation in Commencement Exercises.

GRADUATION PROCEDURES

1) Each student must apply for graduation by completing a Graduation Application form and submitting it to the Registrar's Office no later than the end of the seventh week of the quarter preceding the quarter in which the student expects to graduate. Graduation applications are available from the Registrar's Office or on the Registrar's Office Web site. Medical Informatics Students must also apply to the Medical College of Wisconsin for graduation and have their picture taken. Contact the Medical Informatics program director for further instructions.
2) For those who submit a Graduation Application form by the above stated deadline, the Registrar's Office, in conjunction with the program director, will do preliminary graduation checks before the end of the first week of the quarter in which the students plan to graduate, and notify them if additional courses are required.
3) A student completing graduation requirements by the end of a quarter, but who has not submitted a Graduation Application form by the above stated deadline, may participate in the Commencement Exercises with approval of the program director. The diploma for the student may, however, be delayed.

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GRADUATE PROGRAM DESCRIPTIONS

MASTER OF SCIENCE IN ENGINEERING (MSE)

The MSE program enables the graduate engineering professional to solve problems by drawing from the fields of mechanical engineering, electrical engineering and other related fields. The emphasis of this program is on the integration of technologies rather than focusing on one discipline, although students choose an Engineering Option which, together with the Engineering Project, can provide some degree of concentration.

The MSE is aimed toward engineers who are involved with industrial projects. Students are expected to take engineering courses both within and outside their discipline. Courses cover such topics as material properties, probability and statistics, systems analysis, advanced mechanics, data communications, computer assisted engineering and software engineering. A capstone engineering project is included as part of the program.

In addition to the availability of the MSE program on the Milwaukee campus, course work also is available in the Fox Valley area in Appleton, Wis. Specific courses can be presented at company locations as requested.

Program Director: Dr. Subha Kumpaty, P.E.
(414) 277-7466, kumpaty@msoe.edu

Faculty:

Dr. Kishore C. Acharya, Soud Al-Mishwit, William Barnekow, Dr. Cynthia W. Barnicki, Dr. Steven L. Barnicki, Dr. Jeffrey J. Blessing, Dr. Vincent R. Canino, Dr. Edward W. Chandler, Dr. Michael T. Chier, Dr. Christopher J. Damm, Dr. Eric Durant, Dr. William C. Farrow, Dr. Larry Fennigkoh, John L. Ficken, Dr. John D. Gassert, Dr. Glenn Gratke, Edward J. Griggs, Dr. Gottfried Hoffman, Dr. Mark Hornick, Dr. Jovan Jevtic, Jeffrey Korn, Dr. Peter K. F. Kuhfittig, Dr. Subha Kumpaty, Dr. Andrew J. Kwon, Thomas Labus, John Lunz, Dr. A. James Mallmann, Dr. Russell D Meier, Dr. Richard Mett, Dr. Joerg Mossbrucker, Dr. Joseph C. Musto, Dr. John E. Pakkala, Dr. Matthew A. Panhans, Dr. Owe G. Petersen, Dr. Vincent Prantil, Stephen Rather, Dr. Steven E. Reyer, Dr. Samantha Richerson, Dr. Robert Rizza, Dr. Teodoro C. Robles, Dr. Darrin Rothe, David Sachs, Dr. Matt Schaefer, Dr. Patrick Schroeder, Dr. Thomas F. Schuppe, Dr. Mark J. Sebern, John A. Starr, Dr. Robert A. Strangeway, Dr. Deepti Suri, Michael J. Swedish, Dr. Thomas Swiontek, Dr. Christopher C. Taylor, Dr. Gerald Thomas, Hue Tran, Dr. Charles S. Tritt, Dr. Robert Turney, Thomas S. Wanke, Dr. Henry L. Welch, Dr. Katherine Wikoff, Dr. Stephen Williams, Dr. Gerald A. Woelfl, Dr. Glenn T. Wrate

The MSE program is an interdisciplinary program, spanning electrical engineering and mechanical engineering. It is based on the philosophy that there is a need for engineers who can use a variety of disciplines to solve technical problems. Traditionally, graduate education in the United States has focused on creating specialists – people who can advance the frontiers of knowledge in a narrow field. The MSE program's major emphasis is on the application of engineering skills and knowledge. Engineering concepts and theory are conveyed through the applications presented.

Each course typically meets once per week for 11 weeks during one of the three quarters of the regular academic year. Occasionally, select classes will meet twice weekly.

The required Engineering Project can either draw from the multiple disciplines studied within the program or can focus more on technical areas within the student's chosen Engineering Option.

Program Objectives

The graduate of the MSE program will:

1) have a solid foundation in mathematics and in the disciplines of electrical engineering and mechanical engineering
2) have a deepened understanding of principles in a chosen area of engineering to better prepare him/her for professional practice
3) have an ability to apply engineering principles to practical problem solving
4) have demonstrated analytical skills applicable to problems involving complex engineering systems and components
5) have an ability to formulate and carry out a significant engineering project
6) have the ability to effectively present and communicate technical concepts, both orally and in writing

Curriculum Format

The program is designed for individuals with bachelor's degrees in engineering, engineering technology or other closely related areas. Each student works with the program director to plan a course of study tailored to his or her needs. Individual degree requirements are dependent upon the type of bachelor's degree. Students with a Bachelor of Science degree in Mechanical or Electrical Engineering, Mechanical or Electrical Engineering Technology, or a substantially similar degree from an accredited program are typically required to complete a total of 45 graduate credits. Students with other bachelor's degrees are generally required to complete a total of 54 graduate credits.

Curriculum Content

To ensure that each student has an interdisciplinary program while allowing the program to be tailored to the student's needs, there are certain minimum credit requirements from each of the following disciplines:

Mathematics
MA-611 Engineering Mathematics I (three credits)
MA-612 Engineering Mathematics II (three credits)

Systems Engineering
One course from list (three credits):
GE-703 Simulation and Modeling
GE-705 Computer Assisted Engineering

Electrical Engineering
Typically required if B.S. degree is not EE or EET (nine credits):
EE-502 Systems Analysis and Control
EE-513 Linear Integrated Circuits
EE-520 Electromagnetics and Transmission Lines

Mechanical Engineering
Typically required if B.S. degree is not ME or MET (nine credits):
ME-512 Transport Processes
ME-514 Thermodynamic Applications
ME-521 Science of Engineering Materials

Engineering Option
Select four-course option sequence (EE; ME) (12 credits)

Computer Engineering
CS-780 Software Engineering (three credits)

Technical Elective – Mathematics, Physics or Engineering
One MA, PH, CS, EE, EV, GE, IE or ME course (three credits)

Engineering Project
EN-700, GE-797 and GE-798

Engineering Option

Students select an Engineering Option of at least four courses (12 credits) from one of the areas identified below. The Engineering Option provides each student with the opportunity to extend their level of expertise in a specific technical area. The courses which constitute the basic options are:

Electrical Engineering (EE)
(Complete any four of the following five courses.)
EE-724 Digital Data Communication
EE-871 Modern Control Systems
GE-706 Digital Control Systems
EE-813 Advanced Electronic Systems
EE-814 VLSI Circuit Design

Mechanical Engineering/Materials (ME)
(Complete any four of the following five courses.)
ME-703 Advanced Mechanics
ME-821 Corrosion and Degradation of Materials
ME-822 Structure and Properties of Engineering Materials
ME-861 Finite Element Analysis for Mechanical Engineering
ME-862 Advanced Mechanical System Design

Other options are available but are not offered as a regularly schedule sequence of courses. These options are offered only on a special petition basis. A group of at least eight students must petition to the MSE program director requesting that the option be scheduled. The petition must be submitted by the end of week one of the quarter immediately before the quarter in which the option will begin. The petition will be reviewed and a decision to offer the option will be based upon ensuring that sufficient enrollment be maintained in each of the courses offered.

Engineering Project

The Engineering Project (six credits) is required of all MSE students. In consultation with a faculty advisor, each student develops an engineering project or other suitable technical study that incorporates concepts learned in the program.

Summary of Typical Program Requirements

	Undergraduate Background		
	Mechanical	Electrical	Other
Discipline	**Graduate Credits Required**		
Mathematics (MA)	6	6	6
Systems Engineering (GE)	3	3	3
EE-500-level	9	0	9
ME-500-level	0	9	9
Engineering Option (EE, FP or ME)	12	12	12
Computer Engineering (CS)	3	3	3
EN-700	3	3	3
Technical elective	3	3	3
Engineering Project	6	6	6
Total Credits Required	45	45	54

Model Part-time, Five-year Track[1] (V4.3.1)

		QUARTER CREDITS Fall	Winter	Spring
First Year				
MA-611	Engineering Mathematics I	3		
MA-612	Engineering Mathematics II		3	
GE-7XX	Elective (Systems Engineering)			3
Second Year – Students with BSME - Typical Sequence[2]				
EE-502	Systems Analysis and Control	3		
EE-513	Linear Integrated Circuits		3	
EE-520	Electromagnetics and Transmission Lines			3
Second Year – Students with BSEE - Typical Sequence[2]				
ME-514	Thermodynamic Applications	3		
ME-521	Science of Engineering Materials		3	
ME-512	Transport Processes			3
Third Year				
	EE/ME Option - First Course[3]	3		
	EE/ME Option - Second Course[4]		3	
	EE/ME Option - Third Course[4]			3
Fourth Year				
	EE/ME Option - Fourth Course[4]	3		
CS-780	Software Engineering		3	
	Graduate-level Elective[5]			3
Fifth Year				
EN-700	Technical Communication (Engineering Project Proposal)	3		
GE-797	Engineering Project I		3	
GE-798	Engineering Project II			3
	TOTAL CREDITS 45			

[1]Note: This track applies to students who begin in the fall of an even numbered year. A similar track (V4.3.2) exists for students who begin in alternate years.
[2]Students entering the program need to have their undergraduate records examined to determine MSE course requirements at the 500-level. Students entering the program with a degree other than BSEE or BSME typically need more than 45 total credits for graduation.
[3]EE/ME option - First course is EE-724 for EE option, ME-703 for ME option.
[4]The second, third and fourth courses for the EE/ME option must be selected as specified under the Engineering Options section of the *Graduate Catalog*.
[5]Electives may not be EE-502, EE-513, EE-520, ME-512, ME-514, or ME-521.

MASTER OF SCIENCE IN ENGINEERING MANAGEMENT (MSEM)

The MSEM is a technology-oriented management program designed to meet the needs of engineers, business managers, and other professional and technical personnel desiring to strengthen their management and leadership skills. Graduates of the program possess broad business management knowledge and skills and are prepared to move into general management positions in a wide range of industries.

The MSEM is based on the philosophy that, for companies to grow and compete domestically and internationally, their management needs a deep understanding of both technology and management.

Faculty members have extensive business experience. In addition to their academic qualifications, most are employed in the discipline they teach. Areas of particular emphasis include organizational leadership, project management, product development and design, operations and production management, financial management, technical sales and marketing, technical entrepreneurship, quality and continuous improvement, policy and strategy, supply chain management, and international business.

In addition to offering the program in Milwaukee, the degree program is offered in the Appleton, Wis., area. Courses also are available at several other locations in southeastern Wisconsin including Brookfield/Waukesha. Some courses extensively use the Internet.

Classes are usually small, in the range of ten to fifteen students. Occasionally, in core courses, the size may reach the maximum enrollment limit of 25.

Courses meet for three hours, one evening each week, for 11 weeks during each of the three quarters of the regular academic year. A reduced summer schedule is offered depending on demand.

MSOE also offers a cohort program leading to a Master of Science degree in Engineering Management in two years. In this program, courses are clustered in eight integrated suites of two courses each. These classes meet one evening per week and all day on alternating Saturdays. Assignments for the courses in the suites often complement each other; for example, a student may do a survey for organizational behavior and analyze the results using models from the statistics course.

Courses include lectures, discussions, student presentations and other activities. Guest speakers sometimes appear in class to share their experiences. Class participation by all students in the discussions is essential.

The course work requires, in addition to active participation in class, reading the text and management journals, as well as other books that may be assigned by the instructor; writing term papers and book reviews if required; and completing similar work designed to show the student's mastery of the topic.

Students should expect at least two to three hours of additional individual or group study for every hour of class time. Formal written exams are used in some courses. Many courses require projects to be completed by individuals or small teams of students, often centered on the student's organization.

Students enrolled continuously in the program normally take between two and five years to complete the degree, depending on whether they take more than one course at a time and whether they take summer courses. Students are allowed up to seven years, but are advised against doing so in their own interest. The "Model

Part-time Tracks' following in this catalog illustrate typical programs for a student taking one course all four quarters.

Program Director: Dr. Bruce Thompson

(414) 277-7378, thompson@msoe.edu

Faculty:

Dr. Steven Bialek, Patricia Doyle, Dr. Richard Edwards, James Eggers, Marty Gustafson, Robert Hankes, Terry Hoffmann, Dr. David Howell, Dr. Paul Hudec, Thomas Jerger, Stanley Kosmatka, Dr. George Lephardt, Kimbel Nap, Michael Ostrenga, Curtiss Peck, Dr. Thomas Schuppe, James Spindler, Dr. Bruce Thompson, David Tietyen, Gene Wright

Program Objectives

The graduate of the MSEM program will have:

1) an ability to use modern management techniques, skills and tools
2) an ability to lead and contribute in multidisciplinary teams in a multicultural environment
3) an understanding of professional and ethical responsibility
4) an ability to communicate effectively
5) the broad education necessary to apply management solutions in global and social contexts
6) a recognition of the need for, and an ability to engage in, lifelong learning

Required Curriculum

Nine courses are required: EM-600 through EM-670 and EM-800. All students are expected to complete the first eight required courses, EM-600 through EM-670, prior to movement into more advanced courses. These courses are listed on the following pages. The research and writing requirement may be satisfied either through EM-630 or by taking all three of the one-credit modules: EM-631, EM-632, and EM-633. Because the required courses are taught at the graduate level, students who have taken somewhat similar undergraduate courses normally will not be exempt from the required courses.

Final Activity

Each student completes either a thesis or a three-course specialization track. The final activity has two primary objectives: 1) it is a learning experience in which the student has the opportunity to discover something about a business topic that is not readily accessible, that is not conventional wisdom, and is not found in any book or other common source; and 2) it is a means by which the student demonstrates his or her depth and breadth of learning from the MSEM program. Alumni cite this opportunity as one of the most valuable components of the program in their career advancement.

Students in the regular program have two choices: the Thesis (EM-804, or EM-798 and EM-805) or a Specialization Track.

1) Thesis EM-804 (6 credits), or EM-798 (3 credits) and EM-805 (3 credits)

The thesis starts with a proposition or point of view. It reflects research on some management topic, often applying it to a particular situation to see whether or not the particular management theory is useful. Often it is aimed at finding a solution to a problem at the student's company. Occasionally the thesis takes the form of a case study examining the history of an organizational problem or decision–its

background, why decisions were made the way they were and drawing conclusions applicable to other management situations.

The thesis should follow the Documentation and Style Guide (available at http://www.msoe.edu/gen_st/style/). Students present the results of their work to a faculty committee with guidance from a faculty thesis advisor, generally chosen for expertise in the subject area. Normally, students start the thesis after they have accumulated 33 credits.

The thesis distinguishes the MSEM degree from similar degrees at other universities where work of this level of significance is not produced. It provides the student with a tangible document that demonstrates to employers, and potential employers, the student's basic management knowledge and the ability to apply management principles to specific situations.

2) Specialization Tracks (9 credits)

The Specialization Tracks consist of three consecutive courses that concentrate on a single area of management: two electives in the specialization and a final project. The following tracks are offered:

Quality

"Quality" is a complex combination of results involving satisfying the customer, providing on-time delivery, complying with regulatory requirements, continually improving the value of products and services, being profitable and, at the same time, maintaining the quality of work-life and more. It is quite obvious that such a complex list of desired achievements is not the result of a simple process hut is the result of a very complex, holistic, dynamic and heuristic process involving everyone within an organization on an on-going basis, Quality is achieved, maintained and improved through the way a business is operated in essence through its management processes. This track emphasizes how quality is achieved as a part of the management process rather than as a separate process superimposed on the management process.

Courses in the Quality Specialization Track include the following:
EM-746 Quality Management and Engineering
One course from the following list:

EM-747	Advanced Manufacturing Technology
EM-762	Development and Redesign of Organizations
EM-770	New Product Management
EM-845	Final Project Quality

Marketing

The Marketing Specialization Track gives MSEM students added experience and insight into one of the most critical ingredients of managing a successful and profitable organization. More and more organizations are moving from being technology-driven to becoming marketing-driven in order to effectively compete in today's global markets.

Courses in the Marketing Specialization Track include the following:
Two courses from the following list:

EM-770	New Product Management
EM-771	International Marketing
EM-775	Marketing Strategies
EM-870	Final Project Marketing

Operations Management

The Operations Management Specialization Track addresses the systems that make and provide goods and services in a typically dynamic, ever-changing

environment. Successful operations managers effectively utilize resources to meet today's demands while orchestrating the changes needed to meet future customer and market needs.

Courses in the Operations Management Specialization Track include:
One of the following two courses:

EM-712 Decision Support for Operations Management
EM-744 Supply Chain Management
EM-747 Advanced Manufacturing Management
EM-840 Final Project Operations Management

Program Management

The Program Management Specialization Track is intended to provide the student with the skills to handle programs and projects within the firm. This track gives the engineering manager the ability to provide alternative solutions to programs and projects, prepare justifications, plan for the implementation of projects and programs, manage and control programs and projects and, lastly, provide postmortem feedback on the process.

Courses in the Program Management Specialization Track include:
One of the following two courses:

EM-721 Cost and Capital Investment
EM-765 Managing Project Teams
EM-790/ Total Project Management
EM-795
EM-890 Final Project Program Management

Organizational Management

The Organizational Management Specialization Track is designed to give the student an opportunity to integrate the knowledge, skills and tools of managing/leading the qualitative process and human resource functions of an organization.

Courses in the Organizational Management Specialization Track include the following:
Two courses from the following list:

EM-762 Development and Redesign of Organizations
EM-766 Bargaining and Negotiating
EM-765 Managing Project Teams
EM-767 Team Management
EM-768 Human Resources Management
EM-860 Final Project Organizational Management

Electives

Students pick sufficient electives for a total of 48 credits for those choosing the independent Option and 51 for those choosing a Specialization Track.

Students may take one of these electives from another MSOE graduate program without prior approval. Students planning to take additional courses in another program should get advanced approval from the program director. This should include a one-page statement of how the proposed electives support a student's MSEM project goals.

COURSES		CREDITS	
		Thesis	Specialization Track
EM-600	Management Principles	3	3
EM-610	The Application of Statistics	3	3
EM-620	Finance and Accounting	3	3
EM-630	Principles of Research and Writing*	3	3
EM-640	Operations Management	3	3
EM-650	Managing Information Technology	3	3
EM-660	Operations Management	3	3
EM-670	Marketing Management	3	3
	5 Elective Courses	15	15
EM-800	Strategic Management	3	3
	Thesis	6	
	3 Specialization Track Courses		9
	TOTAL CREDITS REQUIRED	**48**	**51**

* EM-631, EM-632 and EM-633 may be substituted for EM-630.

Model Tracks

The following part time tracks are shown to give an idea of a typical program. Please note, however, that the actual schedule of courses varies by location and year, in order to give student the maximum choice of courses.

Model Part-time Track (V5.1)

Independent (Thesis) Option

		QUARTER CREDITS			
		Fall	Winter	Spring	Summer
First Year					
EM-600	Management Principles	3-0-3			
EM-631	Research and Writing (Module 1)	1-0-1			
EM-610	The Application of Statistics		3-0-3		
EM-632	Research and Writing (Module 2)		1-0-1		
EM-620	Finance and Accounting			3-0-3	
EM-633	Research and Writing (Module 3)			1-0-1	
EM-xxx	Elective				3-0-3
Second Year					
EM-640	Operations Management	3-0-3			
EM-650	Managing Information Technology		3-0-3		
EM-660	Applied Organizational Behavior			3-0-3	
EM-xxx	Elective				3-0-3
Third Year					
EM-670	Marketing Management	3-0-3			
EM-800	Strategic Management		3-0-3		
EM-xxx	Elective			3-0-3	
EM-xxx	Elective				3-0-3
Fourth Year					
EM-xxx	Elective	3-0-3			
EM-804	Thesis		6-0-6		

TOTAL COURSE CREDITS 48

Model Part-time Track (V5.1)

Specialization Track (Capstone Option)

The Specialization Track (Capstone Option) follows the same track as the Thesis Option for the first three years. The fourth year is as follows:

Fourth Year					
EM-XXX	Specialization Track Elective	3-0-3			
EM-XXX	Specialization Track Elective		3-0-3		
EM-8XX	Final Project			3-0-3	
EM-XXX	Elective				3-0-3

TOTAL CREDITS 51

Engineering Management Cohort Program Track (V3.0)

			QUARTER CREDITS			
			Fall	Winter	Spring	Summer
Management Governance Suite		**EMS-1**				
EM-600	Management Principles		3-0-3			
EM-620	Finance and Accounting		3-0-3			
EM-631	Research and Writing (Module 1)		1-0-1			
Management Organization Suite		**EMS-2**				
EM-610	The Application of Statistics			3-0-3		
EM-632	Research and Writing (Module 2)			1-0-1		
EM-660	Applied Organizational Behavior			3-0-3		
Contemporary Operations Integration Suite		**EMS-3**				
EM-640	Operations Management				3-0-3	
EM-633	Research and Writing (Module 3)				1-0-1	
EM-650	Managing Information Technology				3-0-3	
Technology Management Suite		**EMS-4**				
EM-670	Marketing Management					3-0-3
EM-745	Strategic Technology Development					3-0-3
[or EM-74	Quality Management and Engineering]					
Strategic Leadership Suite		**EMS-5**				
EM-744	Supply Chain Management		3-0-3			
EM-800	Strategic Management		3-0-3			
Prereq: All 600-level courses						
PROJECT MANAGEMENT SUITE		**EMS-6**				
EM-765	Leading Project Teams			3-0-3		
EM-795	Managing and Implementing Projects			3-0-3		
Prereq: All 600-level courses						
Application of Business Solutions Suite		**EMS-7**				
EM-708	Executive Management Simulation				3-0-3	
EM-768	Human Resource Management				3-0-3	
Prereq: All 600-level courses						
Capstone Suite		**EMS-8**				
EM-801	Executive Seminar					3-0-3
EM-840 thru EM-890	Capstone Projects					3-0-3
Prereq: All 600-level courses						
TOTAL PROGRAM CREDITS			**51**			

Class meets: Wednesday 6-8:50 p.m., and every other Saturday 8:30 a.m.-3:30 p.m.

MASTER OF SCIENCE IN ENVIRONMENTAL ENGINEERING (MSEV)

In today's industrial world, raw materials are converted into a dizzying array of engineered products used everyday in our homes and businesses. During the design, manufacture and use of these products, waste materials are generated that have the potential to adversely affect the air, water and soil of the environment in which we live. It is the responsibility of environmental engineers to deal with the waste materials generated in such a way as to minimize their adverse effects on human health and the environment. To do this effectively requires that environmental engineers have training in environmental systems design, environmental laws and regulations, and environmental management that will enable them to develop integrated solutions that are environmentally sustainable, technically sound, meet regulatory requirements and are cost-effective.

Program Director: Dr. Frank Mahuta, P.E.
(414) 277-7599
mahuta@msoe.edu

Faculty:

Dr. Carol Diggelman, James F. Drought, P.H., Dr. Donald Gallo J.D., Dr. William Gonwa, P.E., Dr. Deborah L. Jackman, P.E., Dr. Jay Karls, P.E., Kenneth E. Kaszubowski, P.E., Jeffrey A. MacDonald, Dr. Francis Mahuta Jr., P.E., Michael Schuck, P.E., Dr. Kenneth TerBeek

The environmental issues that companies deal with each day significantly impact business planning and decision-making processes. But too often, dealing with these environmental issues is the responsibility of individuals who may not have the environmental background necessary to make well-informed decisions. In addition, practicing engineers and scientists in non-environmental positions, e.g., plant engineering, manufacturing design, research and development, can help their companies avoid unnecessary costs and increase profitability by taking advantage of various waste minimization and pollution prevention opportunities available.

The MSEV program was developed to equip these individuals with a firm grounding in the various aspects of environmental engineering. The MSEV program was developed and tailored to the student who already has a bachelor of science degree in one of the traditional engineering disciplines, such as architectural, chemical, civil, industrial and mechanical engineering but who has had little or no academic training in environmental engineering. The MSEV program is unique in that it provides practicing engineers with extensive instruction in both environmental systems design and environmental management. Our students graduate with the skills necessary to launch successful careers as engineers and managers in the industrial, municipal, regulatory and consulting business sectors. Positions held by MSEV graduates have included environmental health and safety manager, city engineer, senior project manager, research engineer and wastewater plant superintendent.

Program Educational Objectives

The educational objectives of the MSEV program are to provide individuals already holding bachelor of science degrees in the engineering or physical sciences with the following:

1) The additional *technical* training necessary to enable them to make technically sound environmental decisions during the design, manufacture, operation, and use of engineered products and systems
2) The additional *management* training necessary to enable them to make legally and economically sound environmental decisions during the design, manufacture, operation, and use of engineered products and systems
3) The additional *experience* needed to address the complex requirements that must be met when developing a comprehensive, integrated design solution to a real-life environmental problem

Curriculum Format

The MSEV program builds upon the student's already solid foundation in engineering principles. Courses offered within the program cover topics in areas such as waste minimization and pollution prevention, environmental laws and regulations, environmental statistics and modeling, design of air pollution control, wastewater treatment, and soil remediation systems, water resources management, environmental risk assessment, plant safety and OSHA issues, environmental

project management and life-cycle cost analysis. Each course typically meets one evening per week for 11 weeks during the regular academic year (Fall, Winter and Spring Quarters). Class sizes are kept small, in the range of 8-to-12 students.

The culmination of the MSEV program is a capstone design project that is required of all students and begins upon completion of all other course work. The capstone design project includes the selection of an environmental problem to which the student proposes a comprehensive solution that meets all technical standards and regulatory requirements as prescribed. A comprehensive written report is required that must be defended before a faculty review committee. The student is strongly encouraged to select an actual environmental problem based on the student's current or previous industrial experience as the subject of the capstone design project.

Curriculum Content

The MSEV program requires completion of a total of 45 graduate credits. Of these 45 graduate credits, 30 credits are required courses that include nine credits of 600-level environmental science, 12 credits of 700-level environmental management and nine credits of 800-level capstone project courses. The remaining 15 credits of elective courses may be chosen from any of the courses in the (1) water and wastewater treatment, (2) air, soil and groundwater remediation, and (3) environmental management Specialization Tracks. Typically, students will choose their electives from any two of the three Specialization Tracks. Alternatively, students may choose selected courses from each of the three Specialization Tracks depending on their career interests. The two-course capstone design project makes up six of the 45 MSEV graduate credits required for graduation.

A listing of the MSEV courses offered is shown below. In addition, students who have a strong interest in environmental management may opt to take a limited number of elective courses from the MSEM (engineering management) program that may count towards the MSEV elective course requirement.

Required Courses (30 credits total)	Credits
EV-611 Applications of Chemistry in Environmental Engineering	3
EV-612 Environmental Biology	3
EV-614 Environmental Microbiology	3
EV-710 Environmental Statistics and Modeling	3
EV-730 Hazardous and Solid Waste Minimization	3
EV-756 Environmental Project Program Management and Life-Cycle Cost Analysis	3
EV-760 Environmental Law	3
EV-800 Emerging Trends in Environmental Engineering & Mgmt.	3
EV-890 Environmental Engineering Systems Design I	3
EV-892 Environmental Engineering Systems Design II	3

Elective Courses (choose any 5 of 10 courses listed)	Credits
Water and Wastewater Treatment Specialization Track	
EV-720 Municipal Wastewater Treatment	3
EV-724 Industrial Water Pretreatment and Stormwater Management	3
EV-726 Water Resources Management	3
Air, Soil and Groundwater Remediation Specialization Track	
EV-722 Hydrogeology and Groundwater Pollution	3
EV-740 Air Pollution Control	3
EV-754 Soil Science and Remediation Technologies	3
Environmental Management Specialization Track	
EM-XXX MSEM Course Elective*	3
EV-750 Plant Safety/OSHA Issues	3
EV-752 Risk Assessment & Environmental Auditing	3
Independent Study	
EV-799 MSEV Independent Study**	3
Total Quarter Credits	

*Course selection must be approves by both the MSEV and MSEM program directors prior to registration.

**Maximum of three credits per student counted toward the MSEV degree.

Model Part-time, Three-year Track (V2.0)

		QUARTER CREDITS Fall	Winter	Spring
First Year				
EV-611	Applications of Chemistry in Environmental Engineering	3		
EV-XXX	Specialization Track Elective[1] or (EV-799)[2]	3		
EV-612	Biology for Environmental Engineers		3	
EV-XXX	Specialization Track Elective[1] or (EV-799)[2]		3	
EV-614	Microbiology for Environmental Engineers			3
EV-XXX	Specialization Track Elective[1] or (EV-799)[2]			3
Second Year				
EV-710	Environmental Statistics and Modeling	3		
EV-XXX	Specialization Track Elective[1] or (EV-799)[2]	3	3	
EV-760	Environmental Law		3	
EV-756	Environmental Project Program Management and Life Cycle Cost Analysis			3
EV-XXX	Specialization Track Elective[1] or (EV-799)[2]			3
Third Year				
EV-800	Research and Writing on Emerging Trends	3		
EV-890	Environmental Engineering Systems Design I[3]		3	
EV-892	Environmental Engineering Systems Design II[3]			3

TOTAL CREDITS 45

[1]A total of 15 credits of environmental engineering electives must be taken. Given the possibility of students taking a variety of electives, depending on interest, and taking required courses in a variety of sequences, the above sample track is not unique, but represents one of many possible tracks that the student, in consultation with the program director, may choose as his/her program of study. Electives must have enrollment of five students or more to be offered.
[2]Enrollment in EV-799 is subject to instructor availability and program director approval.
[3]Capstone design project.

Model Part-time, Five-year Track (V2.0)

		QUARTER CREDITS Fall	Winter	Spring
First Year				
EV-611	Application of Chemistry in Environmental Engineering	3		
EV-612	Biology for Environmental Engineers		3	
EV-614	Microbiology for Environmental Engineers			3
Second Year				
EV-710	Environmental Statistics and Modeling	3		
EV-760	Environmental Law		3	
EV-XXX	Specialization Track Elective[1] or (EV-799)[2]			3
Third Year				
EV-XXX	Specialization Track Elective[1] or (EV-799)[2]	3		
EV-730	Solid and Hazardous Waste Minimization		3	
EV-XXX	Specialization Track Elective[1] or (EV-799)[2]			3
Fourth Year				
EV-XXX	Specialization Track Elective[1] or (EV-799)[2]	3		
EV-XXX	Specialization Track Elective[1] or (EV-799)[2]		3	
EV-756	Environmental Project Program Management and Life-Cycle Cost Analysis			3
Fifth Year				
EV-800	Research and Writing on Emerging Trends	3		
EV-890	Environmental Engineering Systems Design I[3]		3	
EV-892	Environmental Engineering Systems Design II[3]			3

TOTAL CREDITS 54

[1]A total of 15 credits of environmental engineering electives must be taken. Given the possibility of students taking a variety of electives, depending on interest, and taking required courses in a variety of sequences, the above sample track is not unique, but represents one of many possible tracks that the student, in consultation with the program director, may choose as his/her program of study. Electives must have enrollment of five students or more to be offered.

[2]Enrollment in EV-799 is subject to instructor availability and program director approval.

[3]Capstone design project.

MASTER OF SCIENCE DEGREE IN MEDICAL INFORMATICS (MSMI)

Joint Degree Offering

Our joint Master of Science in Medical Informatics program combines the strength of the **Medical College of Wisconsin,** a leading provider of medical education and research, and the expertise of **MSOE** in the disciplines of business and information technology. The faculty facilitates education through "real world" experiences to reinforce theory and concepts.

Working Definition of Medical Informatics

Medical informatics (MI) is the applied science at the junction of the disciplines of medicine, business and information technology, which supports the health care delivery process and promotes measurable improvements in both quality of care and cost-effectiveness.

MSMI Program Mission Statement

The mission of the Master of Science in Medical Informatics program is to provide an applied graduate educational experience that prepares professionals to participate in and lead multidisciplinary teams in the development, implementation and management of information technology solutions in health care.

Our working definition of medical informatics and mission statement emphasize the applied aspect of using informatics (information science) in the health care setting. This is somewhat different than other MI programs where there is a stronger emphasis on theory. We strive to provide a practical education that prepares students to effectively participate in development, implementation and management teams charged with producing information technology solutions that improve patient care and reduce the cost of care.

Another element of our program that sets us apart from other MI programs is our emphasis on business principles. The projects that we envision our graduates working on are costly and complex. Justification for such projects can only come through the development of a compelling business case that is aligned with the overall organizational strategy. We want our graduates to be able to work with business and information technology experts to develop and defend the business case. Participating in multidisciplinary teams within a health care organization also requires an understanding of "soft" business management principles, as it is well known that impediments to successful projects mostly involve people and organizational issues.

Our program places a strong emphasis on project management skills. Again, the projects that we are preparing our graduates to participate in and lead are large, expensive and complex. Successful development and implementation of information technology solutions in the health care environment requires a strict business discipline and strong project management skills.

It is not the goal of the MSMI program to comprehensively cross train individuals from one medical informatics domain for another. We will not make doctors or nurses into network engineers, database designers, or finance or management experts. Similarly, we will not prepare computer scientists or business experts for patient care. This is not our intent. Rather, our intent is to give our graduates the knowledge and skills to identify, recruit and work with expert resources needed for the successful project. Additionally, with six credits of electives, and a six-credit internship/research project, students have the opportunity to gain additional expertise according to their individual academic and career goals.

Finally, the MSMI program is designed with a focus on the adult learner (non-traditional student). These are students that come with an education and several years of working experience usually in one of the three primary domains described in our working definition. They can immediately see the implications and applications of the MI course topics. All of our core classes meet once a week during the evening so that working adults can fit the course work into an already busy schedule.

The program also is appropriate for the traditional graduate student. These traditional students should expect to gain a knowledge base and skill set that allows them to participate effectively on project teams and is marketable in the industry.

The medical informatics program benefits from the guidance of its external advisory committee – a standing committee of business and industrial leaders who help ensure program offerings stay current.

Program Director: John Traxler, MD, MBA, MSMI (MSOE)
(414) 277-2218, traxler@msoe.edu

Faculty:

Dr. Jeffrey Blessing, Kent Brodie, Dr. John Gassert, Robert Hankes, Thomas Jerger, Jerry Lieberthal, Katie McCarthy, Dr. John Traxler, Dr. Raymond Zastrow

Program Objectives:

Graduates of the medical informatics program should obtain:

1) the broad education necessary to apply informatics solutions
2) the ability to specialize within the field of applied medical informatics
3) the ability to work in the field of medical informatics
4) an ability to lead and contribute in multi-disciplinary teams
5) a recognition of the need for, and the ability to engage in lifelong learning
6) an understanding of professional and ethical responsibility
7) an ability to communicate effectively

Career Opportunities

Informatics solutions in the health care industry are proceeding at a rapid pace, as anyone working in this environment knows. The management of clinical and administrative data is changing from paper to electronic systems. The field of medical informatics is guiding this transition. This change is being driven by efforts from many sectors to improve the quality of care while reducing the cost of providing that care.

The technology has caught up to the vision but health care still lags behind other "information intense" industries in its use of information technology. There is a rapidly growing need for skilled professionals who understand information technology along with both the clinical and business aspects of health care. This creates a tremendous opportunity for those with the right training to work on teams that develop, implement, and manage information systems that can support health care delivery, medical research and education.

As a graduate of the medical informatics program, you will have the education and credentials needed to pursue career opportunities in a variety of settings:

- Health care provider organizations – hospitals, HMOs, clinics
- Software/hardware vendors that develop and install information systems
- Consulting firms
- Third party insurance companies
- Public health agencies
- Biomedical research

Medical College of Wisconsin (MCW)

The MCW is a private educational institution with a medical school that offers the M.D. degree; the Graduate School of Biomedical Sciences, which offers Ph.D., M.S. and M.A. degrees; and a specialized MPH program for physicians. The college traces its origin to two medical schools founded in Milwaukee in the 1890s. In 1913, these schools merged to become the Marquette University School of Medicine. In 1967, the medical school separated from Marquette to become a free-standing institution, subsequently named Medical College of Wisconsin.

Today, MCW is located on the campus of the Milwaukee Regional Medical Center along with Froedert Hospital, Children's Hospital of Wisconsin, Milwaukee County Mental Health Complex, Curative Rehabilitation Center and the Blood Research Institute of the Blood Center of Southeastern Wisconsin. The college benefits from a close working relationship with these institutions, as well as with other Milwaukee institutions, including Zablocki Veterans Affairs Medical Center, Marquette University, University of Wisconsin-Milwaukee and Milwaukee School of Engineering.

MEDICAL COLLEGE OF WISCONSIN

The Schedule

- Students pursuing the program on a full-time basis are able to complete the program in five consecutive quarters of study. Part-time students may take up to five years for completion if they begin in the fall quarter.
- Courses are offered in a predefined sequence and therefore admittance to the program in the Fall Quarter is recommended although not required.

Total Degree Credits: 54

Required courses: (48 credits)

MI-13101	Introduction to Medical Informatics I (3)
MI-13102	Introduction to Medical Informatics II (3)
MI-13202	Ethics in Medical Informatics (3)
MI-693	Intermediate Statistics (3)
MI-720	Six Sigma Quality and Patient Safety (3)
MI-787	Health Care Systems Analysis and Design (3)
MI-13204	Information Systems Project Management (3)
MI-783	Database Structures and Processing (3)
MI-885	Computer Network Design (3)
MI-743	Principles of Health Care Management
MI-756	Health care Provision and Payment (3)
MI-789	Medical Informatics Case Study Seminar (3)
MI-13203	Health Care Decision Support (3)
MI-786	Medical Informatics Journal Club (1 credit – 3 req.)
MI-13297	Internship/Research Project I (3)
MI-13298	Internship/Research Project II (3)

Electives: (6 credits)

Model Full-time Track (V6.0)

		QUARTER CREDITS			
		Fall	Winter	Spring	Summer
First Quarter					
MI-13101	Introduction to Medical Informatics I	3			
MI-13202	Ethics in Medical Informatics	3			
MI-13204	Information Systems Project Management	3			
MI-693	Intermediate Statistics	3			
Second Quarter					
MI-13102	Introduction to Medical Informatics II		3		
MI-787	Health Care Systems Analysis and Design		3		
MI-743	Principles of Health Care Management		3		
MI-720	Six Sigma Quality and Patient Safety		3		
Third Quarter					
MI-783	Database Structures and Processing			3	
MI-885	Computer Network and Design			3	
MI-756	Health Care Provision and Payment			3	
	Elective[1]			3	
MI-786	Medical Informatics Journal Club[2]			1	
Fourth Quarter					
MI-13297	Internship/Research Project				3
MI-13298	Internship/Research Project				3
MI-786	Medical Informatics Journal Club[2]				1
Fifth Quarter					
MI-789	Medical Informatics Case Study Seminar	3			
MI-13203	Health Care Decision Support	3			
	Elective**	3			
MI-786	Medical Informatics Journal Club[2]	1			

TOTAL CREDITS 54

[1]Electives may be taken from any other graduate program at MSOE or MCW. Transfer credits from an outside-accredited graduate program also may be used towards fulfillment of electives (subject to program director approval).

[2]The Medical Informatics Journal Club (MI-786I) is a one-credit class that is offered every quarter (including summer). Students must enroll in this course three times to obtain a total of three credits.

Model Part-time Track (V6.0)

		QUARTER CREDITS			
		Fall	Winter	Spring	Summer
First Year					
MI-13101	Introduction to Medical Informatics I	3			
MI-13204	Information Systems Project Management	3			
MI-13102	Introduction to Medical Informatics II		3		
MI-743	Principles of Health Care Management		3		
MI-756	Health Care Provision and Payment			3	
MI-885	Computer Network and Design			3	
	Elective[1]				3
MI-786	Medical Informatics Journal Club[2]				1
Second Year					
MI-13202	Ethics in Medical Informatics	3			
MI-693	Intermediate Statistics	3			
MI-787	Health Care Systems Analysis and Design		3		
MI-720	Six Sigma Quality and Patient Safety		3		
MI-786	Medical Informatics Journal Club[2]		1		
MI-783	Database Structures and Processing			3	
	Elective[1]			3	
MI-13297	Internship/Research Project I				3
MI-13298	Internship/Research Project II				3
Third Year					
MI-13203	Health Care Decision Support	3			
MI-789	Medical Informatics Case Study	3			
MI-786	Medical Informatics Journal Club[2]	1			

TOTAL CREDITS 54

[1]Electives may be taken from any other graduate program at MSOE or MCW. Transfer credits from an outside-accredited graduate program also may be used towards fulfillment of electives (subject to program director approval).

[2]The Medical Informatics Journal Club (MI-786I) is a one-credit class that is offered every quarter (including summer). Students must enroll in this course three times to obtain a total of three credits.

Part-time students may enroll in fewer courses each quarter than listed above, however, students are expected to complete all degree requirements within five years of beginning the program.

MASTER OF SCIENCE IN PERFUSION (MSP)

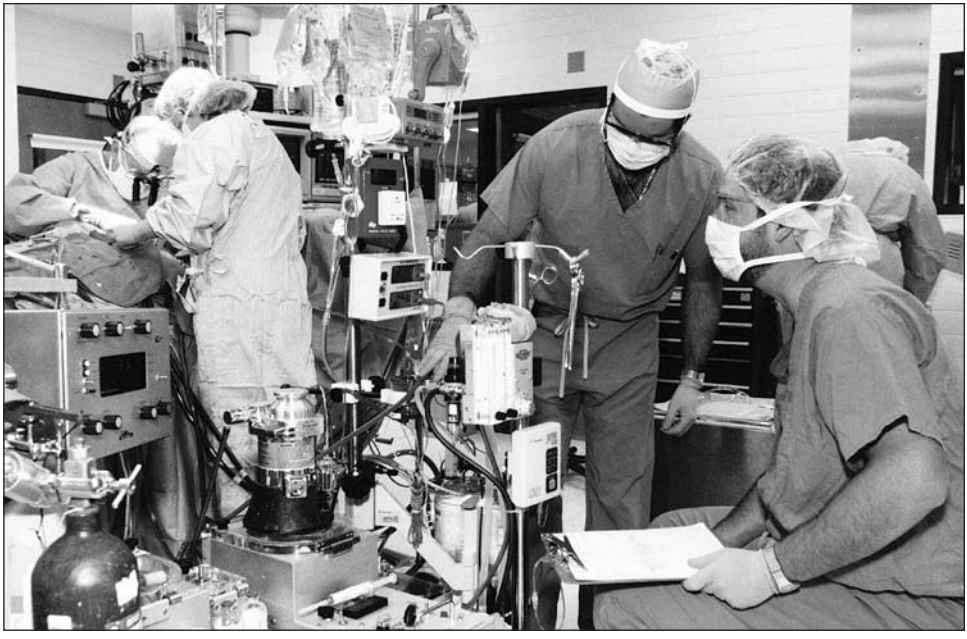
In keeping with the mission of the MSOE, the MSP program aims to provide our students with the highest quality of education available in the field of perfusion. The faculty of MSOE and clinical affiliates associated with the program are highly motivated at teaching the technical and challenging career of perfusion.

The main function of a perfusionist is to operate the heart lung machine, which has the role of taking over the function of the heart and lungs during heart surgeries such as coronary artery bypass grafting, heart valve replacement, heart transplants, lung transplants, and various other procedures requiring extracorporeal circulation.

As with most allied health professionals, advances in biomedical technology have broadened the scope of responsibilities assigned to the perfusionist. This requires a perfusionist to have a greater knowledge base upon graduation, and, even more importantly, he or she has to have the ability to perform and/or evaluate the research being done in the advancing areas.

The MSP curriculum contains approximately 45 academic quarter credits, including a master's thesis, and approximately 15 quarter credits of didactic and supervised clinical work. Each student is required to complete approximately 125 surgical procedures under the supervision of the clinical faculty. The MSP program starts in the Fall Quarter of each academic year (September) and is six consecutive quarters (including a Summer Quarter) in length, if the student successfully completes all of the program requirements. The MSP program is only offered at the Milwaukee campus. Since the curriculum is accredited by the Commission on Accreditation of Allied Health Education Programs (CAAHEP) upon the recommendation of the Accreditation Committee of Perfusion Education, graduates are eligible to sit for the Certified Clinical Perfusionist's examination administered by the American Board of Cardiovascular Perfusion.

Most of the academic courses are scheduled to meet on the campus, but all students are required to provide their own transportation to the various affiliated



clinical sites. Most of the affiliated institutions are located within 25 miles of the campus. Public transportation does not reliably allow the student to arrive at clinical sites, at the time specified, to perform their assigned duties.

The MSP program is currently affiliated with with three surgical groups, covering six hospitals, where adult CPB cases are performed. During the adult cases, students are exposed to a wide variety of surgeries including CABG, valve replacements, redo-operations, VAD placement, heart transplantation, lung transplantation, liver transplantation, cath-lab assist cases (CPS) and deep hypothermia/circulatory arrest. The pediatric rotation is performed at Children's Hospital of Wisconsin under the direction of pediatric cardiothoracic surgeons. Approximately 25 required pediatric cases are performed at this affiliated institution.

Program Director: (MSP) Dr. Ronald Gerrits
(414) 277-7561, gerrits@msoe.edu

Program Director: (Clinical) Professor Matthew Tittl, MS, CCP, LP
(414) 277-7209, tittlm@msoe.edu

Medical Director: Alfred J. Tector, M.D.
(414) 277-7209

Academic and Clinical Faculty:

Dr. Jon K. Borowicz; Scott M. Brown, CCP, LP; Dr. Vincent R. Canino; Dr. Larry Fennigkoh; Dr. John D. Gassert; Dr. Ronald J. Gerrits; Matthew J. Hietpas, CCP, LP; Dr. Daniel T. Minkel; Kathy Princer; Mark W. Simmons, CCP, LP; Dr. Alfred J. Tector; Dr. John Traxler; Dr. Charles S. Tritt; Matthew P. Tittl, CCP, LP; Patrick L. VanderWal, CCP, LP; Shannon R. Voborsky, CCP, LP

Application

In considering an applicant, MSOE takes into consideration the overall academic performance as indicated by transcripts, test scores, personal interview, letters of reference, work experience, if applicable and other factors. Completion of all admission criteria does not ensure that the applicant will be selected for admission into the program. Because of the extensive clinical experience required, the maximum enrollment is limited to eight students per year. In general, applicants selected for admission to the program are the most qualified of all those who apply.

Rules and Guidelines for Student Participation in Clinical Education

At the time a student is offered acceptance into the program, the student will receive a copy of the "Rules and Guidelines for Student Participation in Clinical Education." Applicants wishing to review the complete document prior to submission of an application should contact the clinical program director.

Students will be required to complete criminal background checks and provide documentation of required immunizations prior to being placed at the clinical sites.

Program Objectives

The objectives of the MSP program are that, within one year of graduation:

1. All graduates will become certified clinical perfusionists (CCPs), if that is their desire.
2. Each graduating class will collectively score above the national average on the certification exam.
3. All graduates will be employed in the field of perfusion, if that is their desire.
4. All graduates will feel confident in their abilities to perform the job of a perfusionist.
5. All graduates will be considered an "asset" by their employers/supervisors.

Program Outcomes

The outcomes of the MSP program are that each student, at the time of graduation will:

- have demonstrated educational skills at the master's level in the areas related to cardiovascular science.
- have mastered the clinical skills needed to provide quality perfusion services to the patient.
- make appropriate judgments related to ethical and legal issues related to the practice of perfusion.
- be able to formulate, design, perform, analyze, and communicate the results of a research project.
- understand the need to continue their professional development.

Model Schedule of Courses (V2.5)

		QUARTER CREDITS			
		Fall	Winter	Spring	Summer
First Quarter					
PE-640	Applied Biophysical Transport	3			
PE-673	Advanced Physiology I	3			
PE-7010	Clinical Extra-Corporeal Perfusion I	3			
PE-642	Electronic Medical Instrumentation	3			
Second Quarter					
PE-674	Advanced Physiology II		3		
PE-646	Medical Statistics		3		
PE-675	Pathophysiology		3		
PE-7020	Clinical Extra-Corporeal Perfusion II		3		
Third Quarter					
PE-670	Pharmacology			3	
PE-601	Analysis of Biological Systems			3	
PE-645	Blood Compatible Materials			3	
PE-7040	Pediatric Extra-Corporeal Perfusion			3	
Fourth Quarter					
PE-647	The Design of Experiments				3
PE-648	Biodynamics: Circulation				3
PE-7030	Clinical Extra-Corporeal Perfusion III				3
Fifth Quarter					
PE-7000	Extra-Corporeal Perfusion Laboratory	2			
PE-650	Seminar on Clinical Medicine	2			
PE-651	Seminar on Medical Ethics	2			
PE-7050	Clinical Extra-Corporeal Perfusion IV	3			
Sixth Quarter[1]					
PE-699	Master's Thesis		6		
PE-7060	Clinical Perfusion Practice		1		

[1]During this quarter, the MSP student is expected to do the following:

1) Complete all clinical cases required as specified by the Clinical Competency Review Committee and obtain a letter verifying clinical competence.
2) Write and pass the Clinical Comprehensive Examination.
3) Complete and successfully defend the Master's Thesis.

MASTER OF SCIENCE IN CARDIOVASCULAR STUDIES (MSCS)

The Master of Science in Cardiovascular Studies (MSCS) degree is designed to complement the student's undergraduate education by providing an opportunity to expand their knowledge in the areas of cardiovascular health sciences, physiologic modeling and research methods. Electives allow students to tailor the program to their particular area of interest and might include courses offered in engineering, management, medical informatics, etc.

The core courses and electives in the MSCS program make it appropriate for a variety of individuals. These are not limited to, but may include engineers seeking a greater background in the medical sciences, individuals with science degrees who are interested in learning more about instrumentation, modeling and research methods and statistics, or perfusionists who would like to expand their education but who do not need the clinical experience of the MSP program.

Program Outcomes

The graduate of the MSCS program will have:

1. a foundation in the physiology, pathophysiology and pharmacology of the cardiovascular system
2. an ability to design experiments and apply research methods and statistics
3. an ability to quantitatively analyze physiological systems.
4. an ability to critically review the scientific and medical literature.
5. an ability to communicate effectively.

Program Director: Dr. Ronald Gerrits
(414) 277-7561, gerrits@msoe.edu

Faculty:

Dr. Jon K. Borowicz; Dr. Vincent R. Canino; Dr. Larry Fennigkoh; Dr. John D. Gassert; Dr. Ronald J. Gerrits; Dr. Daniel T. Minkel; Kathy Princer; Dr. John Traxler; Dr. Charles S. Tritt

Model Schedule of Courses (V1.0)

		QUARTER CREDITS			
		Fall	Winter	Spring	Summer
First Quarter					
PE-640	Applied Biophysical Transport	3-0-3			
PE-673	Advanced Physiology I	3-0-3			
PE-642	Electronic Medical Instrumentation	3-0-3			
Second Quarter					
PE-674	Advanced Physiology II		3-0-3		
PE-646	Medical Statistics		3-0-3		
PE-675	Pathophysiology		3-0-3		
Third Quarter					
PE-670	Pharmacology			3-0-3	
PE-601	Analysis of Biological Systems			3-0-3	
PE-645	Blood Compatible Materials			3-0-3	
Fourth Quarter					
PE-647	The Design of Experiments				3-0-3
PE-648	Biodynamics: Circulation				3-0-3
Fifth Quarter					
PE-650	Seminar on Clinical Medicine	2-0-2			
PE-651	Seminar on Medical Ethics	2-0-2			
	Elective 1*	3-0-3			
Sixth Quarter					
MC-699	Master's Thesis		6-0-6		
	Elective 2*		3-0-3		

TOTAL CREDITS 49

*The electives can be any graduate course in the science or engineering area, or one that is otherwise approved by the program director.

MASTER OF SCIENCE IN STRUCTURAL ENGINEERING

The Master of Science in Structural Engineering program emphasizes building structural design and analysis, and meets the needs of architectural, civil or structural engineers who desire increased knowledge to design modern building structural systems.

Courses focus on structural design topics such as advanced design of structural steel members and systems; design of light gage metal members and structures, reinforced concrete members and structures, wood structures, masonry structures, foundations; and selection of structural systems. Courses on advanced structural analysis including applications of the finite element method, structural dynamics, and structural stability, also are presented to provide a broader theoretical background for structural design.

The program culminates with a two-quarter capstone project focusing on structural engineering. The project presents the opportunity for the student to integrate the concepts learned in the classroom into a specific application. The project may focus on design issues, research in an area of structural engineering, or other related topic with the approval of the master of science in structural engineering program director. At the conclusion of the project, a comprehensive presentation (oral and written) will be given to a faculty review committee.

Courses are taught by faculty with extensive practical experience as well as academic credentials. Course work has been planned to show practical applications of structural engineering theory. Classes meet in the evenings so students may work in industry and attend class simultaneously.

The Master of Science in Structural Engineering program assumes the student has completed an undergraduate curriculum that included mechanics of materials, indeterminate structural analysis, basic structural steel design, basic reinforced concrete design and soil mechanics.

The Master of Science in Structural Engineering program currently is being offered as either a full or part-time program and can be completed in five years or less.

Program Director: Dr. Richard A. DeVries, P.E.
(414) 277-7596, devries@msoe.edu

Faculty:

Dr. Richard A. DeVries, Dr. H. Peter Huttelmaier, Dr. Mahmoud Maamouri, Christopher H. Raebel, Dr. Douglas C. Stahl, Dr. John A. Zachar

Program Objectives

The Master of Science in Structural Engineering program will produce graduates who:

1) will become licensed professional engineers;
2) will be employed in the field of structural engineering (if so desired);
3) will be able to confidently meet responsibilities of a professional structural engineer;
4) and will be considered “assets” to employers.

Model Part-time Five-year Track (V2.0)

		QUARTER CREDITS		
		Fall	Winter	Spring
First Year				
AE-610	Applied Finite Elements	3		
AE-616	Structural Stability		3	
AE-732	AISI Steel Design			3
Second Year				
AE-612	Structural Dynamics	3		
AE-614	Lateral Loads on Structural Systems		3	
AE-742	Foundation Design			3
Third Year				
AE-740	Reinforced Concrete Member Design	3		
AE-720	Masonry Design		3	
AE-750	Wood Design			3
Fourth Year				
AE-730	AISC Steel Design	3		
AE-760	Structural Systems Selection for Buildings	3		
AE-746	Reinforced Concrete Structure Design			3
Fifth Year				
	Approved Graduate Elective[1]	3		
AE-890	Capstone Design Project I		3	
AE-892	Capstone Design Project II			3

[1]A 3-credit graduate level course approved by the MSST program director, as relevant to the student's educational objectives and program of study.

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COURSE DESCRIPTIONS

		Lecture Hours Per Week	*Lab Hours Per Week*	*Credit In Quarter Hours*

AE-610 Applied Finite Elements **3** **0** **3**

This course presents the application of the finite element method to building analysis. Topics include element stiffness matrices for beam, plate, shell and continuum elements; solution of equations; material models for steel and concrete; boundary conditions; and applied loading. (prereq: graduate standing)

AE-612 Structural Dynamics **3** **0** **3**

This course introduces analysis of single degree of freedom systems, multidegree of freedom systems, free vibration analysis, forced system response, analysis of earthquake loading, and modal analysis. (prereq: graduate standing)

AE-614 Lateral Loads on Structural Systems **3** **0** **3**

This course focuses on determining earthquake and wind loads on structures. Topics include basis for code procedures, code characterization of loads, code assumptions of elastic versus inelastic behavior, and detailing for inelastic response. (prereq: AE-612)

AE-616 Structural Stability **3** **0** **3**

This course presents structural stability analysis for members and multistory frames. Topics include torsional buckling of beams, plate buckling, modeling structural stability with the finite element method, and post-buckling behavior. (prereq: AE-610)

AE-720 Masonry Design **3** **0** **3**

This course examines design of unreinforced and reinforced masonry structures. Topics include lintels, walls subjected to out-of-plane and in-plane loads, detailing, allowable stress design, and strength design. (prereq: graduate standing)

AE-730 AISC Steel Design **3** **0** **3**

This course presents advanced topics in design of steel structures. Topics include plate girder design, column and frame design, bracing design, connection design, and advanced floor serviceability. (prereq: graduate standing)

AE-732 Steel Design for Buildings (AISI) **3** **0** **3**

This course presents cold-formed structural steel properties and design of cold-formed steel structural members using LRFD methodology published by AISI. It also covers flexural members, compression members, beam-columns, connections and cold-formed steel shear diaphragms for residential construction. (prereq: AE-616)

AE-740 Reinforced Concrete Member Design **3** **0** **3**

This course presents the behavior and design of reinforced concrete structures. Topics include moment-curvature behavior of reinforced concrete members, beam design, detailing of reinforcement in beams, and column design. (prereq: graduate standing)

AE-742 Foundation Design **3** **0** **3**

This course presents the design of foundation systems. Topics include shallow foundations, combined foundations, design of foundations for vibrations, retaining walls, piles and pile caps, and piers. (prereq: graduate standing)

AE-744 Prestressed Concrete Design **3** **0** **3**

This course presents the behavior and design of prestressed concrete members and structures. Topics include PCI and ACI design criteria, flexural member design, compression member design, and connection design. (prereq: AE-740)

AE-746 Reinforced Concrete Structure Design **3** **0** **3**

This course presents the design of reinforced concrete structures. Topics include behavior and design of two-way floor systems, design of connections, detailing for earthquake design, strut-and-tie method. (prereq: AE-740)

		Lecture Hours Per Week	Lab Hours Per Week	Credit In Quarter Hours
AE-750	**Wood Design**	**3**	**0**	**3**

This course presents the behavior and design of wood structures. Topics include sawn beam and column design; engineered wood beam and column design; design of plywood floors, diaphragms, and shear walls; and connection design. (prereq: graduate standing)

AE-760	**Selection of Structural Systems for Buildings**	**3**	**0**	**3**

This course introduces the selection of structural systems for performance, cost and constructability, and resistance to gravity and lateral loads. (prereq: graduate standing)

AE-799	**Structural Engineering Independent Study**	**1**	**0**	**3**

Independent study allows a student with a particular interest in a topic to undertake additional work outside of the classroom format. The student works under the supervision of a faculty member and undertakes studies that typically lead to a report. (A maximum of three credits of independent study may be applied to a Master of Science in Structural Engineering degree; credits for independent study may not be transferred from other institutions.) (prereq: consent of program director or department chairperson)

AE-890	**Structural Engineering Design I**	**3**	**0**	**3**

This two-course sequence (with AE-892) is the independent capstone project of the Master of Science in Structural Engineering program. The student will complete a project that presents a comprehensive solution to a structural engineering problem. The problem is to be formulated by the student under the supervision of a faculty advisor. The project may be based on the student's industrial experience, consist of physical research or consist of an analytic solution. The project must be approved by the Master of Science in Structural Engineering program director and the AE&BC Department chairperson. Satisfactory progress and completion of the capstone project is to be determined by an academic committee consisting of the faculty advisor and at least two additional faculty members. (prereq: consent of Master of Science in Structural Engineering program director)

AE-892	**Structural Engineering Design II**	**3**	**0**	**3**

This two-course sequence (with AE-890) is the independent capstone project of the Master of Science in Structural Engineering program. The student will complete a project that presents a comprehensive solution to a structural engineering problem. The problem is to be formulated by the student under the supervision of a faculty advisor. The project may be based on the student's industrial experience, consist of physical research or consist of an analytic solution. The project must be approved by the Master of Science in Structural Engineering program director and the AE&BC Department chairperson. Satisfactory progress and completion of the capstone project is to be determined by an academic committee consisting of the faculty advisor and at least two additional faculty members. (prereq: AE-890)

CS-780	**Software Engineering**	**3**	**0**	**3**

The software engineering process is presented, including specifications, requirements analysis, feasibility studies, metrics, design, implementation, testing, validation, and maintenance. Subjects covered include detailed analysis and design techniques such as: data-flow oriented, data-structured, object-oriented, and real-time. Students will apply their knowledge of software engineering to a term project. (prereq: graduate standing, computer programming experience)

EE-502	**Systems Analysis and Control**	**3**	**0**	**3**

This course covers the modeling of systems with electric circuits or blocks representing system operators. The course also covers transient and steady-state responses of systems, feedback control systems, interconnection diagrams, and an introduction to nonlinear systems analysis and state space techniques. (prereq: EE-201 or EE-252, MA-235 or equivalent)

		Lecture Hours Per Week	*Lab Hours Per Week*	*Credit In Quarter Hours*
EE-513	**Linear Integrated Circuits**	**3**	**0**	**3**

This course covers the analysis and design of linear integrated circuits. Progressing from basic operational amplifiers, a variety of comparators and counters, signal generators, rectifiers, differential amplifiers, bridge amplifiers, active filters, multipliers and integrated circuit timers are studied. The laboratory requires that each class of circuit be designed and evaluated. (prereq: EE-310 or ET-355 or equivalent)

EE-520	**Electromagnetics and Transmission Lines**	**3**	**0**	**3**

This course covers static electric and magnetic fields and describes them mathematically. Vector analysis techniques are applied to electric and magnetic fields using various coordinate systems. Topics include Gauss's Law, the Divergence theorem, Poisson's and Laplace's equations, Ampere's' Law, Stokes Theorem, and Maxwell's equations. (prereq: graduate Standing, EE-252, MA-235, PH-220 or equivalent)

EE-584	**Neural Networks**	**3**	**0**	**3**

This course introduces the student to the basic concepts of modeling and simulating adaptive and learning systems using neural networks. The underlying concepts of neural networks are introduced, as well as a number of common topologies and learning rules. Students gain first-hand experience of neural networks through computer assignments and a short research project. (prereq: CS-200, EE-290 and, MA-232 or equivalents)

EE-587	**Machine Vision**	**2**	**2**	**3**

This course introduces machine vision and its applications. Topics include lighting and optics, image formation and cameras. Image processing algorithms, processors and interfaces to other manufacturing systems are also covered. Laboratory sessions begin with introductions to various kinds of vision systems, followed by a group design project that develops and implements an inspection process. (prereq: consent of instructor)

EE-588	**Introduction to Artificial Intelligence and Expert Systems**	**3**	**0**	**3**

The objective of this course is to provide the student with an overview of topics in the field of artificial intelligence (AI). The course also provides the student with a working knowledge of designing an expert system and applying expert system technology in designing and analyzing engineering systems. The first part of the course covers historical background, knowledge acquisition and knowledge representation including propositional calculus, predicate calculus, semantic networks, frame systems and production rules. Various search techniques will be discussed. Fuzzy logic systems, neural network systems and computer vision systems will be briefly discussed in the second part of the course. Languages for AI problem solving such as Prolog and/or LISP will be introduced. The third part of this course will be devoted to the design of expert systems. Applications of expert systems in engineering system design and analysis will be stressed throughout. Case studies will be discussed. Students are encouraged to design expert systems for his/her own engineering applications, and an expert shell will be used to implement the design. (prereq: CS-150, MA-262 or consent of instructor)

		Lecture Hours Per Week	Lab Hours Per Week	Credit In Quarter Hours

EE-594 Digital and Microcontroller Systems **3** **0** **3**

The goal of this course is to provide the student with a working knowledge of the analysis, design, and applications of digital systems: combinational and sequential logic systems, and microcontroller systems. The first part of this course will discuss number systems, codes, Boolean algebra, logic functions and logic gates, flip-flops, State diagram, ASM chart, and the analysis and design of both combinational circuits and sequential circuits. Commercially available CAD software will be used for system analysis and design. The second part of this course covers fundamental programming and design of microcontroller-based systems. Topics discussed include microcontroller architecture, assembly language, programming, serial and parallel I/O, interfacing of hardware to microcontrollers, and applications. Commercially available microcontroller development system will be used to enhance the lecture materials. Course assignments includes hardware and software assignments. (prereq: Graduate standing, CS-150 or equivalent)

EE-724 Digital Data Communication **3** **0** **3**

This course covers basic and advanced techniques in digital data communication. Topics include random signals in noise, bandwidth, sampling, quantization, data formatting, matched-filter receivers, ISI, digital modulations, various methods of data communication, error probability, source and channel codings. (prereq: graduate standing, a course in systems analysis including transforms and transfer functions such as, EE-202 or, EE-502, MA-231 or equivalents, Note, EE-521 or, EE-724 may be taken for graduate credit, but not both.)

EE-813 Advanced Electronic Systems **3** **0** **3**

This course covers techniques associated with the design and modeling of electronic systems. Nonlinear effects in bipolar and field effect devices are introduced. Nonideal operational amplifiers are analyzed and modeled. Noise and distortion analyses are discussed for various types of electronic circuits. Electronic circuits employing nonlinearities (e.g. modulators, detectors, phase-locked loops) are analyzed. Industry-recognized programs such as SPICE are used throughout the course. (prereq: graduate standing, courses in circuit analysis and electronics, such as, EE-201 and, EE-310 or equivalents)

EE-814 VLSI Circuit Design **3** **0** **3**

This course presents the structure and properties of MOS transistors, and VLSI circuit design techniques for both digital and analog circuits. Digital circuits designed include the use of logic gates, tri-state devices and multiplexers. Analog circuit designs include amplifier stages and the consideration of noise. The course includes the use of computer-based circuit analysis tools for the simulation of circuit behavior. (prereq: graduate standing, EE-202, EE-290, EE-310 and EE-412, or equivalents)

EE-871 Modern Control Systems **3** **0** **3**

The purpose of this course is to introduce students to principles and practice of modern control engineering. Z-transforms are introduced and utilized in conjunction with the analysis of discrete-time control systems. State-space analysis for continuous-time systems is covered in detail. Techniques on nonlinear systems analysis are developed and applied utilizing computer methods. (prereq: graduate standing, Laplace transforms and a control systems course, such as, EE-370)

EM-600 Management Principles **3** **0** **3**

This course introduces the student to the four basic management functions (planning, organizing, leading and controlling) and provides the basic foundation for more advanced courses in the engineering management program. It explores both the history of management thought and the theories, models, applications and research results that provide the tools for today's manager. This course uses the case study method to illustrate how these principles are applied in actual organizations. (prereq: graduate standing)

		Lecture Hours Per Week	*Lab Hours Per Week*	*Credit In Quarter Hours*

EM-610 The Application of Statistics **3** **0** **3**

Decision-making, planning and the presentation of information can be significantly enhanced by the intelligent use of mathematical methods or statistics. This course expands on a basic understanding of statistics used in business today with the focus being on application rather than the mathematics and theory of the methods. Statistical tools used to describe collections of data, estimate parameters, make comparisons, develop mathematical relationships or models, control processes, predict outcomes, and plan experiments are covered. Specific tools include frequency distributions, estimation, hypothesis testing, Chi-Square analysis, regression and correlation analysis, analysis of variance, control charts, process capability analysis, sampling and the design of experiments. (prereq: Graduate Standing)

EM-620 Finance and Accounting **3** **0** **3**

This course introduces the student to the finance and accounting concepts that are necessary to effectively manage in the business organization of today. It entails looking at both theory and practice, and covers the enterprise from overall operations to projects. It includes acquiring a knowledge of and working with the financial statement as well as the principal aspects of financial planning and control. In addition, basic financial concepts that are covered include cash flow presentation and analysis, capital investment decision making and both long-term and short-term financial decision making. (prereq: Graduate standing)

EM-630 Principles of Research and Writing **3** **0** **3**

This course gives students the necessary writing skills and tools needed to succeed as a graduate student. The course emphasizes both secondary and primary research methodologies; it also offers the student information on graduate writing process and documentation standards. Research methods used for completion of assignments will involve a combination of electronic research using the web and library research. This course is offered in a classroom setting and will be supplemented with an interactive, online environment. It uses the resources of the Internet including WebCT, the World Wide Web, and e-mail communication.

EM-631 Research & Writing (Module One) **1** **0** **1**

This is the first of three modules to familiarize MSEM students with the fundamentals of research and writing necessary for successful completion of graduate work at MSOE. This module includes an all-day workshop at MSOE that all students are required to attend. In addition, students will have access to on-line resources to assist them in completing research and writing projects for this and other MSEM courses. (prereq: Graduate standing)

EM-632 Research & Writing (Module Two) **1** **0** **1**

This is the second of three modules to familiarize MSEM students with the fundamentals of research and writing necessary for successful completion of graduate work at MSOE. Students will have access to on-line resources presented in EM631 to assist them in completing research and writing projects for this and other MSEM courses. (prereq: EM-631)

EM-633 Research and Writing (Module Three) **1** **0** **1**

This is the third of three modules to familiarize MSEM students with the fundamentals of research and writing necessary for successful completion of graduate work at MSOE. Students will have access to on-line resources presented in EM631 to assist them in completing research and writing projects for this and other MSEM courses. (prereq: EM-632)

EM-640 Operations Management **3** **0** **3**

Operations management provides students with an understanding of how service and production organizations manage and control processing of customer requests though customer receipt of products and services. This includes the design and control of the business processes responsible for effectively applying resources (people, equipment, materials, etc.). Good operations management is vital for survival in today's markets that demand fast delivery, better quality, and "lean" organizations. This course is classroom based and includes lecture, discussion topics and problem solving. An individual class project that requires the student to apply the course teachings to an actual company situation is an important part of the learning transfer. (prereq: Graduate standing)

		Lecture Hours Per Week	Lab Hours Per Week	Credit In Quarter Hours

EM-650 Managing Information Technology **3** **0** **3**

This course examines and discusses the role of information technology (IT) and information systems (IS) in managing an organization (MIS - managing information systems). Major topics are: the contribution of MIS to the achievement of organization goals; factors involved in choosing and deploying MIS for use within the organization, and the organization's actions to successfully operate and use IS. Actual case studies are utilized to illustrate how firms have successfully overcome common obstacles to effectively utilize IS. (prereq: Graduate Standing)

EM-660 Applied Organizational Behavior **3** **0** **3**

This course examines the interaction between individuals, groups and the organization in the accomplishment of organizational goals and objectives. It looks to assist students in understanding and predicting the performance of individuals and ultimately the organization in which they work. As an advanced course in management, the course is conducted in a seminar format drawing on case studies, organizational experiences of students, Internet research, and readings. Topics discussed in depth include perception and learning, motivation and work-related attitudes, group processes and work teams, organizational communication and decision making, interpersonal behavior, influence, power, politics and leadership. (prereq: EM-600)

EM-670 Marketing Management **3** **0** **3**

This course introduces the student to the concepts of industrial/business marketing and the marketing management process. Topics include the role of marketing in the business process; the determination of the marketing mix of price, promotion, and distribution; analyzing market opportunities, segmentation and positioning formulation and evaluation of marketing strategies, plans and programs; and marketing's role in new products. The course perspective is from the role of marketing in a total customer satisfaction driven organization. (prereq: EM-600)

EM-704 Technical Entrepreneurship **3** **0** **3**

This course is designed to develop a thorough understanding of the requirements to successfully start and operate a manufacturing or service business. Students choose a new product and develop a comprehensive business plan for starting and operating a business. The plan includes complete information, including product selection, financing, marketing and organization. (prereq: EM-620, EM-630 or EM-633, EM-670)

EM-708 Executive Management Simulation **3** **0** **3**

This is a business simulation with a general management focus. It requires decisions to be made in all major functional areas of a business, at every point in time, in order to achieve successful results. The scope of the data provided is sufficiently broad to require individuals to work in teams with shared functional responsibilities in order to facilitate decision-making. This closely resembles the most common organizational practice. These functional responsibilities can be rotated among students to increase the learning experience. Individuals must be able to assume responsibility for decisions in many areas including production levels, R & D investment, pricing, levels of promotional expenses, marketing activities, employment levels and some capital expenditure. Thus, all aspects of management are practiced during the running of the simulation. (prereq: EM-630 or EM-633, EM-670)

EM-709 International Business and Finance **3** **0** **3**

Businesses compete in a global economy. Therefore, all technical managers must understand the impact of international corporations and cultures on their plans for products and services, or manufacturing. The course includes the following topics: the nature of international business and foreign trade; trade between nations; the multinational corporation and foreign investment; the foreign exchange markets; trade barriers; foreign legal, political and economic environments, the importance of international cultures and mores; accounting and taxation issues; and the control of international businesses. (prereq: EM-600, EM-620, EM-630 or EM-633)

		Lecture Hours Per Week	*Lab Hours Per Week*	*Credit In Quarter Hours*
EM-712	**Decision Support for Operations Management**	**3**	**0**	**3**

This course provides the student with the fundamentals of mathematical decision-making tools as they are used in operations management. Mathematical programming models including linear and integer programming for resource allocation and transportation models are covered. Mathematical forecasting techniques are reviewed. The student is introduced to the basics of simulation. Students need to have access to a recent version of a spreadsheet program which includes these models. (prereq: EM-610, EM-630 or EM-633, EM-640)

EM-721	**Cost and Capital Investment**	**3**	**0**	**3**

This course is intended to integrate with the other management courses by providing the techniques for quantifying business decisions and the selection of the best alternative. The course is based on the time value of money concepts and the interest formulas and their use, which include present worth, annual cost and IRR calculations. Topics in the course include alternative analysis, tax concepts, life cycle costs, cash flow analysis, decision trees, risk analysis, capital budgeting, lease/buy decisions and inflation analysis. (prereq: EM-620, EM-630 or EM-633)

EM-722	**Financial Management**	**3**	**0**	**3**

This course looks at the role of finance and financial management in today's business organization. It addresses the role of finance from both the short-term operational management perspective as well as the long-term strategic planning perspective. Topics include the valuation of corporate investments, the concepts of leverage and discount policy, financial planning, the management of operation assets, mergers and acquisitions and international finance. (prereq: EM-620, EM-630 or EM-633)

EM-724	**Managerial Economics**	**3**	**0**	**3**

Basic microeconomic theory is introduced, including a review of the organization's environment and goals, demand, production and cost theory, and its integration under various market structures (perfect competition, monopoly, oligopoly and monopolistic competition). The application of this theory is made to issues of industry structure and managerial decision-making with respect to pricing of goods and services, and of inputs to production decisions. The use of marginal and incremental cost analysis in making managerial decisions is discussed. (prereq: EM-620, EM-630 or EM-633)

EM-726	**Advanced Managerial Costing**	**3**	**0**	**3**

This course considers the perspective of financial controls in industry from the standpoint of conventional accounting. This is placed in the current backdrop of organizational change. The agenda will consist of lectures, guest speakers, field trips and student project teamwork. Background material covers a broad spectrum of economic, industrial and social factors that are involved in technical change. Current operating controls used in industry and how they compare with long-term perspective are presented. On the long-term, the process deals with strategic planning, capital budgeting, inflation accounting and productivity. The course reviews the current trends that are talking place in financial reporting, such as activity-based accounting and other tools. (prereq: EM-630 or EM-633, EM-722)

EM-735	**Managerial Communication**	**3**	**0**	**3**

This course addresses theory and practice in the design of organizational structure, processes and systems to optimize communication. It demonstrates how improved communications can lead to improved productivity. Among the topics are the communication process, formal and informal communication, interpersonal communication, barriers to effective communication, nonverbal communication, and how to improve the communication process in organizations. (prereq: EM-630 or EM-633, EM-660)

		Lecture Hours Per Week	*Lab Hours Per Week*	*Credit In Quarter Hours*

EM-744 Supply Chain Management **3** **0** **3**

This course examines the modern concept of optimizing the entire supply chain, from raw material to customer. It considers each element going into supply chain management, including forecasting and planning, inventory, transportation, facilities and product availability. Throughout, it identifies pressures to sub-optimize the supply chain, as each player attempts to optimize its own segment of the supply chain. (prereq: EM-630 or EM-633, EM-640)

EM-745 Strategic Technology Development **3** **0** **3**

This course considers the challenges and opportunities involving the philosophy of research, product development and business strategy. It attempts to provide a better understanding of the process of technological innovation and the need to identify and deal with managerial challenges. Background is presented touching on broad economic, industrial and social factors that are involved in technical change. Practical consideration also is given to such areas as project management, technical planning, budgeting and other aspects of managing an organization's technical infrastructure. This course will also examine the types, models and essence of change in organizations. This is a multiple perspective examination that includes individual, organizational, structural and cultural change. It's purpose is to define change in its many forms, identify the organizational environment in which most business change occurs, and develop a set of conceptual and practical skills useful in managing organization change or creating a foundation for change. (prereq: EM-610, EM-630 or EM-633, EM-650, EM-660)

EM-746 Quality Management and Engineering **3** **0** **3**

Productivity and quality are the result of the sound management and use of available resources. The course introduces the fundamental principles for building and managing a business to satisfy its customers and to be successful. It includes definitions of the basic elements and subsystems for a total quality system, the organization for quality, and an introduction to the technologies of quality control including quality control engineering, process control engineering, quality information equipment engineering, and reliability engineering. Various statistical methods and applications as they are related to analyzing, controlling and improving operations are identified and explained. (prereq: EM-610, EM-630 or EM-633)

EM-7461 Six Sigma Black Belt Concepts **3** **0** **3**

This course covers the concepts needed for a Six Sigma Black Belt. These include defining the requirements for success, developing measurement systems, devising a strategy for solving the problem, optimizing the solution, and monitoring the success of the solution. It is taught through the Business Excellence Consortium. To earn graduate credit, students must pass the Six Sigma Black Belt examination. (prereq: EM-630 or EM-633, Graduate Standing)

EM-7462 Six Sigma Black Belt Project **0** **0** **3**

The student will develop and successfully close a project using both the DMAIC (Define, Measure, Analyze, Improve, and Control) and DFSS (Define for Six Sigma) technologies. This option is offered through the Business Excellence Consortium (BEC). To earn graduate credit, the project must be judged acceptable as one of two required for the Six Sigma Black Belt and is subject to review by MSEM faculty. (prereq: EM-630 or EM-633, EM-7461)

EM-747 Advanced Manufacturing Management **3** **0** **3**

This course addresses advanced manufacturing operations management issues and design. The course provides the student with the knowledge of fundamental changes that are required to improve competitiveness. This course is classroom-based and includes lecture, discussion topics, and both individual and team based problem solving. An individual class project that requires the student to apply the course teachings to an actual company situation is an important part of the learning transfer. (prereq: EM-630 or EM-633, EM-640)

		Lecture Hours Per Week	*Lab Hours Per Week*	*Credit In Quarter Hours*

EM-762 Development and Redesign of Organizations 3 0 3

This course explores techniques for studying, analyzing and improving the growth, productivity and development of organizations to be more competitive in today's complex and uncertain global business world. It focuses on contemporary shifts in organization design, strategic direction, values and culture. This course examines the potential driving forces for transformation toward knowledge sharing, empowerment of employees, new structures, new cultures, the breaking down of barriers between departments and organizations, and the joining together of employees in a common mission. This course helps managers deal with value dilemmas, conflict, and resistance to change. (prereq: EM-630 or EM-633, EM-660)

EM-765 Leading Project Teams 3 0 3

This course examines the techniques of studying, analyzing, improving, managing and leading the growth, productivity and development of individual and group competencies to enhance project performance. It includes the processes required to make the most effective use of the people involved with the project. The importance of involving team members in the linking and overlapping of process groups in various project phases is emphasized. This course helps managers deal with value dilemmas, conflict, resistance to change and project team-development skills. (prereq: EM-630 or EM-633, EM-660)

EM-766 Bargaining and Negotiating 3 0 3

This course is designed to familiarize the student with strategies for managing conflict, and the processes involved in distributive and integrative negotiations. Other topics include influencing tactics, persuasion, third-party interventions and negotiating in a group context. Through the use of workshop formats, individual assessment and inquiry, and role playing activities, this course will improve one's conflict resolution and negotiating skills in an organizational environment. (prereq: EM-630 or EM-633, EM-660)

EM-767 Team Management 3 0 3

This course addresses the fundamental aspects of teams: their formation, stages of development, groups vs. teams, types of teams, diversity, leadership and methods to improve their functioning. Hands-on activities are included to provide the student with the opportunity to learn and improve skills to be a more effective team member. Lastly, the course explores the organizational conditions necessary to support, develop and change. (prereq: EM-630 or EM-633, EM-660)

EM-768 Human Resources Management 3 0 3

This course examines the critical role that human resources management plays in the success of today's modern business organization. Human resource management is defined, and its contribution to organization effectiveness is identified. Particular emphasis is placed on the linkage between internal organizational needs, the legal and regulatory environment and external competitive influences, all of which determine organizational success. Elements of study include equal employment opportunity, staffing the organization, compensation and employee relations. (prereq: EM-630 or EM-633, EM-660)

		Lecture Hours Per Week	*Lab Hours Per Week*	*Credit In Quarter Hours*

EM-769 Alternative Reward Systems **3** **0** **3**

This course is designed to acquaint new managers with the role of reward and recognition systems within the broad context of motivation. In addition, determining the need for and timing of reward system modification within large-scale organization change efforts is assessed. Particular emphasis is placed on the linkage between reward systems and firm strategy; core competencies; organization structure (teams, etc.); and organizational culture. The evolving attention on identifying and defining individual competencies as a logical follow-on to firm core competencies identifications is investigated as a potential reward system driver. A review of several modern reward systems will be accomplished, such as small group incentives, skill-based pay, competency-based pay, gain sharing, combinations of these, etc. Completion of this course should sensitize new managers to the evolving organizational role of modern reward systems. In turn, they will be capable of assessing issues of "fit" or linkage between rewards and other critical organizational elements. (prereq: EM-630 or EM-633, EM-660)

EM-770 New Product Management **3** **0** **3**

This course is designed to develop a through understanding of the new product development process. The major stages of the process are ideation, concept, evaluation, commercialization, and on-going product management. The course uses multifunctional teams as the center of the new development process. This team approach is consistent with, and integrates, the concepts of concurrent engineering, empowerment, and total quality customer market driven strategy (prereq: EM-630 or EM-633, EM-670)

EM-771 International Marketing **3** **0** **3**

As the geographical boundaries that have separated countries and continents are broken down by technological advances in communications and transportation, we are faced with global markets unlike those that technical and industrial enterprises have encountered in the past. Dealing with these issues as a marketer requires an understanding of the regional, cultural and country-specific factors. This course addresses unique aspects that students can expect to encounter as managers in this environment. (prereq: EM-630 or EM-633, EM-670 or EM-709)

EM-773 Technical Sales and Management **3** **0** **3**

This course examines selling and the management of a sales force. It emphasizes trade and industrial selling, but also deals with retail and direct-to-customer sales, including the selling of services. It involves the student in the sales process, product application consulting, as well as the legal, social, ethical and personal responsibilities of the sales engineer. It incorporates the nature and scope of sales management, time and territory administration, and it services as the link between selling and marketing. Emphasis also is placed on selling as a process that benefits both buyers and sellers. (prereq: EM-630 or EM-633, EM-670)

EM-774 Marketing Simulations **3** **0** **3**

This course takes the student through marketing decision making in a simulated global market environment. Students work in teams competing against one another with grades determined by their decisions. All decisions are reviewed at the end of the course as to their effectiveness. (prereq: EM-630 or EM-633, EM-670)

		Lecture Hours Per Week	*Lab Hours Per Week*	*Credit In Quarter Hours*

EM-775 Marketing Strategies **3** **0** **3**

Getting close to the customer and building sustainable customer relationships through integrating sales and marketing is mandatory for success in today's highly competitive markets. The level of customer loyalty a firm builds directly influences sales growth and corporate profitability, and the strategies it uses to acquire new customers. This course examines the strategies that have proven effective in building customer loyalty, while at the same time, lowering sales costs. An essential element is to investigate the dual strategies of account penetration and cultivation. Another aspect focuses on using a marketing database for new customer acquisition. Other topics covered include relationship-based marketing techniques, integrated marketing and sales communication, marketing database management and the economics of marketing. (prereq: EM-600, EM-630 or EM-633, EM-670, and Graduate standing)

EM-780 Modern Business Ethics **3** **0** **3**

This course offers a survey of contemporary topics in business ethics germane to students' professional lives and case studies for developing skills in analyzing ethical theory and moral applications. The course seeks a balance between theory and practice appropriate both to the level of the course and to the needs of its students. Readings are drawn from the established philosophical literature in the field. Case studies are generously employed both to explicate issues raised and to develop analytical skills. Topical areas that are likely to be raised in the students' professional experience are selected for discussion. (prereq: EM-630 or EM-633, EM-660)

EM-795 Managing & Implementing Projects **3** **0** **3**

This course presents the theory supporting the project management process, as well as a practical application to successfully implementing projects. The course combines a classroom and hands-on-approach to provide students with the knowledge of defining and managing the scope of a project, preparing and managing a project plan, preparing and managing a project budget, evaluating and managing project risks, managing project issues, and closing and transitioning of the project. This course is the third course in a sequence. It is intended to be the summative project management course and provide opportunities for students to successfully and creatively apply the tools and knowledge to manage projects in any industry. (prereq: EM-620, EM-630 or EM-633, EM-765)

EM-797 Topics of Engineering Management **3** **0** **3**

This course addresses select topics in engineering management. (prereq: EM-630 or EM-633)

EM-798 Thesis: Phase I **3** **0** **3**

This course is intended to launch the student on the graduate thesis. A variety of assignments are targeted at choosing a topic and advisor, developing an outline and bibliography, designing a research strategy and starting to write. This course is followed by EM-805 (prereq: 33 credits, EM-630 or EM-633)

EM-799 MSEM Independent Study **0** **0** **3**

This option allows a student with a particular interest in a topic to undertake additional work outside of the classroom format. The student works under the supervision of a faculty member and undertakes a project and project report. (prereq: 21 credits, EM-630 or EM-633)

	Lecture Hours Per Week	Lab Hours Per Week	Credit In Quarter Hours

EM-800 Strategic Management 3 0 3

This course is designed to assist in understanding business policy, the recognition of both strategy formulation and implementation as distinct managerial activities. Business policy is generally viewed as having two major components: (1) strategic – the choice of purpose, molding organization character, and formulating broad plans and direction for the enterprise; and (2) administrative- implementation actions necessary to mobilize resources, carry out strategic decisions and achieve organizational goals. Matters of business policy are covered with text material, case studies, and assigned or selected readings.
(prereq: Completion of all EM-600 level courses)

EM-801 Executive Seminar 3 0 3

This course consists of informal meetings with presidents, owners and other executives of for profit and non-profit corporations. Students gain insight into current thinking of top management with respect to today's management challenges at the top managerial decision-making levels. Insights gained are aligned with concepts from MSEM foundation courses to evaluate a business initiative familiar to students. (prereq: 27 credits, EM-630 or EM-633)

EM-804 Thesis 0 0 6

The student prepares a thesis demonstrating proficiency in analyzing, solving and implementing the solution of a practical management problem. The thesis is prepared under the direction of a faculty advisor. (prereq: 33 graduate EM credits including, EM-630 or EM-633)

EM-805 Thesis: Phase II 0 0 3

This course completes the last three credits of EM-798. The student continues working on the thesis with the advisor and completes the oral examination. There is no letter grade given. (prereq: EM-630 or EM-633, EM-798)

EM-807 Management Solutions 3 0 3

This course, offered to students in the MSEM Accelerated program, emphasizes collaborative research to identify, analyze, and solve problems within organizations. It focuses on organizational strategies, systems, and effectiveness that are needed to compete in today's turbulent business environment. This course provides the opportunity to learn how to assess and analyze major interdependent organizational systems. Students prepare a comprehensive written report and make a formal presentation to a management team of the participating company. The project will be conducted as a team, with individual students responsible for one or more major management processes. One or more faculty members will function as a team leader/facilitator/advisor. (prereq: EM-630 or EM-633, completion of the 5th suite)

EM-840 Final Project - Operations 3 0 3

This course is designed to give the student an opportunity to integrate the knowledge, skills and tools of managing/leading an operational activity. The student demonstrates the ability to identify a current operation's plan or activity, and develops a project plan utilizing the theory and practice that have been developed in the operation management track courses to improve or change the marketing activity. The student is required to utilize systems thinking and creative learning approaches to develop a plan that would define measurable and value-added outcomes for the organization. The course emphasizes soliciting peer review and feedback, teamwork, open discussion and critique, and the ability to produce and present to review a plan within a structured time frame. (prereq: EM-630 or EM-633, Either EM-712, EM-744 or EM-746, EM-747)

		Lecture Hours Per Week	*Lab Hours Per Week*	*Credit In Quarter Hours*

EM-845 Final Project - Quality **3** **0** **3**

This course is designed to give the student an opportunity to integrate the knowledge, skills and tools of managing/leading the organization's quality activity. The student demonstrates the ability to identify a current process or activity, and develops a project plan utilizing the theory and practice that have been developed in the quality management track courses to improve or change the marketing activity. The student is required to utilize systems thinking and creative learning approaches to develop a plan that would define measurable and value-added outcomes for the organization. The course emphasizes soliciting peer review and feedback, teamwork, open discussion and critique, and the ability to produce and present to review a plan within a structured time frame. (prereq: EM-630 or EM-633, EM-746 and one of the following: EM-747, EM-762 or EM-770)

EM-860 Final Project - Organizational Management **3** **0** **3**

This course is designed to give the student an opportunity to integrate the knowledge, skills and tools of managing/leading the qualitative process and human resources functions of an organization. The student demonstrates the ability to identify a current organizational or departmental improvement opportunity, and develops a project plan utilizing the theory and practice that have been developed in the organizational management track courses to improve or change the organization. The student is required to utilize systems thinking and creative learning approaches to develop a plan that would define measurable and value-added outcomes for the organization. The course emphasizes soliciting peer review and feedback, teamwork, open discussion and critique, and the ability to produce and present to review a plan within a structured time frame. (prereq: EM-630 or EM-633, Two of the following: EM-735, EM-762, EM-765, EM-766, EM-767 or EM-768)

EM-870 Final Project - Marketing **3** **0** **3**

This course is designed to give the student an opportunity to integrate the knowledge, skills and tools of managing/leading the marketing activity. The student demonstrates the ability to identify a current marketing plan or activity, and develops a project plan utilizing the theory and practice that have been developed in the marketing management track courses to improve or change the marketing activity. The student is required to utilize systems thinking and creative learning approaches to develop a plan that would define measurable and value-added outcomes for the organization. The course emphasizes soliciting peer review and feedback, teamwork, open discussion and critique, and the ability to produce and present to review a plan within a structured time frame. (prereq: EM-630 or EM-633, Two of the following: EM-770, EM-771 or EM-775)

EM-890 Final Project - Program Management **3** **0** **3**

This course is designed to give the student an opportunity to integrate the knowledge, skills and tools of managing/leading projects in an organization. The student demonstrates the ability to identify a current project, and develops a plan utilizing the theory and practice that have been developed in the program management track courses to improve or change project management activity. The student is required to utilize systems thinking and creative learning approaches to develop a plan that would define measurable and value-added outcomes for the organization. The course emphasizes soliciting peer review and feedback, teamwork, open discussion and critique, and the ability to produce and present to review a plan within a structured time frame. (prereq: EM-630 or EM-633, EM-721 or EM-7505, EM-790 or EM-795)

		Lecture Hours Per Week	Lab Hours Per Week	Credit In Quarter Hours

EN-700 Technical Communication 3 0 3

This course is designed to help graduate students improve the communication skills needed to produce the MSE Capstone Project Report. Specifically, students will learn how to do a literature review in their field of specialization, how to work with sources at a more sophisticated level, how to prepare a proposal (specifically, the MSE Capstone Project Proposal), how to deliver more professional presentations (including better use of PowerPoint), how to hold more effective meeting (with advisors, for example), how to organize and manage a large writing project (i.e., their MSE Capstone Project Report), and how to improve written style for clarity and correctness.

EV-611 Applications of Chemistry in Environmental Engineering 3 0 3

Course topics include the following: (1) electroneutrality and its application to water analysis; (2) rates of chemical and biochemical reactions; (3) acid-base reactions and the carbonate system; (4) complexation reactions and chelation; (5) precipitation and dissolution reactions; (6) oxidation-reduction reactions; (7) a survey of organic chemistry and how organic compounds react and behave in the environment; (8) adsorption reactions; and (9) a survey of environmental laboratory procedures and analytical techniques in environmental chemistry. Students will also participate in several labs that will illustrate the course topics, including alkalinity, BOD/COD, lime/soda-ash softening, and carbon adsorption. (prereq: graduate standing in MSEV program or department consent)

EV-612 Biology for Environmental Engineers 3 0 3

This course covers the classification and naming of living things, the structure and function of biologically important macromolecules and cells, metabolic pathways and protein synthesis, basic genetic principles and ecological principles. Particular attention is given to practical environmental issues. Each student participates in a small group project focusing on environmentally important organisms or phenomena. (prereq: graduate standing in MSEV program or department consent)

EV-614 Microbiology for Environmental Engineers 3 0 3

This course covers the basic morphology, biology and distribution of the major microbial groups: viruses, bacteria, fungi, protozoa and algae. Distribution of pathogenic microorganisms (and their surrogates) in the environment, and the methods used for their quantification and control are examined. Microbial growth and metabolism, and the resultant molecular transformations, are studied. The activities of microbes in specific habitats (i.e., biofilms, rhizobia, aquifers) are explored. Particular attention is given to microbes used to help solve environmental problems and to those that create environmental problems. (prereq: EV-612)

EV-710 Environmental Statistics and Modeling 3 0 3

This course covers topics in statistics needed for the statistical analysis of water, air, and other environmental systems. It also presents methods for developing statistical models. Specific topics include: (1) determining if significant differences exist between data sets using parametric and non-parametric methods, (2) experimental design, (3) constructing linear and non-linear regression models, (4) developing Monte Carlo models, (5) analyzing time-series, and (6) special topics. (prereq: undergraduate course in introductory probability and statistics, graduate standing)

EV-720 Municipal Wastewater Treatment 3 0 3

Course topics include the following: (1) wastewater characterization and estimation of design flows and loadings; (2) design considerations for unit operations and processes used in wastewater treatment, including suspended solids removal, aerobic biological treatment, anaerobic biological treatment, nutrient removal, disinfection, and sludge treatment and disposal; and (3) process control systems. A term paper is required on a subject of the student's choosing, addressing a topic that was not covered in class. (prereq: EV-611 or department consent; coreq: EV-614)

		Lecture Hours Per Week	*Lab Hours Per Week*	*Credit In Quarter Hours*

EV-722 Hydrogeology and Groundwater Pollution 3 0 3

Course topics include the following: (1) presentation of the hydrologic cycle–rainfall, water losses, and groundwater runoff and routing models; (2) the unit hydrograph concept; (3) flood flows; (4) reservoir design; (5) governing equations of groundwater flow through porous media; (6) interaction of surface and groundwater flows; (7) groundwater contaminant transport; (8) numerical methods for parameter estimation applications to groundwater models; (9) hydraulics of wells; (10) analysis of seepage through dams; (11) seepage from canals; and (12) land drainage systems. (prereq: graduate standing in MSEV program or department consent)

EV-724 Industrial Water Treatment and Stormwater Management 3 0 3

Course topics include the following: (1) review of treatment standards and regulations as mandated by the Clean Water Act, Resources Conservation and Recovery Act (RCRA) and various industrial standards; (2) presentation of the unit treatment processes for industrial water and wastewater pretreatment, including pH adjustment, coagulation and flocculation, activated carbon absorption, microfiltration, ultrafiltration, reverse osmosis, ion exchange, greensand filters/iron removal, evaporation, disinfection and oxidation with UV/ozone, settling tanks, and oil and hydrocarbon removal; and (3) a survey of the current stormwater permitting. Students perform case studies of water treatment systems from several industries as part of a required research project. (prereq: graduate standing in MSEV program or department consent)

EV-726 Water Resources Management 3 0 3

This course will familiarize the student with the design and regulatory aspects of modifying the water environment, especially as it pertains to site development. Specific topics include: (1) hydrologic modeling, (2) stormwater management facilities design, (3) water quality protection, (4) construction site erosion control, (5) water regulatory permits, (6) wetland protection and mitigation, (7) floodplains and floodways, and (8) watershed and regional-scale issues. (prereq: Graduate standing in MSEV program or department consent)

EV-730 Solid and Hazardous Waste Minimization 3 0 3

Course topics include the following: (1) presentation of the hydrologic cycle – rainfall, water losses, and groundwater runoff and routing models; (2) the unit hydrograph concept (3) flood flows; (4) reservoir design; (5) governing equations of groundwater flow through porous media; (6) interaction of surface and groundwater flows; (7) groundwater contaminant transport; (8) numerical methods for parameter estimation applications to groundwater models; (9) hydraulics of wells; (10) analysis of seepage through dams; (11) seepage from canals; and (12) land drainage systems. (prereq: graduate standing or department consent)

EV-740 Air Pollution Control 3 0 3

This course presents strategies for waste minimization and pollution prevention and introduces the student to the concepts of air pollution control design, and the regulatory and environmental concerns that drive the air pollution control industry. Students are led through the design process from basic theory through practical application and case studies. The sources of air pollution and the available control options are presented and discussed in detail. (prereq: graduate standing in MSEV program or department consent)

		Lecture Hours Per Week	Lab Hours Per Week	Credit In Quarter Hours

EV-750 Plant Safety/OSHA Issues 3 0 3

Course topics include the following: (1) federal regulations governing worker occupational safety and health; (2) an overview of the Occupational Safety and Health Administration; (3) a brief survey of human anatomy, physiology and pathology of the lungs, skin, ears and eyes within the context of potential industrial pathogens, chemical irritants or physical hazards; (4) identification and evaluation of industrial hazards including solvents, particulates, dermatosis, industrial noise, radiation, temperature extremes, ergonomically incompatible equipment and biological hazards; (5) techniques for the control of hazards, including ventilation, protective equipment, noise reduction strategies, principles of ergonomic design and product substitutions; and (6) case studies in designing and implementing an industrial hygiene program for various types of industries, including a description of the necessary record keeping, paperwork and documentation required. (prereq: graduate standing in MSEV program or department consent)

EV-752 Risk Assessment and Environmental Auditing 3 0 3

Course topics include the following: (1) a review of the environmental risk assessment process; (2) a review of environmental auditing procedures, including an introduction to ISO 14,000 and its impact on the environmental auditing process; (3) an overview of federal requirements relating to environmental assessments and impact statements; and (4) a project involving the conducting of an actual audit of a facility. (prereq: graduate standing in MSEV program or department consent)

EV-754 Soil Science and Remediation Technologies 3 0 3

This course presents an overview of techniques to be used to clean up existing pollutants in soil, water or air in the vicinity of hazardous waste sites. Emphasis is on the remediation of pre-existing pollution rather than on pollution prevention strategies. Topics to be covered include the following: (1) surface water control strategies such as capping of surface impoundments, floating lagoon covers, grading, revegetation, diversion and collection; (2) groundwater contaminant clean-up and control strategies such as groundwater pumping, subsurface drains, subsurface barriers, and groundwater treatment procedures such as air and steam stripping, carbon absorption, biological treatment, ion exchange absorption, chemical treatments and reverse osmosis; (3) soil remediation procedures such as in-situ bioremediation, chemical remediation, soil flushing and physical treatment techniques; (4) procedures for the control of gas emissions and fugitive dust control from surface impoundments and landfills; (5) waste, soil and sediment disposal techniques; (6) monitoring strategies for remediated sites and leak detection strategies; and (7) remediation of leaking underground storage tanks (LUST). (prereq: graduate standing in MSEV program or department consent)

EV-756 Environmental Project Program Management and Life Cycle Cost Analysis 3 0 3

Today's environmental manager is faced with numerous environmental issues, all of which must be managed simultaneously. For any one environmental problem within a business or manufacturing setting, there are a number of possible technical approaches to controlling or eliminating that problem. The environmental manager for that business must select the best technical option from among many. This course presents techniques for evaluating, on a life cycle cost basis, the merit of the various technical options. Included in any life cycle costing is discussion on estimating long-and short-term liability costs. These potential liability costs represent a large proportion of the overall exposure a company faces when implementing a program to manage environmental wastes. Since many companies rely on the advice of consultants to make environmental decisions, this course also presents techniques for evaluating the competency of various consultants and presents strategies for working with consultants. (prereq: graduate standing in MSEV program or department consent)

		Lecture Hours Per Week	Lab Hours Per Week	Credit In Quarter Hours
EV-760	**Environmental Law for Environmental Engineers**	**3**	**0**	**3**

This course presents case law and regulations relating to all areas of environmental compliance needed by the practicing environmental engineer. Specific topics include common law liability issues; insurance; the rule-making process; the Federal National Environmental Policy Act; surface and groundwater regulations, including the Clean Water Act (CWA) and the Oil Pollution Act; regulations relating to solid waste and recycling, and to hazardous wastes, including the Resource Conservation and Recovery Act (CRA); laws relating to brownfields redevelopment; Sara Title III and community right-to-know laws; OSHA regulations; the Toxic Substances Control Act; Department of Transportation (DOT) regulations relating to shipments of wastes; the Clean Air Act (CAA); an laws relating to new source construction and major source operation permits. The emphasis throughout the course is on teaching the student processes by which the rules are made, and on where to research existing regulations and laws, so that the student can adapt to the constantly changing status. (prereq: graduate standing in MSEV program or department consent)

EV-799	**MSEV Independent Study**	**0**	**0**	**3**

Independent study allows a student with a particular interest in a topic to undertake additional work outside of the classroom format. The student works under the supervision of a faculty member and undertakes studies that typically lead to a report. (The maximum number of credits of independent study applied to an MSEV degree is three. Credits may not be transferred from other institutions.) (prereq: graduate standing in MSEV program, consent of program director or department chair.)

EV-800	**Writing and Research on Emerging Trends in Environmental Engineering and Management**	**3**	**0**	**3**

This course will explore emerging developments and trends in the fields of environmental engineering and environmental management. Topics will vary from year to year, and may include topics recommended by faculty, industrial advisors, alumni, or be of current interest or concern. Topics may also be coordinated with the MSEV symposium series so that students can research topics and have the opportunity to meet and discuss the topics with symposium presenters. The course will also give students an opportunity to develop research skills, critical reading skills and technical report writing skills. Students will be required to write brief research papers on the topics covered in class following MSOE's documentation and style guidelines. (prereq: graduate standing in MSEV program, written consent of the MSEV program director)

EV-890	**Environmental Engineering Systems Design I**	**1**	**0**	**3**

This is the first quarter of a capstone design course in which the student selects an environmental problem requiring resolution and proposes a comprehensive solution. The solution proposed must meet all technical standards and regulatory guidelines. Facsimiles of any necessary regulatory paperwork must be completed just as if the project were to be actually implemented. Requirements of the first quarter of the course include the following: (1) identify the objectives of the project; (2) perform a literature review; (3) develop primary and alternative solution strategies with consideration given to the relative risks and short- and long-term liabilities associated with each; and (4) prepare a work schedule detailing tasks to be performed during the detailed design and evaluation phase of the project in the second quarter of the course. The course will culminate with an oral presentation by the student providing an overview of the project before a faculty review committee. Selection of an environmental problem based on the student's current or previous industrial work experience is strongly encouraged. (prereq: completion of all EV courses except EV-892, written permission of the MSEV program director)

		Lecture Hours Per Week	*Lab Hours Per Week*	*Credit In Quarter Hours*

EV-892 Environmental Engineering Systems Design II **1** **0** **3**

This is the second quarter of a capstone design course in which the student selects an environmental problem requiring resolution and proposes a comprehensive solution. The solution proposed must meet all technical standards and regulatory guidelines. Facsimiles of any necessary regulatory paperwork must be completed just as if the project were to be actually implemented. Requirements of the second quarter of the course include the following: (1) performance of the detailed technical design for all hardware components of the project; (2) preparation of all required software, I.e., completion of all required regulatory documents; (3) preparation of a final written report detailing the project. [The report shall include as a minimum: (i) background on the project and a description of the environmental problem being solved; (ii) a literature review of previously encountered problems of a similar nature and of any relevant technologies; (iii) a description of the solution methodology chosen for the project, including a discussion of any alternative strategies that were considered during the design phase; (iv) a presentation of the final design including details of the economics of the proposed design, as well as technical specifications and completed regulatory paperwork]; and (4) an oral presentation providing an overview of the project before a faculty review committee. (prereq: EV-890)

GC-8992 MSEM Graduate Continuation Fee **0** **0** **0**

This registration is required each quarter (except summers) that a graduate student is not registered for graduate credits, following that student's initiation of a master's project, thesis or other capstone activity.

GC-8994 MSMI Graduate Continuation Fee **0** **0** **0**

This registration is required each quarter (except summers) that a graduate student is not registered for graduate credits, following that student's initiation of a master's project, thesis or other capstone activity.

GE-703/705 Simulation and Modeling **3** **0** **3**

The purpose of this course is to introduce the student to the basic concepts of engineering systems and analysis and design using computer modeling and simulation. Topics covered include classification of systems and models, steps in developing computer models for continuous systems and discrete even systems, simplification, verification, validation, stability analysis and applications of simulation and modeling. Applications of parallel processing and artificial intelligence methods such as expert systems, neural networks, and fuzzy logic in system modeling and simulation are also presented. Ethics in computer simulation also will be discussed. To provide the student with practical experience, commercial simulation software is used to implement and simulate the models. The student is encouraged to select systems in his/her own engineering area for assignments.

GE-706 Digital Control Systems **3** **0** **3**

The purpose of this course is to provide a sound introduction to the techniques applicable to the analysis and design of digital control systems. Topics include sampling, difference equations, z-transform analysis, signal flow diagrams, digital filters, frequency response, stability analysis, and extensions of controller design criteria from analog to digital systems. (prereq: graduate standing, Laplace transforms and a control systems course such as EE-370) Note: Either GE-706 or EE-579 may be taken for graduate credit, but not both.

GE-797 Engineering Project I **3** **0** **3**

A six-credit project is required of all MSE students. This GE-797 course designation is used for the first three-credit registration. In consultation with a faculty advisor, each student develops and analytical study, engineering project or other suitable technical study that incorporates the concepts learned in the program. The project can draw from multiple disciplines or can focus on a technical area within the student's chosen field of study. (prereq: completion of 21 graduate quarter credits, EN-700 and consent of program director)

		Lecture Hours Per Week	*Lab Hours Per Week*	*Credit In Quarter Hours*

GE-798 Engineering Project II **3** **0** **3**

This GE-798 course designation is used for the second three-credit registration for the engineering project. This is a continuation of GE-797. (prereq: GE-797)

MA-611 Engineering Mathematics I **3** **0** **3**

Linear algebra topics include matrix algebra, linear systems, determinants, vector spaces, and eigenvectors. Complex variables topics include algebra in polar and rectangular coordinates, differentiable and analytic functions, harmonic functions, elementary functions, Cauchy's theorem, Cauchy's integral formula, Taylor and Laurent series, and integration by residues. (prereq: graduate standing and undergraduate calculus through differential equations)

MA-612 Engineering Mathematics II **3** **0** **3**

Topics include first-order differential equations, numerical and graphical methods, second-order linear differential equations, systems of first-order linear differential equations by eigenvalues and the Laplace transform. (prereq: graduate standing and undergraduate calculus through differential equations)

MA-701 Probability and Statistics **3** **0** **3**

This course presents statistical methods used in engineering. Topics covered are the laws of probability, probability distributions, moments, the central limit theorem, confidence intervals, tests of hypotheses, correlation and regression, statistical quality control, and reliability and life testing. (prereq: graduate standing, undergraduate calculus)

MA-702 Dynamical Systems **3** **0** **3**

Topics covered include dynamical systems, hyperbolicity, symbolic dynamics, topological conjugacy, chaos, structural stability, Sarkovski's Theorem, the Schwarzian derivative, bifurcation theory, maps of the circle, Mose-Smale diffeomorphisms, homoclinic points and bifurcations, period-doubling, kneading theory, genealogy of periodic units. (prereq: graduate standing, undergraduate calculus through differential equations)

ME-512 Transport Processes **3** **0** **3**

This course explains the behavior of incompressible fluids under static and dynamic conditions. It addresses the principles of heat transfer by conduction, radiation and conversion as applied to both steady-state and transient systems. The application of heat transfer analysis is included. (prereq: ME-311 or MT-355 or equivalent)

ME-514 Thermodynamic Applications **3** **0** **3**

This course offers a study of applications of thermodynamic principles to typical devices and systems such as compressors, nozzles, turbines, steam power plants, internal combustion engines, air conditioning, refrigeration, heat pumps and gas turbines. (prereq: ME-311 or MT-355 or equivalent)

ME-521 Science of Engineering Materials **3** **0** **3**

The structure and solid-state reaction in single and multiphase materials under equilibrium and nonequilibrium conditions are covered. Elastic, plastic and viso-elastic behavior of materials are analyzed. Material systems, service stability, failure of materials and the selection of materials are considered. (prereq: PH-110, PH-220, CH-200 or equivalent)

ME-703 Advanced Mechanics **3** **0** **3**

This course re-examines basic strength of materials and explores how it is extended for analysis of situations having complicated geometries, loading and stress distributions. Topics include development of approximate solutions using energy methods, the concepts of finite element analysis and applications of planar theory of elasticity. (prereq: Graduate standing, Undergraduate calculus through differential equations, ME-207 or equivalent)

		Lecture Hours Per Week	Lab Hours Per Week	Credit In Quarter Hours

ME-821 Corrosion and Degradation of Materials **3** **0** **3**

This course covers the principles and mechanisms of corrosion and degradation for a variety of materials. Emphasis is given to the corrosion of metals; however, the degradations of polymers and polymer matrix composites also are covered. This course is intended to aid in understanding corrosion failures, and assist in material selection, materials substitution and corrosion prevention. (prereq: ME-521 or equivalent)

ME-822 Structure and Properties of Engineering Materials **3** **0** **3**

This course provides the student with an in-depth look at various engineering alloy and material systems. The effect of microstructural features on mechanical properties is discussed. Material property comparisons are made in order to demonstrate the advantages and disadvantages of various materials for specific applications. (prereq: ME-521 or equivalent)

ME-823 Powder Metallurgy **3** **0** **3**

The objective of this course is to introduce the principles of the powder metallurgy to the students. Applications of P/M parts are today associated with improved quality, high productivity, new and improved material properties as well as conserving raw material and energy. The course will mainly focus on sintered iron and steel, and will teach the students to consider P/M as a design alternative. In the lab the students will characterize the powder, mix powders to form their own alloy, study the effect of process parameters, and determine the mechanical properties. Fracture analysis using the scanning electron microscope will show the differences between P/M materials and conventional steels. (prereq: ME-521 or equivalent)

ME-861 Finite Element Analysis for Mechanical Engineering **3** **0** **3**

Application of the finite element method in the areas of stress analysis, heat transfer and fluid flow is covered in this course. Theoretical background is presented, and the interpretation of the results of the analysis as applied to the design process is stressed. Stress analysis includes 2-D and 3-D applications, contact problems and nonlinear analysis. Heat transfer analysis includes steady-state and transient, conduction and convection analysis in two and three dimensions. Fluid flow analysis also includes steady-state and transient, laminar and turbulent flow in two and three dimensions. This course stresses FEA as a design tool rather than the development of finite element theory. A commercial FEA program is used to perform the analysis, and illustrate and interpret the output.

ME-862 Advanced Mechanical System Design **3** **0** **3**

This course reviews the analysis of springs and screws when subjected to a combination of steady and alternating loads. The course investigates the design and analysis of advanced machine components. Included are topics such as belting, clutches, brakes, welds, rivets, journal bearings, cams, impact stresses and fans. (prereq: Graduate Standing, ME-205 or equivalent, ME-206 or equivalent, ME-207 or equivalent)

ME-871 Mathematical Modeling of Fluid Power Systems **2** **2** **3**

This course examines basic circuit theorems and the methods of solution. Emphasis is placed upon the methods of development, useful mathematical models of fluid power components such as valves of all common types, actuators, power sources, interconnecting lines and cavitation phenomena. Use of the computer to solve engineering problems is stressed. (prereq: Graduate Standing, One year of undergraduate calculus, ME-471 or MT-372)

		Lecture Hours Per Week	*Lab Hours Per Week*	*Credit In Quarter Hours*

ME-872 Theory of Fluid Power Dynamics **2** **2** **3**

A review is made of conventional methods for solving dynamic systems, i.e., Laplace transforms, Bode analysis, Nyquist analysis, root-locus and state-space representations. Methods are presented for mathematical modeling of complete hydraulic systems along with methods of solving the equations. Simulation, synthesis and identification methods are covered and comparisons are made. Practical methods of system linearization are applied to examples. Use of the computer is stressed. (prereq: ME-871, and ME-431/432)

ME-873 Design of Feedback Control for Fluid Power Systems **2** **2** **3**

In this course, an electrohydraulic design project is undertaken by the student. The scope of the project should have industrial relevance and employ electrohydraulic technology in a closed-loop control application. Simulation of the proposed system is required, with the project results being presented in written and oral form. (prereq: ME-872)

MI-13101 Introduction to Medical Informatics I **3** **0** **3**

This course will be taught over two quarters for three credits per quarter. MI-13101 is the first course in the 2-course schedule. This course provides the foundation for graduate study in medical informatics and covers topics such as medical records, clinical information systems (hospital, outpatient, nursing, laboratory, pharmacy, radiology, etc.), decision-support systems, clinical research and health-assessment systems, technology assessment and healthcare accounting. The focus of the class content is on the United States' system of healthcare delivery and the role of informatics within the U.S. system. The course format is designed to be part "in person" (for course meetings, special speakers and tours), as well as part "online". Students are expected to participate in weekly discussion forums, as well as occasional weekly on-line chat sessions. (prereq: Consent of Program Director)

MI-13102 Introduction to Medical Informatics II **3** **0** **3**

This course will be taught over two quarters for three credits per quarter. MI-13102 is the second course in the 2-course schedule. This course provides the foundation for graduate study in medical informatics and covers topics such as medical records, clinical information systems (hospital, outpatient, nursing, laboratory, pharmacy, radiology, etc.), decision-support systems, clinical research and health-assessment systems, technology assessment and healthcare accounting. The focus of the class content is on the United States' system of healthcare delivery and the role of informatics within the U.S. system. The course format is designed to be part "in person" (for course meetings, special speakers and tours), as well as part "online". Students are expected to participate in weekly discussion forums, as well as occasional weekly on-line chat sessions. (prereq: Consent of Program Director)

MI-13202 Ethics in Medical Informatics **3** **0** **3**

This course explores the ethical and legal issues applied to information access and use in the healthcare environment. Topics include patient privacy and confidentiality, data security, coding and reimbursement, conflicts of interest, intellectual property rights, medical error reporting, and business/professional responsibility. (prereq: Admission in the Medical Informatics program)

MI-13203 Health Care Decision Support **3** **0** **3**

Because of the sheer complexity of healthcare both clinically and operationally, organizations are turning to computer applications that support the decision making process. This course highlights both clinical and operational decision support systems (DSS) as they are currently used and explores future applications. Clinical DSS topics include electronic medical records, computerized physician order entry, disease management systems, expert systems/neural networks, automated documentation, Bayesian networks, clinical vocabularies, and evidence-based medicine. Operational DSS topics include executive information systems, consumer informatics, and contract modeling. This is critical content as healthcare institutions increasingly focus on outcomes measures for clinical and business decision-making. (prereq: MI-13200, MI-743, MS-756, MI-783, MI-787)

		Lecture Hours Per Week	Lab Hours Per Week	Credit In Quarter Hours

MI-13204 Information Systems Project Management 3 0 3

The design and implementation of an informatics application in the healthcare environment is an incredibly complex project. This course provides a basic methodology for understanding and defining the scope of the project, planning and running it, as well as post implementation assessment. As a final project, students work either individually or in groups to produce their own project management documentation.

MI-13297 Internship or Research Project I 3 0 3

The student and an advisor design this project jointly. Each project is designed to provide the maximum learning experience. In most cases, this will be an applied project within a healthcare environment. The project should reflect the student's area of professional interest. (prereq: Completion of 27 credits in the MSMI program)

MI-13298 Internship or Research Project II 3 0 3

The student and an advisor design this project jointly. Each project is designed to provide the maximum learning experience. In most cases, this will be an applied project within a healthcare environment. The project should reflect the student's area of professional interest. (prereq: Completion of 27 credits in the MSMI program)

MI-693 Intermediate Statistics 3 0 3

Correct decisions in the healthcare industry that improve patient safety, the quality of service and efficiency and effectiveness of care can only come through the appropriate analysis of numerical data. The concepts in this course are also needed to assess information system performance. Topics include probability theory, discrete and continuous variables, hypothesis testing, regression and performance improvement. (Prereq: Introductory course in statistics) (prereq: Admission in the MSMI Program)

MI-720 Six Sigma Quality and Patient Safety 3 0 3

Everyone wants high-quality, safe healthcare that is accessible and affordable. Since the Institute of Medicine's landmark study, To Error is human, there has been a nationwide focus on patient safety issues and the quality of healthcare services more generally. Six Sigma is a modern management methodology that can be widely applied in healthcare environments to address these issues of quality and patient safety. At the same time, this methodology also incorporates the organizational change management required to achieve successful outcomes – improved quality and reduced errors. Students in this course will learn to use and apply the Six Sigma tools to define, measure, analyze, improve and control the complex processes of healthcare delivery. Patient safety will be the main "issue" addressed by the Six Sigma methodology. These same tools can also be applied to create quality processes related to the development, implementation and management of informatics solutions.

MI-743 Principles of Health Care Management 3 0 3

This course provides students with an overall understanding of the principles of management as are practiced in today's healthcare environment. Emphasis will be on those fundamentals of management that impact the performance of interdisciplinary teams and the interaction that occurs between individuals, the team, the organization and beyond. Topics include organizational theory, information and control, strategic planning, leadership, motivation and employee development, change management, project management, uncertainty, conflict, ethics and social issues. Case studies illustrating the topics in healthcare settings are used throughout. (prereq: Graduate standing)

		Lecture Hours Per Week	*Lab Hours Per Week*	*Credit In Quarter Hours*

MI-756 Health Care Provision and Payment 3 0 3
This course will give students an understanding of some of the more quantitative and methodological aspects of both the provision and payment of healthcare services and the provision and payment of information technology solutions in healthcare organizations. The course we will build on the student's understanding of the healthcare industry, environment, healthcare public policy and the organizational culture, which began in the Intro class. Models of healthcare provision and payment will be presented. Principles of healthcare finance are presented so that students gain an understanding of the capitol budgeting and decision making processes. Additionally, the course will expose students to methodologies necessary for the efficient and effective deployment of information systems.

MI-783 Database Structures and Processing 3 0 3
This course provides an overview of the current database modeling techniques, database technologies, and database design principles. Topics include entity-relationship and semantic data modeling, relational, network, and hierarchical database technologies, normalization, data dependencies, resource sharing and distributed databases. (Prereq: Introduction to Medical Informatics II) (prereq: MI-13201B)

MI-786 Medical Informatics Journal Club 0 0 1
Weekly readings will be selected from contemporary literature in medical informatics. Each student will choose an article once during the quarter, write a summary and questions for online discussion with other students. Students must enroll in this course three times, for a total of 3 credit hours. (prereq: Admission in the MSMI program)

MI-787 Healthcare Systems Analysis and Design 3 0 3
This course covers systems development methodologies; the systems development life cycle, and the concepts, tools and techniques currently used in the analysis of healthcare information systems and the design of new systems and applications. You will work in project teams to develop the preliminary design of an informatics application for a fictitious organization. (Prereq: Introduction to Medical Informatics)

MI-789 Medical Informatics Case Study Seminar 3 0 3
This course is an in-depth study of real world medical informatics systems. It is run in seminar format and requires considerable reading in preparation for each class discussion. Case studies based on student internship/research projects (see MI-13297& MI-13298) will be used to discuss how and why a system is designed and implemented. The medical, business/financial, and legal implications of automating a healthcare function are discussed. (Prereq: Advanced standing in the MSMI program and consent of course instructor or program director) (prereq: MI-783, MI-787)

MI-799 Medical Informatics Independent Study 0 0 3
As an elective, this course allows a student with a particular interest in a topic to undertake a course of study outside of the traditional classroom format. Goals and deliverables from the independent study must approved by the program director. Alternatively, graduate students may take an undergraduate course for graduate credit under the independent study designation. Additional requirements will be placed on students in this situation (See *catalog* section entitled, "MSOE Graduate Policy on Receiving Graduate Credit for an Undergraduate Course") (Prereq: Consent of program director)

MI-885 Computer Network and Design 3 0 3
This course provides an introduction to telecommunication concepts necessary for understanding network design and operation both within and between healthcare organizations. Topics include network designs (topology), client-server and mainframe environments, the operation of various network hardware devices (servers, routers, gateways, modems, cable types, etc.), network operating systems (NT, W2000, Unix, etc.), and other network applications. The understanding of telecommunications concepts is essential for teaming with technical professionals.

		Lecture Hours Per Week	Lab Hours Per Week	Credit In Quarter Hours

PE-601 Analysis of Biological Systems 3 0 3

This course covers topics in mathematics, fluids, and mass transfer with specific applications to medicine and the life sciences. Topics include first and second order linear differential equations compartmental analysis, Laplace transforms, models of the heart and circulation, gas transport in the lungs and electrical properties of cell membranes. MATLAB is used as the computer software tool to solve many of the problems presented in this course. (prereq: graduate standing)

PE-640 Applied Biophysical Transport 3 0 3

The objective of this course is to present the principles of fluid, mass and heat transfer as they apply to equipment used in extra-corporeal perfusion. MATLAB is used to solve various problem assignments.

PE-642 Electronic Medical Instrumentation 3 0 3

The objective of this course is to introduce students to medical devices that they might be in contact with in clinical practice. Following a review of basic electrical and electronic fundamentals, this survey cause progresses with a broad overview of the theory and clinical applications associated with a variety of diagnostic and therapeutic medical devices. Emphasis will include the basic design and operation of these devices along with discussion of their inherent risks, failure modes and safety precautions. Laboratory and/or demonstration exercises will be integrated when possible. (prereq: graduate standing)

PE-645 Blood Compatible Materials 3 0 3

The objective of this course is to present the principles for selection of materials used in cardiopulmonary bypass (CPB) medical devices. Topics include the following: concepts of biocompatibility, structure and behavior of solids, metals, polymers, ceramics, biological tissues, blood-material interactions, sterilization, biocompatibility testing, vascular grafts, extra-corporeal blood pumps, ventricular assist devices (VAD), oxygenators, heart valves, pacer leads and blood substitutes. (prereq: graduate standing)

PE-646 Medical Statistics 3 0 3

This course will provide a graduate level introduction to biostatistics. As a result of this course the students will be expected to understand and prepare statistical analysis of data from physiological systems in the laboratory and clinical environment. The students will learn basic probability theory that includes discrete and continuous probability distributions. They will learn how to apply that theory to hypothesis testing using parametric and nonparametric statistical techniques. The students will be expected to understand and prepare statistical analysis for the response of physiological systems or perfusion devices. They will be expected to understand statistical procedures that are presented in current research publications and use the procedures in preparation of research reports. (prereq: PE-640)

PE-647 The Design of Experiments 3 0 3

As a continuation of PE-646, this graduate course addresses the broader issue of experimental design and methodology as it applies to medical research. Emphasis is give to the entire research process from defining and refining the original research question, to evaluating its feasibility, assessing the reliability and validity of dependent and independent variables and measurements, selection of the appropriate statistical design, interpretation and presentation of results. Experimental and statistical techniques for the control of error variance also are covered. (prereq: PE-646)

PE-648 Biodynamics: Circulation 3 0 3

This graduate course is a continuation of PE-640. It deals in more detail with the mechanics of circulation. The major topics include blood flow in arteries, veins, microcirculation, lungs, coronary arteries and veins and skeletal muscle. (prereq: PE-640 or consent of the instructor)

		Lecture Hours Per Week	*Lab Hours Per Week*	*Credit In Quarter Hours*

PE-650 Seminar on Clinical Medicine **2** **0** **2**

This graduate seminar on clinical medicine includes the following topics: assessment and management of risk factors for open heart surgery, blood conservation, hemodynamic monitoring, ventilator support, dialysis/hemofiltration, IABP/pacemakers/defibrillators, ventricular support devices, transplantation and special topics in cardiopulmonary bypass. (prereq: PE-670, PE-675)

PE-651 Seminar on Medical Ethics **2** **0** **2**

This graduate seminar entails a self-conscious consideration of the requirements of professional ethics corresponding to the emergence of perfusion as an autonomous profession. Two topics dominate the discussion: the tension between the requirement of professional autonomy and the surgeon's presumed role as the "captain of the ship," and perfusion ethics' unique combination of elements of the fields of business ethics and biomedical ethics. (coreq: PE-705 or consent of the instructor)

PE-670 Pharmacology **3** **0** **3**

This is a graduate-level course introducing the general principles of pharmacology. The main emphasis is on the basic mechanisms of drug actions and interactions with biological systems. The basic physiology, receptors that mediate drug actions, as well as the drugs themselves, are emphasized in each of the subject areas. Although the course is taught as an overview of pharmacology, special attention is directed to drugs that affect the heart, peripheral vasculature, kidneys and other areas pertinent to cardiopulmonary bypass.

PE-673 Advanced Physiology I **3** **0** **3**

The objective of this course is to present the anatomy and physiology of systems, with an emphasis on how they relate to the profession and practice of perfusion. Topics covered include: cell structure and function (with an emphasis on membrane function and transporters), membrane potentials and action potentials, skeletal and smooth muscle structure and function, and cardiovascular structure, function and regulation. (prereq: graduate standing or consent of the instructor.)

PE-674 Advanced Physiology II **3** **0** **3**

The objective of this course is to continue the study of anatomy and physiology begun in PE-673. Topics covered include: fluid compartments and regulation, plasma pH balance and regulation, and respiratory, renal, liver, endocrine and nervous systems function. (prereq: PE-673)

PE-675 Pathophysiology **3** **0** **3**

The objective of this graduate course is to present basic pathologic processes in general. In addition, the course emphasizes those pathology topics more relevant to cardiovascular perfusion. These topics include thrombosis and hemostasis, congenital and acquired heart diseases, cardiomyopathies, and lung and brain pathology. (prereq: PE-673)

PE-699 Master's Thesis **6** **0** **6**

Students working toward the degree of Master of Science in Perfusion must design, perform, write and defend an original research project dealing with either the theory or practice of cardiopulmonary perfusion. (prereq: consent of the MSP program director)

PE-7000 Extra-Corporeal Perfusion Laboratory **1** **3** **2**

The object of this laboratory is to have the students use extra-corporeal equipment to study transport phenomenon as it applies to the practice of perfusion. Further, each student is required to study and demonstrate competence in catastrophic event management. (prereq: graduate standing and consent of the instructor)

	Lecture Hours Per Week	Lab Hours Per Week	Credit In Quarter Hours

PE-7010 Clinical Extra-Corporeal Perfusion I **2** **3** **3**

The object of this course is to provide a general introduction to principles of extracorporeal technology, define the scope of practice for the perfusionist, and convey a general familiarity of the equipment, personnel and practices within the cardiac operating room. Topics include the following: history of cardiac surgery and perfusion, aseptic technique, extra-corporeal equipment and circuit design, hemodynamic monitoring, principles of gas transfer and oxygenator design, blood salvage techniques, intra-aortic balloon counterpulsation, and perfusion safety. In the operating room, students observe cardiopulmonary bypass (CPB) procedures and assist in the set up and priming of CPB equipment. The primary clinical goal for the MSP student at the conclusion of PE-7010 is to be able to set up and prime the heart-lung machine consistently without the aid of the clinical instructor. During surgical cases, students are under the direct supervision of physicians and board certified clinical perfusionists. (prereq: graduate standing and consent of the instructor)

PE-7020 Clinical Extra-Corporeal Perfusion II **2** **3** **3**

The objective of this course is to present to the MSP student detailed concepts of perfusion technology. Topics include the following: hemodilution, hypothermia, myocardial protection; preservation, coagulation management and pathophysiology of cardiopulmonary bypass (CPB). In the operating room, the student begins to assume more responsibility. There is continued emphasis on perfecting set-up and prime techniques. Students start to perform ancillary perfusion duties during the case such as charting, blood gas/ACT draws, cardioplegia delivery, and function as the primary perfusionist during the middle portion of the case. As the course progresses, the student attempts to initiate and terminate CPB. The primary clinical goal for the MSP student at the conclusion of PE-7020 is to function as the primary perfusionist for the entire case. During surgical cases, students are under the direct supervision of physicians and board certified clinical perfusionists. (prereq: PE-7010)

PE-7030 Clinical Extra-Corporeal Perfusion III **2** **3** **3**

The objective of this course is to continue to present to the MSP student detailed concepts of perfusion technology. Topics include the following: pharmacological review with emphasis on perfusion application, further discussions about the pathophysiology of cardiopulmonary bypass (CPB), pulsatile blood flow and other clinical management techniques, and circulatory assist device applications. In the operating room, the student has assumed the responsibilities as the primary perfusionist and begins to demonstrate proficiency in the practice of extra-corporeal technology in a more independent nature, but still under the direct supervision of physicians and board certified clinical perfusionists. The cases theoretically increase in difficulty with regards to the technical complexity, and the degree of involvement and/or application of advanced techniques by the student. The student is assigned cases, as they become available, including the following: adult ECMO, cardiac transplantation, ventricular assist device implantation and total artificial heart implantation. The clinical goal of the MSP student is to continue to improve perfusion techniques and gain more experience. (prereq: PE-7020)

PE-7040 Pediatric Extra-Corporeal Perfusion **2** **3** **3**

The objective of this course is to provide a fundamental basis of extra-corporeal technology applications for neonatal and pediatric patients. Topics include the following: fetal, neonatal and pediatric anatomy/physiology; congenital heart defects; pediatric perfusion circuits and devices; extra-corporeal membrane oxygenation (ECMO); and other associated topics. The course lectures are divided weekly into two parts: the first is an in-depth clinical perspective on associated topics by various health care providers from Children's Hospital of Wisconsin (CHW); the second is lecture by a pediatric perfusionist on the fundamentals of neonatal/pediatric perfusion. In the operating room at CHW, the student is exposed to a variety of neonatal/pediatric patients and various extra-corporeal applications. While in surgery, students are under the direct supervision of CHW physicians and board certified clinical perfusionists.

		Lecture Hours Per Week	*Lab Hours Per Week*	*Credit In Quarter Hours*
PE-7050	**Clinical Extra-Corporeal Perfusion IV**	**2**	**3**	**3**

The objective of this course is to provide lectures in the management of special cases and unusual problems associated with the application of extra-corporeal technologies, and to prepare the student for the American Board of Cardiovascular Perfusion (ABCP) Certification Examinations. Topics include the following: catastrophic event management, liver transplantation, operative field isolation, perfusion of the pregnant patient, hemoglobinopathies, accidental hypothermia and electrophysiology. The clinical goals for the MSP student are as follows: (1) complete all clinical cases and rotations; (2) obtain clinical release from the MSP Clinical Competency Review Committee; (3) complete all catastrophic event management testing; and (4) pass the written MSP Final Clinical Examination. While in surgery, students are under the direct supervision of physicians and board certified clinical perfusionists. (prereq: consent of the MSP clinical program director)

PH-863	**Electronic Materials and Devices**	**3**	**0**	**3**

Four broad areas covered in this course are: the crystal structure of solids, electronic properties of solids, the principles of p-n junctions and semiconductor device and integrated-circuit technology. Specific topics covered include: space lattices and crystal structure, the energy band theory of solids, theory of the p-n junction, semiconductor diodes, zener diodes, varactor diodes, light-emitting diodes, solar cells, bipolar junction transistors, junction and insulated-gate field-effect transistors, and integrated-circuit design potentials and limitations. (prereq: consent of instructor, graduate standing, one year of college physics)

THE ROSTER

Administration of MSOE

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Vice President of Finance and Treasurer

A current listing of MSOE's officers, Regents, Regent Emeriti and Corporation members may be obtained from the President's Office or the Vice President of Academic's Office.

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