



**BACHELOR OF  
MATERIALS SCIENCE AND ENGINEERING  
PROGRAM**

**DEPARTMENT OF CHEMICAL ENGINEERING  
AND MATERIALS SCIENCE**

**UNIVERSITY OF MINNESOTA**

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## I. MATERIALS SCIENCE AND ENGINEERING (MSE)

Advances in technology, and improvements in our quality of life, are directly linked via the development of engineering materials. For example, high purity silicon makes it possible to have miniaturized electronics and high speed computers; strong, light-weight alloys and improved battery materials increase the energy efficiency of cars; polymeric contact lenses are available as an alternative to traditional eyewear; ceramic space shuttle tiles have helped to revolutionize space travel; and nanotechnology and nanomaterials promise to revolutionize many areas of science and technology. How were engineering materials such as these selected? What physical properties of the materials influence these choices? How can the materials be manufactured in the required size and shape? These are questions for a materials scientist or materials engineer. Materials scientists and engineers are trained to develop new and improved materials for engineering applications. These engineers know how to measure a material's properties, characterize its structure, and determine how properties and structure are affected by the conditions of use. Materials scientists and engineers are also involved in the design of the manufacturing processes used to integrate these engineering materials into products.

A Bachelor's degree in MSE prepares you to be on the forefront of developing new materials and technology. Coursework in MSE covers the structure, properties, processing, and performance of engineering materials. An engineering material's structure is made up of atoms and molecules as the fundamental building blocks. The nature of the interatomic and intermolecular bonds, and the way in which the atoms or molecules pack in the solid structure, are responsible for many of the differences in materials properties. For example, differences in bonding explain why most metals are good conductors of electricity and most ceramics are not. Structure on a larger length scale (microstructure) influences properties as well. Characterization methods, including atomic force microscopy and light microscopy, allow us to image structural features down to an atomic scale and up to the millimeter level. A host of physical properties are of interest to materials scientists and engineers, including mechanical properties, such as strength and ductility, and electrical properties, such as conductivity. In addition, an engineer may need to know about the magnetic, optical, thermal, and chemical properties of materials. For any engineering material to be used, it must be fabricated or processed into the necessary shape and size. The way in which a material is processed determines its structure and therefore influences its properties. Students in the MSE program gain an appreciation of the interrelationships between structure, properties, and processing, and can thus contribute effectively to the development of new products and applications for materials.

Materials scientists and engineers are employed in many industries, including microelectronics, nanotechnology, automotive, aerospace, biomedical, consumer products

and communications. They may contribute to the engineering operations of a company or to a research and development team. In these jobs, they often work in groups with other engineers, such as electrical, mechanical and chemical engineers. They may also enter management, marketing, service or sales positions, which make use of their scientific and engineering background. Some go on to graduate school to earn advanced engineering degrees or enter law or medical degree programs.

## **II. EDUCATIONAL OUTCOMES AND OBJECTIVES**

The MSE program is accredited by the Engineering Accreditation Commission of ABET (the Accreditation Board for Engineering and Technology). The program is designed to achieve educational objectives and lead its graduates to achieve outcomes. These objectives and outcomes are then updated, based on feedback from students, faculty, industrial advisors, and alumni.

### **Program Educational Objectives**

The MSE program is designed to prepare students to achieve the following career and professional accomplishments after graduation:

- 1: Be employed as a materials engineer or in a related engineering or science position, using and developing his or her skills based on the demands of the job.
- 2: Enter into a graduate or professional program, applying his or her knowledge and experience toward an advanced or professional degree.
- 3: Be an effective team member, using and developing communication and teamwork skills.
- 4: Be a responsible engineer/scientist or professional, demonstrating ethical and professional responsibility and continuing to learn through formal and informal educational experiences.

### **Student Outcomes**

MSE graduates will be equipped with:

- 1: An ability to apply knowledge of mathematics, science and engineering.
- 2: An ability to design and conduct experiments, as well as to analyze and interpret data.
- 3: An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, health and safety, manufacturability, and sustainability.
- 4: An ability to function in multidisciplinary teams.
- 5: An ability to identify, formulate, and solve engineering problems.
- 6: An understanding of ethical and professional responsibility.

- 7: An ability to communicate effectively.
- 8: The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.
- 9: A recognition of the need for, and an ability to engage in life-long learning.
- 10: A knowledge of contemporary issues.
- 11: An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Any comments or suggestions related to the Program Educational Objectives or Program Outcomes should be directed to the Director of Undergraduate Studies.

### III. COLLEGE OF SCIENCE AND ENGINEERING INFORMATION

The CSE website (<http://www.cse.umn.edu>) is a great source of information, as is the CSE section of the Undergraduate Catalog (<http://www.catalogs.umn.edu/ug/index.html>). These resources supplement the University information contained on the Student OneStop page (<http://onestop.umn.edu/>).

### IV. REQUIREMENTS FOR THE B.Mat.S.E. DEGREE

In order to obtain a Bachelor of Materials Science and Engineering degree, you must complete the requirements below. See section V for sample 4 year plans. Students must complete 128 semester credits.

#### **Liberal Education (LE) and Writing Intensive (WI) Requirements**

Students need to complete enough courses to satisfy the LE requirements. Note that 2 core course requirements (physical sciences with a lab and mathematical thinking) are satisfied by the lower division required courses, and the environmental theme requirement is satisfied by Chem 1061. Students are advised to take EngC 1011 (or equivalent) and Biol 1009 (or equivalent biology with a lab) in their freshman year.

Students must take at least 4 courses with the writing intensive (WI) designation. Note that 2 of the required lower division courses are writing intensive (Phys 1301W, Phys 1302W). At least 2 WI courses must be taken at a level of 3xxx or above. The following MSE courses have WI designation: MatS 3851W, MatS 4301W, and MatS 4511W.

#### **Lower Division (Pre-major)**

The following is a list of required courses that are taken in the lower division. All required courses must be taken on the A/F grade basis and a grade of C- or better is required for the course to fulfill your program requirement.

Chem 1061/1065, 1062/1066, 2301

Math 1371 or 1271, 1372 or 1272, 2374 or 2263, 2373 or 2243

Phys 1301, 1302, 2303 (or Chem 4502)

AEM 2011

CE 3101

MatS 3011

You should apply to enter upper division by filing an application with CSE (105 LindH). To be admitted to the upper division of the Materials Science and Engineering program, you must have a technical GPA of 2.0 or higher, and you must have taken AEM 2011, Chem 2301, Math 2374 or 2263, 2373 or 2243, and Phys 2303. CE 3101 may be taken in sophomore year or first semester of the junior year. **MatS 3011 (Introduction to Materials Science and Engineering) should be taken in the sophomore year.** Note that procedures regarding admission to your chosen major have changed. See the following site for details:

[http://cse.umn.edu/services/advising/CSE\\_CONTENT\\_188611.php](http://cse.umn.edu/services/advising/CSE_CONTENT_188611.php)

### Upper Division (Major)

The following is a list of required courses that are taken in the upper division. All required courses, including technical electives, must be taken on the A/F grade basis and a grade of C- or better is required for the course to fulfill your program requirement.

MatS 4001, 4002, 3012, 3801, 3851W, 4013, 4212, 4214, 4221, 4301W, 4400

AEM 3031, 4511

Technical Electives (13 cr, see below)

Individual courses in this core may be replaced by appropriate substitutes if acceptable justification for replacement can be stated, but replacement always requires approval by the MSE Director of Undergraduate Studies.

### Technical Electives

Students must complete at least 13 semester credits of technical electives in addition to the required courses stated above. The table below shows a *selection* of IT courses that *may* be taken as technical electives. The technical electives are grouped into emphasis areas so that students can easily find courses that suit their interests. **Students do not need to choose an emphasis area; they may pick technical electives from a variety of areas.** Most of the courses in the table do not require prerequisites beyond those already required in the MSE program, but prereq's should always be checked as some courses must be taken in

sequence. *The table below does not include all possible technical electives.* Approval to take other classes as MSE tech electives requires approval from the Director of Undergraduate Studies. Most upper division IT courses (3xxx, 4xxx or 5xxx level) may serve as technical electives but only with permission of the MSE Director of Undergraduate Studies.

**Technical Electives in the B.Mat.S.E. Program**

<b>Interest Area</b>	<b>Course Number</b>	<b>Title</b>	<b>Credits</b>
Advanced MSE	MatS 4512/ MatS 4511W	Corrosion and Electrochemistry of Corrosion	4
	MatS 5531	Electrochemical Engineering	3
	MatS 5517	Electron Microscopy	3
	ChEn 5771	Colloids and Dispersions	3
Biomaterials	BioC 3021	Biochemistry	3
	BMEEn 5001	Advanced Biomaterials	3
	MatS 4512	Corrosion and Electrochemistry of Corrosion	4
Chemistry	Chem 2302	Organic Chemistry II	3
	Chem 2311	Organic Chemistry Lab	4
	Chem 4701	Inorganic Chemistry	3
	Chem 4201	Materials Chemistry	4
Chem. Eng.	ChEn 2001	Material and Energy Balances	4
	ChEn 4xxx	Any ChEn upper division course	4
Civil Eng.	CE 3402	Construction Materials	3
	CE 3501	Environmental Engineering	3
	CE 3502	Fluid Mechanics	4
	CE 4232	Cemented Materials	3
	CE 4121	Computer Applications II	3
Electr. Mat'ls	EE 3005	Fundamentals of Electrical Engineering	4
	EE 3006	Fundamentals of Electrical Engineering-Lab	1
	EE 3161	Semiconductor Devices	3
	EE 5171	Microelectronic Fabrication	4

Interest Area	Course Number	Title	Credits
	EE 5173	Basic Microelectronics Laboratory	1
	EE 5657W	Thin Film Science and Technology	4
Industrial Eng.	IE 4521	Statistics, Quality & Reliability	4
	IE 5441	Engineering Cost Accounting, Analysis and Control	4
	IE 5541	Project Management	4
Math/Statistics	Math 4242	Applied Linear Algebra	4
	Math 4512	Differential Equations with Applications	3
	Math 4428	Mathematical Modeling	4
	Math 4457	Methods of Applied Mathematics I	4
	Math 4458	Methods of Applied Mathematics II	4
	Stat 3011*	Introduction to Statistical Analysis	4
	Stat 3012*	Introduction to Probability and Statistics	3
	Stat 3022	Data Analysis	4
Polymers	Chem 2302	Organic Chemistry II	3
	MatS 4223W	Polymer Lab	2
Physics	Phys 4001	Analytical Mechanics	4
	Phys 4002	Electricity and Magnetism	4
	Phys 5701	Solid State Phys. for Engineers & Scientists	4

*\*students may not take both Stat 3011 and Stat 3012*

### **Academic Performance Expectations**

Students must meet the University requirements for maintaining academic performance. A student is placed on probation if his/her cumulative or term GPA drops below a 2.0. CSE notifies all students who are placed on probation and instructs them to see an advisor immediately. Any upper division MSE student who is placed on probation must see the MSE Director of Undergraduate Studies immediately to discuss probation and how to improve performance. A probation contract must be completed for the current term.

## V. SCHEDULING YOUR DEGREE PROGRAM

Sample schedules for a student who starts his or her higher education on the Twin Cities Campus and are provided at the following location:

[http://cse.umn.edu/services/advising/CSE\\_CONTENT\\_188609.php](http://cse.umn.edu/services/advising/CSE_CONTENT_188609.php)

A generic version is also shown at the end of this brochure, in the appendix, along with a “course map”. If you follow this schedule, you will be able to obtain your B.Mat.S.E. degree in four years. Note that this is a sample course schedule, and that your own situation may lead you to depart from it, particularly in scheduling your Liberal Education and Technical Electives. New students and new transfer students are required to register for at least 13 credits each semester. This rule is designed to encourage students to complete their degrees in a timely fashion.

In planning your degree program, you should remember that many courses, especially the core required courses in MSE, are offered only once a year and have prerequisites that you must satisfy. Department and University policy prohibits taking two courses offered with overlapping class hours.

## VI. ADVISING APPOINTMENTS AND THE “GRADUATION PLANNER”

All lower division (pre-major) students have CSE academic advisors (<http://cse.umn.edu/services/advising>). Upon entry into the MSE major each student is assigned an MSE advisor. These assignments are based on the first letter of your last name:

<b>First letter of your Family Name</b>	<b>Advisor</b>	<b>Email address</b>
A, B, C, D	D. C. Morse	morse012@umn.edu
E, F, G	R. J. Holmes	rholmes@umn.edu
H, I, J, K	C. W. Macosko	macosko@umn.edu
L, M, N	C. D. Frisbie	frisbie@umn.edu
O, P, Q, R	L. F. Francis	lfrancis@umn.edu
S, T, U, V, W, X, Y, Z	C. Leighton	leighton@umn.edu

You may always consult with the MSE Director of Undergraduate Studies as an alternate. Lower division students in general receive advising through the IT Lower Division Programs Office in 128 Lind Hall. However, lower division students are still welcome to consult with their departmental advisor. To make an appointment with your advisor, you should stop by his or her office or send email. If you have difficulty contacting your advisor, you may consult the MSE Director of Undergraduate Studies. Those pursuing a double major or

seeking approval for course substitutions should see the MSE Director of Undergraduate Studies.

New juniors should see their faculty advisor in the Fall to discuss plans for selection of classes. For these, and all other advising appointments, the University has developed an online tool to help students plan their course selections as they move on the path to a degree. This Graduation Planner can be found at the OneStop website (<http://onestop.umn.edu/>). **Use of the Graduation Planner is now mandatory for all MSE students, and a print out of your Graduation Plan should be brought to advising meetings.** To ensure that you see your MSE undergraduate advisor at least once a year an “**advising hold**” will be placed that is lifted simply by meeting with your advisor, bringing along your graduation plan. Once your plan is approved you will be able to register for the next semester classes.

## VII. GRADUATION

You should review your Academic Progress Audit System (APAS) report at least two semesters before you plan to graduate. A copy of your APAS is available from the Registrar in 200 Fraser Hall and on line (<http://onestop.umn.edu/>, click on the APAS link). The APAS shows courses you must complete successfully in order to obtain your B.Mat.S.E degree, and it reflects all the requirements stated above. One semester before your intended graduation date, review your APAS to be sure that all requirements are satisfied. If you have questions, see the MSE Director of Undergraduate Studies. Recall that to graduate, you must complete the courses listed on the APAS, accumulate 128 semester credits, and maintain a grade point average of at least 2.0.

Complete and submit an Application for Degree Form by the deadlines listed on the web under the academics section of the student one stop (typically mid-September for December graduation and late January for May graduation). There is no fee associated with this form. Copies of the form are available on the web <http://www.onestop.umn.edu/onestop/graduating.html>. The completed form must be submitted to 150 Williamson Hall.

## VIII. SENIOR DESIGN THESIS OPTION

Students interested in carrying out a more intensive, typically laboratory-based, senior project should consider doing a 2-semester senior design thesis (MatS 4401 and MatS 4402). This 2-semester experience is an alternative to MatS 4400 – Senior Design Project, which is offered in the Spring semester. To qualify for the thesis option, students must have

a GPA of 3.0 or higher and arrange the project with a faculty advisor. The best way to go about finding an advisor and project is to identify CEMS faculty carrying out research interesting to you. Check the web site (<http://www.cems.umn.edu/resrch/areas/>). Any faculty member in CEMS can advise a senior design thesis. You will note that the 2-semester option carries 4 credits while the one semester senior design project is 3 cr. Students choosing the thesis option will have the number of required technical electives dropped from 13 to 12 cr. The culmination of the 2-semester is a written thesis that will qualify as an honors thesis. If you have any questions, please ask the MSE Director of Undergraduate Studies.

## IX. HONORS DEGREES

You may earn the B.Mat.S.E. degree with one of the Latin honors designations *cum laude*, *magna cum laude*, or *summa cum laude*, if the requirements are satisfied and proper applications submitted. Questions about the honors program should be directed to the current CEMS Honors Program Director, Professor Prodromos Daoutidis (daout001@umn.edu). In order to obtain a Latin Honors degree, a student must apply for admission to UHP (Undergraduate Honors Program) before they enter into their last 4 semesters of study. UHP program admission procedure and requirements are found at: <http://honors.umn.edu/admission/index.html>. Requirements for the Latin degrees are found at <http://honors.umn.edu/academics/graduation.html>

If you do not participate in the honors program, you will still automatically receive your bachelor's degree with the designations *with distinction* or *with high distinction* if your overall grade point average is in the ranges 3.50–3.79 and 3.80–4.00, respectively.

Participation in UHP is not required for students to carry out research in the department (see below).

## X. CO-OP AND INTERNSHIP PROGRAMS

The co-operative education (Co-Op) experience involves two assignments at a company, integrated with coursework. An internship is a shorter industrial project. Both programs give students valuable experience. In some cases, academic credit can also be earned. See Prof. D. A. Shores, the Faculty Internship/Co-op Coordinator (108 Amundson Hall, [dshores@umn.edu](mailto:dshores@umn.edu)) for more information.

## XI. RESEARCH EXPERIENCE

Many opportunities exist on campus, and in the CEMS department, for students to participate in a research project. Participating in a research project is a very good way to learn what research is all about. For those interested in graduate school, undergraduate research is the best way to sample graduate student life and become better acquainted with a professor. One can either receive credits by registering for independent study or directed research (MatS 4591 or MatS 4594) or receive monetary compensation for research. For MatS 4591 or MatS 4594, the student must first receive the consent of the supervising faculty member. Upon completion of the project, a short summary (no more than two pages) of the project must be submitted to the MSE Director of Undergraduate Studies, in addition to a full report submitted to the supervising faculty member.

The research section of the CEMS department website (<http://www.cems.umn.edu/resrch/areas/>) can be used to learn about the professors' research. Paid positions are generally available in the department; some professors post announcements of these opportunities near room 132.

Other opportunities are:

**UROP:** Awards of stipend and research expenses are available from the Education Development Office under the Undergraduate Research Opportunities Program (UROP). See <http://www.urop.umn.edu> for more information

**Work Study:** If you qualify for work-study, be sure to tell the professors you are interested in working with. They need to use research funds for a portion of the stipend on work-study jobs.

## XII. SCHOLARSHIPS

In the Spring Semester or shortly thereafter, some scholarships are awarded by the department, and others are awarded by CSE. These are TWO SEPARATE SCHOLARSHIP PROGRAMS. You may apply to BOTH. At the beginning of the Spring Semester, obtain the application forms for department scholarships from Laura Ericksen (151bb Amundson Hall), and for the CSE scholarships in 105 Lind. Note that students who we believe meet the selection criteria will likely receive direct emails bringing these scholarships to their attention.

## XIII. STUDY ABROAD

Students interested in exploring foreign cultures may be able to arrange up to one year of study in a materials science and engineering department in a foreign country. Studying

abroad is a great opportunity for one to cultivate a global view of technological and economical development and to appreciate a different culture. Many courses taken in a university abroad can be transferred for credits. However, it is likely that foreign study will delay graduation beyond the normal four-year period. Students should view such an experience as a personal enrichment, but not merely a partial substitution of regular education in this department. Students interested in studying abroad are urged (i) to consult with their Director of Undergraduate Studies as early as your freshmen year regarding planning for academic coursework, (ii) to arrange foreign language courses if necessary, and (iii) to assess financial cost and possible assistance from various sources. Information on study abroad programs at the University of Minnesota can be found at the Learning Abroad Center, 230 Heller Hall (<http://www.umabroad.umn.edu>; [http://www.it.umn.edu/students/learning\\_abroad.html](http://www.it.umn.edu/students/learning_abroad.html)).

#### XIV. JOBS

Many students hold a part time job while pursuing their B.Mat.S.E. degree. Some jobs provide technical experience as well as financial benefits. For example, you can be employed as an undergraduate research assistant in a university laboratory or a technical aid or intern at a company. While such jobs are beneficial, students should be aware of the hazards of overwork, especially during upper division years. Even without part-time work, many students find themselves having to adjust their study habits after entering upper division. Students must put education as the first priority. Working more than 10 hours a week during the semester is not advised for those who plan to finish the B.Mat.S.E. degree in four years.

#### XV. CONDUCT AND DISCIPLINE

The following CSE website provides detailed information on expectations for conduct:

[http://cse.umn.edu/services/advising/CSE\\_CONTENT\\_188716.php](http://cse.umn.edu/services/advising/CSE_CONTENT_188716.php)

Acts of scholastic dishonesty are considered **serious offenses** that may result in expulsion. IT defines scholastic dishonesty as:

- submission of false records of academic achievement
- cheating on assignments or examinations; plagiarizing
- altering, forging, or misusing a University academic record
- taking, acquiring, or using test materials without faculty permission
- acting alone or in cooperation with another to falsify records or to obtain dishonest

grades, honors, awards, or professional endorsement.

All students in the Department of Chemical Engineering and Material Science are expected to abide by the highest professional ethical standards. In the unfortunate event that dishonest conduct occurs, the department will pursue actions diligently according to the procedures outlined by the Office of Student Conduct and Academic Integrity (<http://www1.umn.edu/oscai/>).

## **XVI. CEMS FACILITIES AND MSE STUDENT ORGANIZATIONS**

### **Undergraduate Study Room**

The departmental Undergraduate Study Room is Amundson 132. The room is accessed by a key code, which changes each semester. The key code is communicated to CEMS upper division students by email.

### **Computer Facilities**

The Department of Chemical Engineering and Materials Science has an Undergraduate Study Room in Amundson 132. There are computers for your use in 132A and 132C inside room 132. Upper division CEMS students can have accounts on the CEMS computer system. For more information, contact the CEMS systems administrator by email ([uglab@cems.umn.edu](mailto:uglab@cems.umn.edu)) or in person (185 Amundson Hall).

### **MSE Student Organizations**

There are two student organizations in the department: Material Advantage (<http://materialadvantage.org/>) and the student chapter of the Materials Research Society (MRS). Students should watch for postings, emails, and class announcements about meetings and activities. Students are also invited to meetings of the Minnesota Chapter of ASM International. Involvement in these activities will increase your awareness of opportunities in your profession, give you a chance to meet materials scientists and engineers working in industry, and give you leadership experience.

## **XVII. OTHER FACILITIES AND ORGANIZATIONS**

### **CSE Computer Facilities**

For a full description of available CSE facilities and support see: (<http://cse.umn.edu/services/academicssupport/index.php>)

## **Counseling**

University Counseling and Consulting Services in Eddy Hall offers a wide variety of services and provides help on problems of study skills, career decisions, communication skills, anxiety, stress, time management, etc. Drop by 109 Eddy Hall, call 624-3323 or visit:

<http://cse.umn.edu/services/academicsupport/index.php>

## **Libraries**

Visit <http://www.lib.umn.edu> directly, or go to:

<http://cse.umn.edu/services/academicsupport/index.php>

## **Career Center**

The Career Center for Science and Engineering is in Room 50, Lind Hall (<http://www.ccse.umn.edu/>). Every year, particularly in the Fall Semester, companies seeking to hire scientists and engineers set up interview schedules through this office. Interviews are set up for summer internships, co-ops, and permanent positions. You can also drop by to browse through the Career Center's collection of company brochures.

## **Student Organizations**

There are student organizations for virtually every kind of activity — sports, hobbies, politics, religion, arts, student government, professions, music, travel, ethnic culture, etc. Engineering student groups include the IT Student Board (624-4366), the IT Board of Publications (624-9816), which publishes Minnesota Technolog and IT Connection, Tau Beta Pi (626-0209), Plumb Bob (626-1552), the Society of Women Engineers (626-0093) and National Society of Black Engineers (626-7501), as well as many others. Go to [http://www.it.umn.edu/students/campuslife/student\\_orgs.html](http://www.it.umn.edu/students/campuslife/student_orgs.html) for a complete list. Most of these organizations have offices in Lind Hall.

## **Tutoring**

The IT Undergraduate Academic Center in 150 Lind provides free one-on-one tutoring by experienced students for help with Math, Physics, and Chemistry problems. Similar tutoring is available in dormitories. Call 624-2890 or visit:

<http://cse.umn.edu/services/academicsupport/index.php>

## **XVIII. REQUIREMENTS FOR DOUBLE MAJORS AND MINORS**

If you wish to earn a second major (e.g., ChEn, BME), or a minor, follow the directions in the CSE Student Survival Guide (available in 128 Lind). The Director of Undergraduate Studies in MSE has sample plans and course lists for the common double majors –

ChEn/MSE, BME/MSE and PHYS/MSE. Individual advising is necessary to plan these degree programs. Please be aware that engineering degrees cannot be chosen as minors.

## MSE Four Year Plan

### Materials Science & Engineering

Rev. Date:  
1/3/12

#### Freshman Year

Fall Semester	Spring Semester
Chem 1061/65 Chem Prin I <i>(placement into course or 1015)</i> 4	Chem 1062/66 Chem Prin II <i>(C- or better in 1061/62)</i> 4
Math 1371 Calc I <i>(placement into course or pre-req)</i> 4	Math 1372 (or 1272) Calc II <i>(C- or better in 1371)</i> 4
ChEn/MatS 1001 <i>(optional)</i> 1	Phys 1302W Intro Phys II <i>(1301, &amp;Math 1372)</i> 4
Phys 1301W Intro Phys I <i>(&amp;Math 1371)</i> 4	Lib Ed* 4
Lib Ed* 4	

\*Take Writ 1301 or 1401 in freshman year

#### Sophomore Year

Fall Semester	Spring Semester
Chem 2301 Org Chem I <i>(C- or better in 1022)</i> 3	AEM 2011 Statics <i>(Phys 1301, &amp;Math 2374)</i> 3
CE 3101 Computer Appl I <i>(CE, GeoE student, Math 1372)</i> 3	Phys 2303 Phys III :Matter <i>(Phys 1302, Math 1272)</i> 4
Math 2374 Multivar Calc. <i>(C- or better in 1372)</i> 4	<b>OR</b> Chem 4502 Quantum Chem <i>(Phys 1302, &amp;Math 2374)</i> 3
MatS 3011 Intro MatSci <i>(Chem 1061/62, Math 1372, Phys 1302)</i> 3	Math 2373 Lin Alg/Diff Eq <i>(C- or better in 1372)</i> 4
Lib Ed 3/4	Lib Ed 3/4

#### Junior Year

Fall Semester	Spring Semester
MatS 4013 Electrical Mtls <i>(UD, Chem 3502 or Phys 2303)</i> 3	MatS 3851W Mtls Prop. Lab <i>(3801, 4013)</i> 3
MatS 3012 Metals and Alloys <i>(UD, 3011)</i> 3	MatS 4002 Mass Tns & Kinet. <i>(4001, CE 3101, Math 2373)</i> 4
MatS 3801 Struct Char Lab <i>(UD, 3011)</i> 3	MatS 4214 Polymers <i>(UD, 3011, 4001 or ChEn 4101/3101)</i> 3
MatS 4001 Thermodynamics <i>(UD)</i> 4	AEM 3031 Deform. Body Mech. <i>(2011, Math 2374, &amp;Math 2373)</i> 3
Lib Ed 3/4	Tech Elective I 3

#### Senior Year

Fall Semester	Spring Semester
MatS 4212 Ceramics <i>(UD, 3011, 4001 or ChEn 4101/3101)</i> 3	AEM 4511 Composite Matr. <i>(ITUD or grad stdt, 3031)</i> 3
MatS 4221 Mat. Performance <i>(3012)</i> 4	MatS 4301W Mat. Processing <i>(4212, 4214)</i> 4
Tech Elective II 3	MatS 4400 Sr Design Proj. <i>(MatS Sr)</i> 3
Tech Elective III 4	Tech Elective IV 3
Lib Ed 3/4	

#### About This Plan

- This plan is not a contract. Curriculum can change.
- Shaded courses are only offered in the indicated semester.
- Course pre-requisites and co-requisites (designated by &; can be taken concurrently) are listed below the course number and title.
- Students can take either the IT or non-IT version of the math course (Math 1371/1271, 1372/1272, 2373/2243, 2374/2263).

#### Required for Admission into Major

Admission into the major is competitive and based on specific courses and technical GPA.

**Total Credits Needed for Degree: 123/124**

#### Department Contact Information

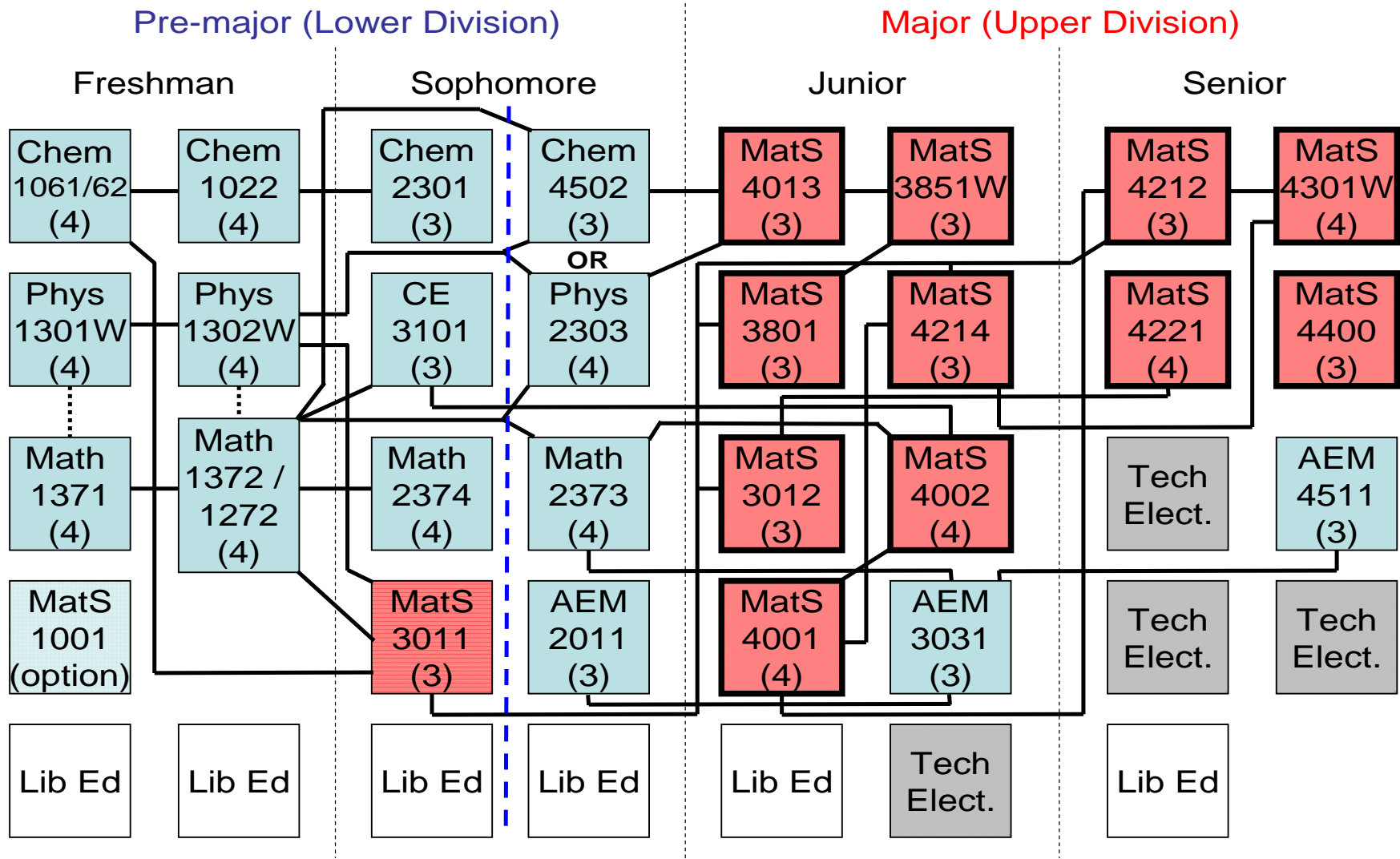
- Website: [www.cems.umn.edu](http://www.cems.umn.edu)
- Main Phone: 612-625-1313
- Main Office: 151 A mundson Hall
- Director of Undergraduate Studies: Professor Chris Leighton
- Departmental Advisor: Laura Ericksen, erick073@umn.edu

#### Liberal Education Information

All students must complete the following lib ed requirements:

WRITING:	CORES:	THEMES:
<ul style="list-style-type: none"> <li>• Freshman Writing (Writ 1301, 1401 or equivalent)</li> <li>• 4 WI courses (2 must be 3/4/5xxx level, 1 of those must be in major); WI courses are designated by a W after the course number</li> </ul>	Bio/L Phys/L HP SSci Lit AH Math	CLE DSJ Env't GP TS  (4 of 5 req'd)

### MSE Four Year "Map"



Red boxes: Major classes. Bold boxes: requires UD. Solid lines: Pre-reqs.