UNDERGRADUATE STUDIES IN MATERIALS SCIENCE AND ENGINEERING

STUDENT HANDBOOK

Department of Materials Science and Engineering
The Pennsylvania State University
124 Steidle Building
University Park, PA

Fall 2003

Accessible on the web at: www.matse.psu.edu

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Introduction

The roots of the Department of Materials Science and Engineering at Penn State date back nearly 100 years to the formation of academic programs in metallurgy and ceramic technology. With the addition of academic programs in polymer science in the 1970's and electronic and photonic materials in the 1990's, the Department of Materials Science and Engineering enjoys a rich history, and a lasting legacy of a myriad of scientists and engineers to the materials science-related disciplines. Complementary undergraduate and graduate studies programs, combined with a wide array of focused research centers at the University, contribute to the Department being widely regarded as one of the finest and best-balanced materials departments in the United States.

2.0 Mission of the Department of Materials Science & Engineering

The mission of the Department of Materials Science and Engineering is to provide our students with a well-rounded engineering education with specific emphasis on materials science and engineering in order to meet the needs of industry, academia, and government; to conduct research at the frontiers of the field; and to provide an integrating and leadership role to the broad multi-disciplinary materials community.

3.0 Undergraduate Studies Office

The undergraduate office is located at 124 Steidle Building and is open from 7:30 am to 4:30 pm, Monday through Friday.

Administration of the undergraduate studies is coordinated by the Associate Head for Undergraduate Studies (Dr. John R. Hellmann; 124A Steidle Building (phone: 814-865-0163, fax: 814-865-0016, email: hellmann@matse.psu.edu)

The office coordinates all undergraduate course offerings, class scheduling, drop/add, documenting course requirements, recruiting, scholarships, etc. Assistance in all matters pertaining to undergraduate studies can be initiated through visiting the undergraduate studies office and speaking with Stacy Davidson (814-865-5765; sjp123@psu.edu).

Academic advisors are appointed at the start of each academic year, and stay with the student through matriculation. Appendix A (p. 15) lists the advisors by class standing for each option, as well as for students on the Honors track.

4.0 Organization

The Department is organized into two academic tracks: Undergraduate Studies and Graduate Studies. The Undergraduate Studies track offers a four year curriculum culminating in a Bachelor of Science degree in Materials Science and Engineering, with options in four sub-disciplines: Ceramic Science and Engineering, Electronic and

Photonic Materials, Metals Science and Engineering, and Polymer Science and Engineering. The Ceramics, Metals, and Electronic and Photonic Materials study tracks are fully accredited by the Accreditation Board for Engineering and Technology (ABET) of the Engineering Accreditation Commission; the Polymer Science and Engineering study track sought its inaugural accreditation in the fall semester, 2002 and is currently awaiting the final determination from ABET.

4.1 Ceramic Science and Engineering (CerSE)

The Ceramic Science and Engineering option culminates with a Bachelor of Science degree in Materials Science and Engineering. The degree requires a thesis based on original research or design.

The undergraduate option covers the processing, characterization manufacture and usage of a wide variety of inorganic materials. The curriculum prepares students for operating, research, and development positions in all sectors of the materials industry where ceramics are used. Graduates also find employment in many industries, such as electronic and communications, energy generation, automotive, aeronautical and aerospace. The option is fully accredited by the Accreditation Board for Engineering and Technology (ABET).

4.2 Electronic and Photonic Materials (EPM)

The Electronic and Photonic Materials option offers the Bachelors of Science Degree in Materials Science and Engineering. It also requires a thesis based on original research or design.

The option covers the processing, properties and performance of semiconductor, optoelectronic, and optical materials and devices. These are the materials which form the functional basis of computers, semiconductors, lasers, telecommunication systems, copying machines, faxes, compact disc players, video cameras, and the multitude of other electronic and optical devices that characterize the age in which we live. Graduates find employment in the electronics, telecommunications and computer industries. The option is fully accredited by the Accreditation Board for Engineering and Technology (ABET).

4.3 Metals Science and Engineering (MetSE)

The Metals Science and Engineering option offers the Bachelor and Masters of Science and Doctor of Philosophy Degree in Materials Science and Engineering, each of which require a thesis based on original research or design.

The option provides an opportunity to explore a broad range of both scientific and engineering principles as applied to metals and alloys, their extraction, their production and their use. A graduate of this option will thus typically apply basic concepts of chemistry, physics mathematics and engineering science to problems concerning the processing and/or the properties of metals. Graduates find employment in a wide

spectrum of positions such as technical sales, research, operations or management. An increasingly large fraction of our graduates are finding employment in a diverse group of industries which use metals, such as those in the electronic or aerospace fields. This option is fully accredited by the Accreditation Board for Engineering and Technology (ABET).

4.4 Polymer Science and Engineering (PlmSE)

The Polymer Science and Engineering offer Bachelor and Masters of Science and Doctor of Philosophy degree in Materials Science and Engineering, each of which require a thesis based on original research or design.

The option provides instruction in the basic concepts in chemistry, physics, mathematics and engineering science and how to apply these concepts to the problems involved in the synthesis, structure, properties and processing of polymers. There exists a strong and steady demand for polymer scientists for fundamental research, as well as in applied science and technology, such as in the application of processing methods to manufacturing products comprised of polymer and composites containing them.

This option sought its inaugural accreditation by ABET in Fall 2002 and is currently awaiting final determination from ABET.

5.0 Faculty

The undergraduate students in all options are taught by a dedicated faculty who are nationally and internationally known for their research, publications and activities in government committees and commissions, and in professional organizations, where many hold high office. Furthermore, the Materials Science and Engineering faculty have strong intercollege and interdepartment associations throughout the University. The faculty maintain an awareness of the needs and problems of industry through industrial research grants and consultation with industry and government. Students have daily contact and dialogue with these faculty members who teach them in small classes and laboratories. The undergraduate program is strengthened by its association with this vigorous research enterprise, combined with an excellent graduate program. These feature contribute significantly to maintaining relevance and timeliness in the curriculum, as well as in providing outstanding opportunities for independent study required in the senior thesis project.

A dedicated writing instructor (Dr. Joe Schall, room 248D Deike) has also been provided by the EMS College to assist students in technical writing and a full time tutor (Dr. John Lee, 248C Deike) is available for mathematics.

The Materials Science and Engineering faculty is listed in Appendix B (P.16) of this handbook. Further information on each faculty member's research interests can be found on their websites at http://www.matse.psu.edu/ .

6.0 Facilities

The Department is well endowed with equipment dedicated to undergraduate instruction. A state-of-the-art computer laboratory, equipped with over thirty PC and MacIntosh platforms, color laser printers, scanners, and a wide range of site-licensed software is available 24 hours a day, seven days a week for all undergraduates in the Department. In addition, our classrooms are equipped with computer projection equipment to facilitate the use of computer technology in instruction. The Department provides a Student Commons Room in which students may congregate to socialize, work collaboratively on assignments, and keep up to date on job opportunities, Department announcements, and professional development opportunities.

The Department offers several newly renovated and equipped laboratories, with full time technical staff support, in which all undergraduate laboratory instruction takes place. The Department is well endowed with state-of-the-art research equipment for the processing and characterization of ceramics, metals, polymers, and composites comprised thereof; undergraduates frequently use this equipment in laboratory instruction as well as in the performance of their senior thesis research. In addition, due to the faculty's extensive interaction with materials research centers campus-wide, our students enjoy access to a broad array of world-class analytical and characterization facilities than would be possible without such a vigorous research enterprise.

7.0 Degree Requirements

7.1 Educational Objectives of the Materials Science and Engineering Program

The general objective of the Materials Science and Engineering undergraduate program is embedded in our mission statement – to provide our students with a well-rounded engineering education with specific emphasis on materials science and engineering that will meet the needs of industry, academia, and government. Specific program objectives have been established to attain this general objective:

a. To produce graduates with the ability to apply the fundamentals of mathematics and the physical sciences.
b. To produce graduates who have a general knowledge of all classes of engineering materials, but specific expertise in one of the sub-disciplines: ceramics, electronic and photonic materials, metals, polymers.
c. To produce graduates who have a first hand knowledge of the inter-relationships between processing, structure, properties, and the performance of materials.
d. To produce graduates who have the ability to define problems, including design problems, develop and evaluate economically feasible solutions from diverse knowledge bases, and implement an acceptable solution.

e. To produce graduates who have the ability to function effectively in cross-functional teams, both within the materials discipline and in multidisciplinary teams.
f. To produce graduates who are adept at using the modern tools of materials science and engineering, including instrumentation for characterizing the structure and properties of materials and computational hardware and software for analysis, design, and communication.
g. To produce graduates who understand the global/societal context of engineering problems, understand their responsibility to their profession and society and the ethics associated with it, and understand the value of lifelong learning.

7.2 Educational Outcomes

The undergraduate curricula in Materials Science and Engineering are organized such that upon graduation, our students shall possess the following skills, which will enable them to perform successfully as practitioners of materials science and engineering. Specifically, the curriculum is established such that:

(a) Graduates will be able to apply knowledge of mathematics and advanced science and engineering principles to materials systems.

(b) Graduates will be able to design and conduct experiments and to analyze and interpret data.

(c) Graduates will be able to design a process, a microstructure, or a component to satisfy system needs.

(d) Graduates will be able to function on multi-disciplinary teams.

(e) Graduates will be able to identify, formulate, and solve engineering problems.

(f) Graduates will understand professional and ethical responsibility.

(g) Graduates will be able to communicate effectively, both in writing and in speech.

(h) Graduates will possess the broad education necessary to understand the impact of engineering solutions in a global and societal context.

(i) Graduates will recognize the need for, and be able to engage in, lifelong learning.

(j) Graduates will have a knowledge of contemporary issues.

(k) Graduates will be able to use the experimental, analytical, statistical, and computational tools for engineering practice in the materials discipline.

(l) Graduates will be able to apply the fundamental principles underlying and connecting the structure, processing, properties, and performance of materials systems.

The educational objectives and outcomes are reviewed annually by the faculty and adjustments are made where necessary to keep the curriculum fresh and timely.

7.3 Academic Requirements

General education academic requirements in all options are specified by the University for all Bachelor Degree programs, these are augmented by additional requirements by the College of Earth and Mineral Sciences and the individual study options within the Department, subject to approval by the Faculty Senate. A list of the undergraduate courses required to satisfy the requirements for each of the options is included in Appendix C: Undergraduate Curriculum in Materials Science and Engineering (p.20). The two main concerns for the undergraduate student are the grade point requirements and the course requirements.

7.3.1 Grade Point Requirements

In order to receive a Bachelor of Science degree in any of the options in Materials Science and Engineering, the student must finish with a grade point average (GPA) of at least 2.0. In addition, however, the University Senate has mandated that **students must have a 2.0 or better in courses designated in the University Bulletin as "Requirements for the Major"**. You can also obtain a list from 124 Steidle Building. *Therefore, even if the student has an overall GPA greater than the 2.0, if his/her "major" GPA is less than 2.0, then he/she will not receive a B.S. in Materials Science and Engineering.*

In addition, the University requires that students must receive at least a grade of C in a minimum of 15 credits designated by the major (i.e., you must receive a C in each course). For Polymer Science and Engineering (MatSE 201, 436, 441, 443, 473, and 494W); Ceramics Science and Engineering (MatSE 201, 400, 401, 402 and 430); Electronic and Photonic Materials (MatSE 400, 201, 401, 402, and 430); Metals (MatSE 201, 430, 401, 402, and 423).

7.3.2 General Course Requirements

The University Faculty Senate requires 18 credits of ***General Education*** courses comprised of six credits of Arts, six credits of Humanities and six credits of Social and Behavioral Sciences ***(SHA Electives).*** A student who has developed interests and competencies in any of the three distribution areas may, in consultation with an adviser and with the approval of the EMS Associate Dean for Resident Instruction, substitute 200 to 499-level courses for those on the list of depth courses (see Appendix D, p.31.) Note further that, with the approval of your advisor and the EMS Associate Dean for Resident Instruction, nine credits may be taken in one of the three categories reducing the required credits to three in one of the other categories. To be acceptable to the EMS College, the

third course in this 9 credit sequence must be a suitably advanced course with a course number designation of 300 or 400.

The University also has a ***Diversity Requirement*** to increase awareness of the richness and variety of backgrounds which students, faculty and staff bring to our academic community. To fulfill this requirement a student must take 3 credits of Diversity Focused (DF) courses. The DF courses also fulfill the General Education requirements, thus one course may satisfy both an SHA and a Diversity requirement.

The University also requires all students that have at least 3 credits of **'Writing Intensive'** course work (See requirements for specific options). The University **Health and Physical Activities Requirement** is satisfied by completing 3 credits of GHA-designated course work.

7.3.3 Prescribed, Supporting and Additional Courses

The prescribed, supporting and additional courses for the each of the options in the MatSE major constitute the discipline-specific coursework. The prescribed and additional courses are specified by each option's curriculum, but additional courses can be selected from an approved list of technical electives. The Accreditation Board for Engineering and Technology (ABET) requires that each engineering option has a strong emphasis on design in the prescribed and additional courses.

7.3.4 Technical Electives

A minimum of six credits of technical electives are required in each option's curriculum. Technical electives are courses which should be carefully selected, in conjunction with the student's advisor, to add depth beyond the basic MatSE curriculum.

The Accreditation Board for Engineering and Technology (ABET) favors a flexible approach to curricular content, but expects coverage in: 1.) Mathematical and Basic Sciences, 2.) Engineering Science and Design, and 3.) Humanities and Social Sciences contributing to a student's appreciation of the economic, environmental, manufacturability and sustainability, ethical, safety and health, social and political constraints on engineering. **At least 37.5% of the coursework credits to satisfy the degree for a given option must be engineering courses (i.e. contain Engineering in the course title).** This requirement and the following guidelines should be applied by the student in the selection of their technical electives, in consultation with their advisor:

1) Depth in Engineering Sciences and Design

   These are courses that enhance a student's depth in a particular area of materials engineering. Naturally, all MatSE courses not already prescribed by a particular option's curriculum are acceptable electives for each MatSE option. In addition, up

to three credits of Cooperative Education work experience (ENGR x95 or SC x95,) in increments of one credit per semester of COOP, may be used as technical electives.

Many other courses outside of the department are also acceptable technical electives. Appendix E lists some courses which the MatSE faculty have suggested for satisfying technical electives in a variety of materials related specializations (e.g. electronic materials, processing science, structural materials, biomaterials, computer science and engineering, etc.)

2) Depth in Humanities and Social Sciences

These are courses that do not fall necessarily under the General Education requirements of the University but will allow engineers to be more aware of their social responsibilities. These fall into two categories.

a) Foreign Language.

In a global economy, there is a strong need to communicate, understand and interact with people of other cultures. For students choosing this approach, all six (6) elective credits must be advanced level courses in a language other than the student's native tongue.

b) Technology-Related Courses.

These are courses that consider the relationship between the engineering profession and other human affairs. This could include courses on professional ethics, occupational health and safety, social responsibility, product safety and design, etc. Of particular interest are courses that consider realistic, non-technical constraints on the engineering design process; e.g., economic factors, safety, reliability, aesthetics, ethics and social impact. Careful consultation with the student's advisor is recommended in selection of appropriate courses to satisfy this approach.

3) Military Training

Students may use up to six (6) credits of upper division ROTC courses (Air, Army, NAVSC) which must contain a substantial leadership or management component, to satisfy the technical elective requirement.

In summary, there are many ways to satisfy the technical elective requirement in each curriculum. Other courses than those listed here may be used with the approval of the student's advisor and the Associate Head for Undergraduate Studies.

7.3.5 Honors Courses

Most 400-level courses can be taken with an H-option (honors option). The H-option requires that the course coverage contain advanced information/knowledge, additional in-

depth material and an integration with other courses in a general topic area. More information regarding the Honors track can be found in Appendix F (p.37). Students interested in taking an honors course should consult the honors advisor for their option.

7.3.6 Senior Thesis

ABET accreditation requires that the curriculum contain a senior capstone project. Each senior in Materials Science and Engineering is required to complete a research project, which is then documented in the form of a thesis. The senior thesis involves selection of a research topic offered by a faculty member at the beginning of the fall semester. The planning and design of the research program is initiated in the fall semester and performed over 1 1/2 semesters of the senior year. To perform the research, the student must do a literature review, outline a research plan and, in most cases, process and fabricate samples, followed by the measurement of properties relevant to the thesis objective.

The senior thesis requires the student to integrate knowledge learned in their undergraduate option courses. An important component of this integration of knowledge is a demonstration that the student has considered the following engineering standards and realistic constraints:

- economic issues
- environmental impact or relevancy of the research
- sustainability of the knowledge derived from the research
- issues regarding manufacturability of materials or devices from the research
- ethical issues governing the performance of the research or implementation of the results
- health and safety issues related to the research
- social and/or political implications of the research

The literature review incorporated into the thesis must address most, if not all, of these issues.

The thesis is a high quality, bound publication that is collected in the Earth and Minerals Science Library (105 Deike). The format for the thesis should follow the guidelines set forth in Appendix G. It is critical that students formulate a set of program milestones for the thesis, in conjunction with their adviser. A draft of the thesis is due to the thesis adviser by April 1 and the final version, signed by the adviser, to the Undergraduate Office by the last day of classes. For graduating seniors, failure to meet this last deadline will lead to removal from the graduation list. In addition, the department hosts an undergraduate poster competition in the Spring Semester, at which time all seniors are required to present their research in poster format.

7.3.7 Cooperative Education Curricula

Cooperative (COOP) education is an option for a student who wishes to gain professional experience prior to graduation. Coop students participate in three semesters of work assignments in industry, for which they earn academic credit as well as being paid. In general, the Cooperative Education process will require one additional academic semester for graduation, but the student will have one full year of industrial experience by graduation. This has proven to be a significant advantage to students when seeking full-time employment.

Students are eligible for the Coop program starting in their fifth semester. Careful coordination of the student's academic scheduling with Coop assignments is highly advised to ensure timely graduation. The program is coordinated through the College of Engineering (Cooperative Education office is in 205 Hammond Building.) Students are highly recommended to consult with their academic advisor prior to planning a Cooperative Education track. Sample curricula for Cooperative Education are given in Appendix H (48).

8.0 Academic Integrity

The Faculty of the *Materials Science and Engineering Department* believes strongly in the importance of academic and professional integrity. Section 49-20 of *Policies and Rules: A Handbook For Students* states:

Definition and expectations: Academic integrity is the pursuit of scholarly activity in an open, honest and responsible manner. Academic integrity is a basic guiding principle for all academic activity at The Pennsylvania State University, and all members of the University community are expected to act in accordance with this principle. Consistent with this expectation, the University's Code of Conduct states that all students should act with personal integrity, respect other students' dignity, rights and property, and help create and maintain an environment in which all can succeed through the fruits of their efforts.

Any form of academic dishonesty is a very serious matter, and it will not be tolerated. The policy handbook states that evidence of academic dishonesty will be dealt with by notification of the student and, at the prerogative of the course instructor, (a) a zero on the entire assignment will be given; (b) the student will be invited to a special oral exam, the result of which will determine the student's grade; (c) the student will be given a course grade of F and will be referred to the Committee on Academic Integrity; (c) the student will be given a course grade of F and will be referred to the Office of Conduct Standards.

Among the penalties that have been agreed upon by the various options faculty are the following:

- *Any evidence of plagiarism will result in a zero for the entire assignment.*
- *Any evidence of cheating on examinations will result in a zero grade for that test. No material pertinent to the course may be written on any article of clothing,*

portion of the body, or other material brought into the exam unless explicitly permitted by the faculty member. A violation of this policy will be considered cheating regardless of whether of not the material is visibly referred to during the test. Similarly, talking during the exam or looking at another student's paper will result in the same penalty.

Other types of academic dishonesty will be dealt with in a similar fashion, within the guidelines established by the Faculty Senate, and documented on the Senate website at http://www.psu.edu/ufs/policies/

9.0 Safety Examination

Prior to participation in the junior and senior laboratories, students are required to obtain a Safety Manual that describes appropriate safety procedures. The students must pass an examination before they can participate in any laboratory classes or research activities in the department of Materials Science and Engineering.

10.0 Scholarships

Various scholarships and loan funds are available "in-house", as well as, through the Earth and Mineral Sciences College and the University itself. In general, scholarships are based on academic merit and/or financial need. Decisions on scholarship allocations are made in May for the following academic year. Students interested in being considered for scholarships must file an application in the Undergraduate Studies office (124 Steidle) no later than April 1st each year. Scholarship application forms are included in Appendix I. (P.51). In addition, scholarships with financial need criteria are only available to students who have filed the necessary financial aid disclosure forms (FAFSA) with the University. Applications for, and information on the above can be obtained through the Undergraduate Studies Office (124 Steidle) or the Dean's Office (104 Deike.)

Scholarships are typically distributed over two semesters in the academic year. Students participating in Cooperative Education are not eligible for scholarship support during the semester they are on COOP rotation.

Scholarships are also available from professional societies. Students are encouraged to join and be active in their respective societies, and to apply promptly whenever such scholarship announcements are made.

11.0 Employment Opportunities

Obtaining employment in the field of Materials Science and Engineering requires significant planning and effort throughout the course of a student's academic training. Students who have obtained prior experience in the field through cooperative education and/or summer employment compete most successfully for permanent positions. Now is the time to get going on finding a summer position, which will improve your technical breadth in the field of materials science and engineering!

11.1 Summer Internships

Opportunities for summer employment as research and/or engineering interns exist in industry, national laboratories, and universities. There is a notice board for jobs in 120 Steidle. The Department highly encourages students to review these opportunities frequently.

The types of positions, and monetary compensation, vary significantly. A student's success at obtaining the best positions is generally dictated by two factors: 1) good grades, and 2) willingness to relocate during the summer if necessary. The Materials Science and Engineering faculty can assist you in making a suitable marriage of your skills and background with available internship opportunities. However, a significant part of the process is the level of effort the student puts into: 1) defining his/her academic and career goals, 2) compiling and frequently updating a resumé and transcript, and 3) informing the faculty of their interest in securing an internship position. Fall semester is the time to compile your resumé and transcript, and to discuss your interests with your academic advisor. Be sure that your resumé contains no misspellings or grammatical errors, as these are sure to "shoot down" any internship application. Assistance in compiling a resumé can be sought from the College's technical writing tutor (Mr. Joe Schall, 863-6077, u3w@ psu.edu,) and through your academic adviser.

11.2 Cooperative Education Program

Cooperative education is a more formalized version of an internship. Coop students participate in three semesters of work assignments in industry, for which they earn academic credit as well as being paid. In general, the Cooperative Education process will require one additional academic semester for graduation, but the student will have one full year of industrial experience by graduation. This has proven to be a significant advantage to students when seeking full-time employment.

Students are eligible for the Coop program starting in their fifth semester. Careful coordination of the student's academic scheduling with Coop assignments is highly advised to ensure timely graduation. This option is coordinated through the College of Engineering (205 Hammond, 863-1032, coop@engr.psu.edu), and the College of Science (Susan E. Knell, Director of Office of Cooperative Education, 865-5000, sek104@psu.edu).

11.3 Full-time Employment

Materials scientists and engineers are employed in industries involved in the entire life cycle of materials, including synthesis and processing, component design and product development, manufacturing, use, and reclamation and recycling. They hold positions as process engineers, research scientists, production managers, marketing engineers, quality control engineers, plant managers, technical sales representatives, etc. Penn State Materials Science and Engineering graduates are employed at all levels in prominent industries, laboratories, and universities worldwide.

Finding a job requires a concerted effort by the student in maintaining an up-to-date resumé and transcript, reviewing job postings, interacting with professionals in the discipline wherever and whenever possible, and using all of the job placement resources available at Penn State. Again, it is never too early to start the job-hunting process. It typically takes several months of preparation and interviewing to land the first job offer.

The Department highly recommends starting the process with a consultation with staff at the Career Development and Placement Services at Penn State late in your junior year to get a perspective of what a well-structured job search process entails. This is an important step to ensure that you understand what CDPS can offer to you in your search, and will be invaluable later when job openings and interview schedules are posted.

An equally valuable resource in your job search is the Undergraduate Studies office and your faculty! The Department routinely posts job openings as we learn of them, and coordinates on campus interviews throughout the year for our students. Job postings can be reviewed on the bulletin board in 120 Steidle. In addition, faculty are frequently aware of job openings in industry, and can be a valuable resource in helping you hone your interests and career goals.

Other resources are available through a variety of professional organizations, such as the American Ceramic Society and ASM International, among others. For example, Ceramic Futures is the ACerS's resumé database system for professionals and students seeking employment in the ceramics and related materials industry. Companies with job openings turn to Ceramic Futures for a list of qualified candidates. The database is linked to other materials-related societies for increased employment opportunities. In addition, the ACerS provides an on-line resumé service; this service is free to ACerS members. Contact the ACerS at http//www.acers.org for more information.

11.4 Professional Development

Numerous professional societies exist to serve the technical and professional needs of materials scientists and engineers. The Department strongly encourages undergraduates to become active in the student and national chapters of a professional society early in their stay at Penn State. Such participation dramatically enhances professional development, and offers a myriad of opportunities to build friendships and technical contacts, which are of utmost importance in one's career, and to have fun!

Several student-run chapters are active at Penn State: the American Ceramic Society Student Branch, Materials Research Society, and ASM International. Several other societies that are closely aligned with our Department include The Metallurgical Society (TMS,) the American Institute of Metallurgical, Mining and Petroleum Engineers (AIME,) the American Physical Society (APS,) and the American Institute of Chemical Engineers (AIChE.) In addition, there are several honorary and professional fraternities active within the Department: Keramos National Professional Ceramic Engineering Fraternity and Alpha Sigma Mu, as well as the Polymers Club.

The student groups generally meet monthly, and are active in coordinating technical seminars, professional development activities such as poster sessions and speaking contests, coordinating travel and participation in national technical meetings, educational outreach, recruiting, and fun social activities. The student officers of these societies are listed in Appendix J (Page 54).

The Department also has strong ties to the Pennsylvania Ceramics Association, which meets annually each September to host a technical forum, banquet, and football game tailgate at Penn State. Undergraduate students are welcome to attend; consult with the Undergraduate Studies office early in the Fall semester for details on participating.

In addition, the Department hosts an annual McFarland Award banquet and award ceremony. The McFarland Award is a long standing affair aimed at recognizing a Penn State Alumna/Alumnus who has distinguished herself/himself in the metallurgical profession. Run by Penn State's chapter of ASM International, the award ceremony consists of a keynote lecture by the Awardee, followed by a banquet which is attended by Penn State metals faculty, students and throngs of alumni. It is an outstanding way you meet your predecessors and to build technical contacts for the future!

Students are also encouraged to pursue becoming licensed professional engineers after graduation. To achieve this, students must take the 'Fundamentals of Engineering' examination to be certified as an Engineering Intern, followed by the 'Practice of Engineering Exam' after fours years of engineering experience.

Appendix A. Academic Advisors in the Department of Materials Science and Engineering

DEPARTMENT OF MATERIALS SCIENCE AND ENGINEERING
UNDERGRADUATE ADVISORS*

Fall 2003/Spring 2004

Advisors for students who declared an option:

	CERAMICS	EPM	METALS	POLYMER
FRESHMAN (1-2)	D.Green/A.Kimel	D. Green/A.Kimel	D.Green/A.Kimel	D.Green/A. Kimel
SOPHOMORE (3-4)	B.Dickey	V. Gopalan	C. Muhlstein	P. Painter
JUNIORS (5-6)	P. Brown	J. Redwing	D. Koss	E. Manias
SENIORS (7+)	S. Trolier-McKinstry (Sp04-Green will sub in McKinstry's absence)	D. Schlom	E. Ryba	J. Runt
HONORS	D. Green	S. Mohney	E. Ryba	P. Painter
		EPM Minor Advisor S. Mohney (MATSE) J. Ruzyllo (for EE)	Biomaterials Minor Advisor Vogler	ChemE Option R. Colby

Option Counselors:

Green	Ceramics
Debroy	Metals
Painter	Polymer
Mohney	EPM (Redwing until Mohney returns)

APPENDIX B: FACULTY in the Department of Materials Science and Engineering (See http://www.matse.psu.edu/)

JAMES ADAIR, Associate Professor of Ceramic Science and Engineering (jadair@mrl.psu.edu), 249A MRL 3-6047 - Professor Adair is interested in the principles of colloid and interfacial chemistry.

DAVID L. ALLARA, Professor of Materials Science and Chemistry (dla3@psu.edu), 185 MRL 5-2254 Professor Allara's research is focused on developing a fundamental understanding of chemical structures and processes at organic film interfaces.

WILLIAM BITLER, Professor Emeritus of Materials Science and Engineering (wrb1@psu.edu) 3-0624 122 Steidle Bldg.University Park, PA 16802
"Solid state diffusion, in particular the contributions of grain boundary diffusion to the penetration of metal films covering metal substrates and soft ferromagnetic materials such as oriented silicon iron."

PAUL W. BROWN, Professor of Materials Science and Engineering (etx@psu.edu), 136 MRL 5-5352 Professor Brown studies the chemical formation of advanced ceramics and novel composites at low temperatures and pressures.

LONG-QING CHEN, Associate Professor of Materials Science and Engineering; Associate Head for Graduate Studies (chen@ems.psu.edu), 123 Steidle 3-8101 - The main focus of Professor Chen's current research is modeling and predicting microstructural evolution during processing of advanced materials using computer simulations.

T. C. (MIKE) CHUNG, Professor of Polymer Science (chung@ems.psu.edu), 325 Steidle 3-1394 Professor Chung is interested in the development of new polymer chemistry that can lead to new materials.

RALPH COLBY, Professor of Materials Science and Engineering, (rhc@plmsc.psu.edu), 309 Steidle 3-3457 - Using rheological techniques to probe the dynamics of polymer liquids is the thrust of Professor Colby's research program. .

MICHAEL COLEMAN, Professor Emeritus of Materials Science and Engineering, (**coleman@matse.psu.edu**), 330 Steidle, University Park, PA 16802.
Professor Coleman is interested in the application of vibrational (infrared and Raman) spectroscopy to the study of multicomponent polymer systems.

PAOLO COLOMBO, Associate Professor of Materials Science, Universities of Bologna and Padua, Italy, Adjunct Professor of Materials Science and Engineering (paolo.colombo@unipd.it),
Activities in Paolo Colombo's lab focus on the development of advanced ceramic materials and components from preceramic polymers.

TARASANKAR DEBROY, Professor of Materials Science and Engineering (**rtd1@psu.edu**), 115 Steidle 5-1974 - The main focus of Professor DebRoy's research involves fusion welding processes.

ELIZABETH C. DICKEY, Assistant Professor of Materials Science and Engineering (**ecd10@psu.edu**), 195 MRI 5-9067 - Professor Dickey's research interests are in the area of interface materials science.

JOHN W ELMER, Deputy Program Element Leader, Lawerence Livermore National Laboratory and Adjunct Professor of Materials Science and Engineering , 121 Steidle 5-0497

VENKATRAMAN GOPALAN, Assistant Professor of Materials Science and Engineering (vgopalan@psu.edu), 252 MRL 5-2910 - The central theme of Dr. Gopalan's research is studying the interaction of light and matter.

DAVID J. GREEN, Professor of Ceramic Science and Engineering (green@ems.psu.edu), 230 Steidle 3-2011 - The research areas Professor Green investigates are centered on the mechanical behavior of ceramics.

IAN HARRISON, Professor of Polymer Science (irh1@psu.edu), 321 Steidle 5-3130
My background and training are in polymer science and engineering, and my earlier research efforts were in understanding structure, property, processing relationships in polymers. However, for the past several years my research has focused on the development of educational materials. In particular the use of animation to describe basic scientific, mathematics, technology and engineering concepts (SMET). This work also includes the use of virtual instruments (VIs) to give students the ability to discover for themselves basic SMET principles. VIs have recently been expanded so that they can also be used in assessment of student understanding of materials

JOHN R. HELLMANN, Associate Professor of Ceramic Science and Engineering, Associate Head of Undergraduate Studies (jrh3@psu.edu), 124 Steidle 5-0163 - Professor Hellmann's research interests focus on developing new materials and design methodologies for their application as structural and thermal members in high-performance applications.

SHIN-ICHI HIRANO Professor of Inorganic Materials Chemistry and Adjunct Professor of Materials Science and Engineering

PAUL R. HOWELL, Professor of Metallurgy (howell@ems.psu.edu), 231 Steidle 3-3363
Microstructural development in metals and alloys is a primary concern in Professor Howell's research.

ALLEN KIMEL, Assistant Professor of Materials Science and Engineering, rak189@psu.edu, 118C Steidle 865-1605 - Research interests focus on the aqueous synthesis and processing of nanosized inorganic particles and the consolidation of nanoparticulate systems.

S. V. KRISHNASWAMY, Fellow Scientist, Northrup Grumman Science and Technology Center and Adjunct Professor of Materials Science and Engineering, (silai_v_krishnaswamy@md.northgrum.com)

DONALD A. KOSS, Professor of Materials Science and Engineering (koss@ems.psu.edu), 202A Steidle 5-5447 - Professor Koss's research examines the multiaxial failure criteria and ductile fracture mechanisms characteristic of steel base plate and weldments using Navy HY and HSLA steels as model systems.

SANAT KUMAR, Professor of Materials Science and Engineering (kumar@plmsc.psu.edu), 316 Steidle 5-3294 - A fundamental understanding of the thermophysical properties of complex polymer mixtures in the bulk and near surfaces is critical to their use in applications.

MICHAEL LANAGAN, Senior Research Associate, Associate Professor of Materials Science and Engineering, and Associate Director of the Materials Research Institute (mxl146@psu.edu), 258 MRL 5-6992 - Dr. Lanagan's present interests include synthesis, processing, and characterization of new materials for wireless communications and power electronics applications.

ZI-KUI LIU, Assistant Professor of Materials Science and Engineering (zikui@psu.edu), 209 Steidle 5-1934 Dr. Liu's research interests are computational thermodynamics, phase transformation, and system materials design for steels, polymers, refractory alloys, and materials for electronic and nuclear applications.

DIGBY D. MACDONALD, Professor of Materials Science and Engineering, Director of the Center for Electrochemical Science and Technology (digby@essc.psu.edu), 201 Steidle 3-7772
Dr. Macdonald is currently developing chemistry and corrosion sensors for thermal power plants.

EVANGELOS MANIAS, Assistant Professor of Materials Science and Engineering, Virginia S. and Philip L. Walker, Jr. Faculty Fellow (manias@psu.edu), 325D Steidle 3-2980
Dr. Manias combines experimental and computer modeling techniques to investigate the structure and

dynamics of polymers near surfaces, at interfaces, and in extreme confinements.

GARY L. MESSING, Professor of Ceramic Science and Engineering, Head, Department of Materials Science and Engineering (messing@ems.psu.edu), 121 Steidle 5-2262
The complex relations among the myriad processes embraced in ceramic processing is the general focus of Professor Messing's research program.

CHRIS MUHLSTEIN, Assistant Professor of Materials Science and Engineering (clm28@psu.edu), 310 Steidle 5-1523
Dr. Muhlstein's research group studies the mechanical behavior of both bulk and thin film materials with an emphasis on the mechanisms of fracture and fatigue

SUZANNE E. MOHNEY, Associate Professor of Materials Science and Engineering, (mohney@ems.psu.edu), 109 Steidle 3-0744
Professor Mohney is interested in electronic materials, particularly metallization and oxidation for electronic devices.

KWADWO OSSEO-ASARE, Professor of Metallurgy and Geo-Environmental Engineering (asare@ems.psu.edu), 208 Steidle 5-4882
Research in Professor Osseo-Asare's lab focuses on the (electro)chemical behavior of metallic, semiconductor, and insulator materials.

PAUL C. PAINTER, Professor of Polymer Science and Engineering; Undergraduate Program Coordinator (painter@ems.psu.edu), 320 Steidle 5-5767
Professor Painter is interested in the effect of strong specific intermolecular interactions on polymer properties, particularly their ability to mix with solvents, other polymers, and liquid crystalline materials.

CARLO G. PANTANO, Distinguished Professor of Materials Science and Engineering; Director of the Materials Research Institute (pantano@ems.psu.edu), 123 Steidle, 198 MRI 3-2071
Activities in Professor Pantano's laboratories focus on glass surface characterization and how the composition and treatment of glass surfaces influence the microstructure and properties of vapor deposited thin films, polymer coating adhesion, and interface stability.

HOWARD W. PICKERING, Distinguished Professor of Metallurgy (pick@ems.psu.edu), 326 Steidle 3-2640
Professor Pickering's teaching and research activities focus on the principles of electrode reactions and their application to metal corrosion, methods for its prevention, and the electrodeposition of metals.

CLIVE A. RANDALL, Professor of Materials Science and Engineering, Director of the Center for Dielectric Studies (car4@psu.edu), 144 MRL, 325C Steidle 3-1328
Professor Randall's research centers on the scientific and technological implications of electroceramic device miniaturization.

JOAN REDWING, Assistant Professor of Materials Science and Engineering (jmr31@psu.edu), 108 Steidle 5-8665 - Dr. Redwing's research in electronics materials synthesis and characterization has a special emphasis on compound semiconductor fabrication by metalorganic vapor phase epitaxy, currently used to produce a variety of high performance optical and electronic devices—including light emitting diodes, laser diodes, and heterojunction transistors.

JAMES P. RUNT, Professor of Polymer Science (runt@ems.psu.edu), 101 Steidle 3-2749
Professor Runt's research is focused in two areas. The first is the study of crystallization and microstructure in crystalline polymers and polymer blends.

JERZY RUZYLLO, Professor of Electrical Engineering (jxr6@psu.edu), 214 EE West 5-5193
Professor Ruzyllo's research stresses gas-phase conditioning of silicon surfaces and also involves developing tools for gas-phase surface processing microelectronics manufacturing.

EARLE R. RYBA, Associate Professor of Metallurgy (ryba@ems.psu.edu), 304 Steidle 5-3760
Professor Ryba has studies the crystal structures of many intermetallic compounds, including quasicrystals that lack a three-dimensional repeat structural repeat unit, making their structures difficult to determine.

JOGENDER SINGH, Senior Scientist, Professor of Materials Science and Engineering, Head, Advanced Coatings/Applied Research Laboratory (jxs46@psu.edu), 165 ARL, 115 MRI 3-9898
Professor Singh is interested in the development of oxidation, corrosion, wear and erosion and thermal protection coatings by PVD (sputtering) and electron beam-PVD methods for aggressive environments.

DARRELL G. SCHLOM, Associate Professor of Materials Science and Engineering (schlom@ems.psu.edu), 108 MRI, 310 Steidle 3-8579
Professor Schlom's group investigates the growth and properties of oxide materials for electronic uses.

KARL E. SPEAR, Professor Emeritus of Materials Science and Engineering (spear@matse.psu.edu), 123 Steidle 863-0990
Dr. Spear's research focuses on predicting and understanding materials behavior though experimental and theoretical applications of high-temperature chemistry principles, phase equilibria, and thermodynamics.

RICHARD E. TRESSLER, Professor emeritus of Materials Science and Engineering (tressler@matse.psu.edu), 118A Steidle 5-7961

SUSAN TROLIER-MCKINSTRY, Associate Professor of Materials Science and Engineering, Corning Faculty Fellow of Ceramic Science and Engineering and Director of the W.M. Keck Smart Materials Lab (STMcKinstry@ psu.edu), 151 MRL, 325C Steidle 3-8348
Professor Trolier-McKinstry is interested in developing electronic ceramics as active materials for sensors and actuators.

ERWIN A. VOGLER, Associate Professor of Materials Science and Engineering and Bioengineering (eav3@psu.edu), 103 Steidle 3-7403
The major objective of Dr. Vogler's research program is developing a fundamental understanding of the biophysical mechanisms that underlie the biological response to materials.

CHAO-YANG WANG, Associate Professor of Materials Science and Engineering (cywang@matse.psu.edu) 338A Reber 3-4762
Interests include fuel cell and battery materials, proton conducting polymers, electrocatalysts, and electrode fabrication.

QING WANG, Associate Professor of Materials Science and Engineering (wang@matse.psu.edu) 863-0042, 319 Steidle Building
Research in Wang group is focused on the development of novel polymeric nanomaterials that possess unique electronic, photonic and biological properties. Our research is focused around two targets, aimed at exploring new functional molecular and macromolecular architectures, as well as structural property control by nanoscale self-assembly and patterning.

WILLIAM O. WILLIAMSON, Professor Emeritus, Ceramic Science, 122 Steidle Bldg. 3-0624

XIAXING XI, Associate Professor of Materials Science and Engineering (xi@matse.psu.edu) 3-5350, 220 Davey Lab
Physics underlying the electronic and photonic applications of metal-oxide and boride thin film materials. My research focuses on the understanding of the fundamental electrical and optical properties of thin film metal oxides and borides and the effects of structural and interfacial defects on them. Pulsed Laser Deposition is used to fabricate oxide thin films and heterostructures. A Hybrid Physical-Chemical Vapor Deposition (HPCVD) technique has been developed to deposit epitaxial boride thin films.

Appendix C. Undergraduate Curriculum in Materials Science and Engineering

The first five semesters in the undergraduate curriculum are essentially identical among the four options, with minor differences in the math and chemistry sequence. Subsequent semesters become more option specific. The curriculum for semester 1-4 is presented in the following section; the curricula for semesters 5-8 for each of the options will be presented separately in subsequent subsections.

NOTE: Effective SP 2002, the nomenclature for courses in materials science and engineering was changed to all MATSE prefixes, and some new numbering. The table on the next page defines the "old" versus "new" nomenclature.

Changes in course nomenclature effective Spring 2002

Present MATSE Course	Changed listing
CERSE 404	MATSE 490
CERSE 406	MATSE 411
CERSE 408	MATSE 412
CERSE 414	MATSE 414
CERSE 415	MATSE 415
CERSE 430	MATSE 417
CERSE 461	MATSE 466
CERSE 462	MATSE 467
CERSE 463	MATSE 468
CERSE 464	MATSE 469
MATSC 081	MATSE 081
MATSC 101	MATSE 101
MATSE 436	Course Unchanged
MATSE 493W	Course Unchanged
MATSE 494W	Course Unchanged
METAL 310W	MATSE 310W
METAL 400	MATSE 420
METAL 402	MATSE 421
METAL 404	MATSE 422
METAL 405	MATSE 423
METAL 406	MATSE 424
METAL 408	MATSE 425
METAL/NucE 409	MATSE 409
METAL 426	MATSE 426
METAL 432	MATSE 427
METAL 435	MATSE 471
METAL 436	MATSE 472
METAL 455	MATSE 428
PLMSE 400	MATSE 441
PLMSE 401	MATSE 442
PLMSE 406	MATSE 443
PLMSE 407	MATSE 444
PLMSE 409	MATSE 445
PLMSE 410	MATSE 446
PLMSE 412	MATSE 473
PLMSE 413	MATSE 474
PLMSE 442	MATSE 447
PLMSE 497A	MATSE 448

Undergraduate Curriculum in Materials Science and Engineering
(effective FA 2003)

SEMESTER 1 **15-17 Credits**

• CHEM 12	3	CHEMICAL PRINCIPLES
• CHEM 14	1	EXPERIMENTAL CHEMISTRY
• MATH 140	4	CALCULUS WITH ANALYTICAL GEOMETRY I
• EM SC 100S	3	FRESHMAN SEMINAR IN EMS♦
• SHA-1	3	SHA ELECTIVE €
• GHA –1	1-3	HEALTH AND PHYSICAL ACTIVITY ELECTIVE €

SEMESTER 2 **16-18 Credits**

• CHEM 13	3	CHEMICAL PRINCIPLES
• CHEM 15	1	EXPERIMENTAL CHEMISTRY
• MATH 141	4	CALCULUS WITH ANALYTICAL GEOMETRY II
• PHYS 211	4	MECHANICS
• ENGL 15	3	RHETORIC AND COMPOSITION
• GHA-2	1-3	HEALTH AND PHYSICAL ACTIVITY ELECTIVE €

SEMESTER 3 **17 Credits**

• MATH 220	2	MATRICES§
• MATH 231	2	CALCULUS OF SEVERAL VARIABLES §
• PHYS 212	4	ELECTRICITY AND MAGNETISM
• MATSE 201	3	INTRODUCTION TO MATERIALS SCIENCE #‡
• COMPSC 201	3	COMPUTER PROGRAMMING FOR ENGINEERS (CerSE, EPM, and MetSE option)
• SHA-2	3	SHA ELECTIVE €
• CHEM 38	3	ORGANIC CHEMISTRY (PlmSE option)

SEMESTER 4 **17 Credits**

• E MCH 210	5	STATICS AND STRENGTH OF MATERIALS (Not required for PlmSE option) *
• MATH 251	4	ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS
• PHYS 214	2	WAVES & THERMODYNAMICS
• COMPSC 201	3	COMPUTER PROGRAMMING FOR ENGINEERS (PlmSE option)
• CHEM 36	2	LABORATORY IN ORGANIC CHEMISTRY (PlmSE option)
• CHEM 39	3	ORGANIC CHEMISTRY (PlmSE option)
• SHA-3	3	SHA ELECTIVE €
• SHA-4	3	SHA ELECTIVE (CerSE, EPM, and MetSE option) €

* EMCH 11(3) and EMCH 13(3) may be taken in place of EMCH 210

‡ Commonwealth Campuses students should schedule MATSC 201 for Semester 5

♦ Students on the Commonwealth Campuses should schedule SPCOM100A instead.

§ Math 230 may be substituted for Math 220 and 231

Students must obtain grade C or better in these courses.

** Students on the Commonwealth Campuses will need to schedule MATSE 201 this semester and move IE 424 to a later semester.

€ Course can be scheduled any other semester. A total of 3 credits are needed in GHA, 18 credits in SHA, and 6 credits in technical elective categories. Scheduling of SHA and GHA courses can be shifted as needed in order to permit registering for the particular course or section desired by the student.

Ceramic Science and Engineering Curriculum
(effective FA 2003)

SEMESTER 5 16 Credits

- MATSE 400 3 CRYSTAL CHEMISTRY #
- MATSE 401 3 THERMODYNAMICS OF MATERIALS #
- MATSE 430 3 MATERIALS CHARACTERIZATION #
- MATSE 460 1 INTRODUCTORY LABORATORY IN MATERIALS
- IE 424 3 PROCESS QUALITY ENGINEERING **
- SHA-5 3 SHA ELECTIVE€

SEMESTER 6 15.5 Credits

- MATSE 402 3 MATERIALS PROCESS KINETICS #
- MATSE 410 3 PHASE RELATIONS IN MATERIAL SYSTEMS
- MATSE 413 3 SOLID STATE MATERIALS
- MATSE 436 3 MECHANICAL PROPERTIES OF MATERIALS
- MATSE 466 0.5 CERAMICS LABORATORY I
- ENGL 202C 3 TECHNICAL WRITING

SEMESTER 7 15 Credits

- MATSE 411 3 PROCESSING OF CERAMICS
- MATSE 412 3 THERMAL PROPERTIES AND REFRACTORIES
- MATSE 415 3 INTRODUCTION TO GLASS SCIENCE
- MATSE 467 0.5 CERAMICS LABORATORY II
- MATSE 468 0.5 CERAMICS LABORATORY III
- MATSE 490 1 SENIOR FIELD TRIP AND SEMINAR
- MATSE 493W 1 SENIOR THESIS
- TECH EL-1 3 TECH ELECTIVE **€**

SEMESTER 8 14.5 Credits

- MATSE 417 3 ELECTRICAL AND MAGNETIC PROPERTIES
- MATSE 435 3 OPTICAL PROPERTIES OF MATERIALS
- MATSE 469 0.5 CERAMICS LABORATORY IV
- MATSE 494W 2 SENIOR THESIS
- TECH EL-2 3 TECHNICAL ELECTIVE **€**
- SHA-6 3 SHA ELECTIVE **€**

TOTAL CREDITS 127

Ceramic Science and Engineering Curriculum Check List

Name _____ Advisor_____

For BS. degree in Materials Science & Engineering (CerSE Option), 127 credits are required

Gen. Ed. Requirements (48 credits) Requirements for the Major (65-66 credits)

Communication	**(9 credits)**
Engl 15	3
Engl 202C	3
EMSC 100S	3

Quantification	**(8 credits)**
Math 140	4
Math 141	4

Natural Sciences	**(10 credits)**
Chem 12	3
Chem 13	3
Physics 211	4

Arts#	**(6 credits)**

Humanities #	**(6 credits)**

Social-Behavioral#	**(6 credits)**

Health & Physical Activities	**(3 credits)**

Intercultural & International Competence‡	**(3 credits)**

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Advisor Signature

Prescribed Courses	**(65 credits)**
Chem 14	1
Chem 15	1
Math 220$	2
Math 231$	2
Math 251	4
CompSc 201	3
MatSE 201¢	3
MatSE 400¢	3
MatSE 401¢	3
MatSE 402¢	3
MatSE 410	3
MatSE 413	3
MatSE 430¢	3
MatSE 435	3
Phys 212	4
Phys 214	2
MatSE 490	1
MatSE 411	3
MatSE 412	3
MatSE 436	3
MatSE 415	3
MatSE 417	3
MatSE 460	1
MatSE 466	0.5
MatSE 467	0.5
MatSE 468	0.5
MatSE 469	0.5
MatSE 493W	1
MatSE 494W	2

Additional Courses	**(8-9 credits)**
IE 424	3
E Mch 210 **OR**	
E Mch 11 and E Mch 13	5-6

Supporting Courses and

Related Areas*	**(6 credits)**
Tech El-1	3
Tech El-2	3

*6 credits of ROTC can be applied here.
See advisor for Tech El approval.
¢ Must obtain grade C or better
$ Math 230 can be substituted for 220 & 231
‡ Can be used to satisfy SHA simultaneously
# SHA can be also split into a 3-6-9 sequence

Electronic and Photonic Materials Curriculum
(effective FA 2003)

SEMESTER 5 16 Credits

- MATSE 400 3 CRYSTAL CHEMISTRY #
- MATSE 401 3 THERMODYNAMICS OF MATERIALS #
- MATSE 430 3 MATERIALS CHARACTERIZATION #
- MATSE 460 1 INTRODUCTORY LABORATORY IN MATERIALS
- IE 424 3 PROCESS QUALITY ENGINEERING **
- ESC 314 3 APPLICATION OF MATERIALS FOR ELECTRICAL ENGINEERS

SEMESTER 6 15 Credits

- MATSE 402 3 MATERIALS PROCESS KINETICS #
- MATSE 435 3 OPTICAL PROPERTIES OF MATERIALS
- MATSE 413 3 SOLID STATE MATERIALS or PHYS 237 INTRODUCTION TO MODERN PHYSICS
- EE 418 3 SOLID STATE DEVICE TECHNOLOGY
- ENGL 202C 3 TECHNICAL WRITING

SEMESTER 7 15 Credits

- MATSE 450 3 SYNTHESIS AND PROCESSING OF EPM #
- MATSE 455 3 PROPERTIES AND CHARACTERIZATION OF EPM
- MATSE 463 1 CHARACTERIZATION AND PROCESSING OF EPM LAB
- MATSE 490 1 SENIOR FIELD TRIP AND SEMINAR
- MATSE 493W 1 SENIOR RESEARCH PROJECT
- TECH EL-1 3 TECH ELECTIVE €
- SHA-5 3 SHA ELECTIVE €

SEMESTER 8 14.5 Credits

- MATSE 417 3 ELECTRICAL AND MAGNETIC PROPERTIES
- MATSE 469 0.5 CERAMICS LABORATORY IV
- MATSE 494W 2 RESEARCH AND DESIGN SENIOR PROJECT
- TECH EL-2 3 TECHNICAL ELECTIVE €
- TECH EL-3 3 TECHNICAL ELECTIVE €
- SHA-6 3 SHA ELECTIVE €

TOTAL CREDITS 126.5

Electronic and Photonic Materials Undergraduate Curriculum Check List

Name _____ Advisor_____

For BS. degree in Materials Science & Engineering (EPM Option), 126.5 credits are required

Gen. Ed. Requirements (48 credits)

Communication	**(9 credits)**
Engl 15	3
Engl 202C	3
EMSC 100S	3
Quantification	**(8 credits)**
Math 140	4
Math 141	4
Natural Sciences	**(10 credits)**
Chem 12	3
Chem 13	3
Physics 211	4
Arts#	**(6 credits)**
Humanities #	**(6 credits)**
Social-Behavioral#	**(6 credits)**
Health & Physical Activities	**(3 credits)**
Intercultural & International Competence‡	**(3 credits)**

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Advisor Signature

Requirements for the Major (65-66 credits)

Prescribed Courses	**(65 credits)**
Chem 14	1
Chem 15	1
Math 220$	2
Math 231$	2
Math 251	4
CompSc 201	3
MatSE 201¢	3
MatSE 400¢	3
MatSE 401¢	3
MatSE 402¢	3
MatSE 417	3
MatSE 413	3
MatSE 430¢	3
MatSE 435	3
MatSE 450	3
MatSE 455	3
MatSE 460	1
MatSE 463	1
MatSE 469	0.5
MatSE 490	1
MatSE 493W	1
MatSE 494W	2
Phys 212	4
Phys 214	2
Esc 314	3
EE 418	3

Additional Courses	**(8-9 credits)**
IE 424	3
E Mch 210 **OR**	
E Mch 11 and E Mch 13	5-6

Supporting Courses and Related Areas* **(9 credits)**

Tech El-1	3
Tech El-2	3
Tech El-3	3

*6 credits of ROTC can be applied here.
See advisor for Tech Elective approval.

¢ Must obtain grade C or better
$ Math 230 can be substituted for 220 & 231
‡ Can be used to satisfy SHA simultaneously
# SHA can be also split into a 3-6-9 sequence

Metals Science and Engineering Curriculum
(effective FA 2003)

SEMESTER 5 16 Credits

• MATSE 400	3	CRYSTAL CHEMISTRY
• MATSE 401	3	THERMODYNAMICS OF MATERIALS #
• MATSE 430	3	MATERIALS CHARACTERIZATION #
• MATSE 460	1	INTRODUCTORY LABORATORY IN MATERIALS
• IE 424	3	PROCESS QUALITY ENGINEERING **
• SHA-5	3	SHA ELECTIVE

SEMESTER 6 16 Credits

• MATSE 402	3	MATERIALS PROCESS KINETICS #
• MATSE 436	3	MECHANICAL PROPERTIES OF MATERIALS
• MATSE 423	4	PHASE TRANSFORMATIONS IN METALS AND ALLOYS #
• MATSE 310W	2	METALLURGICAL LITERATURE
• MATSE 471	1	METALLURGY LABORATORY II
• ENGL 202C	3	TECHNICAL WRITING

SEMESTER 7 14 credits

• MATSE 421	3	CORROSION ENGINEERING
• MATSE 422	3	THERMOCHEMICAL PROCESSING
• MATSE 425	3	PROCESSING OF METALS
• MATSE 472	1	METALLURGY LABORATORY III
• MATSE 490	1	SENIOR FIELD TRIP AND SEMINAR
• MATSE 493W	1	SENIOR RESEARCH PROJECT
• TECH EL -1	3	TECHNICAL ELECTIVE

SEMESTER 8 14 credits

• MATSE 426	3	AQUEOUS PROCESSING
• MATSE 417	3	ELECTRICAL AND MAGNETIC MATERIALS
• MATSE 494W	2	RESEARCH AND DESIGN SENIOR PROJECT
• TECH EL -2	3	TECHNICAL ELECTIVE
• SHA-6	3	SHA ELECTIVE

TOTAL CREDITS: 127

Metals Science and Engineering Curriculum Check List

Name _____ Advisor_____

For BS. degree in Materials Science & Engineering (MetSE Option), 126 credits are required

Gen. Ed. Requirements (48 credits) Requirements for the Major (65-66 credits)

Communication	**(9 credits)**
Engl 15	3
Engl 202C	3
EMSC 100 S	3

Quantification	**(8 credits)**
Math 140	4
Math 141	4

Natural Sciences	**(10 credits)**
Chem 12	3
Chem 13	3
Physics 211	4

Arts#	**(6 credits)**

Humanities #	**(6 credits)**

Social-Behavioral#	**(6 credits)**

Health & Physical Activities	**(3 credits)**

Intercultural & International Competence‡	**Supporting Courses and (3 credits)**

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Advisor Signature

Prescribed Courses	**(65 credits)**
Chem 14	1
Chem 15	1
Math 220$	2
Math 231$	2
Math 251	4
CompSc 201	3
MatSE 201¢	3
MatSE 400	3
MatSE 401¢	3
MatSE 402¢	3
MatSE 430¢	3
Phys 212	4
Phys 214	2
MatSE 310W	2
MatSE 417	3
MatSE 421	3
MatSE 422	3
MatSE 423	4
MatSE 425	3
MatSE 426	3
MatSE 436	3
MatSE 460	1
MatSE 471	1
MatSE 472	1
MatSE 490	1
MatSE 493W	1
MatSE 494W	2

Additional Courses	**(8-9 credits)**
IE 424	3
E Mch 210 **OR**	
E Mch 11 and E Mch 13	5-6

Related Areas*	**(6 credits)**
Tech El-1	3
Tech El-2	3

*6 credits of ROTC can be applied here.
See advisor for Tech El approval.
¢ Must obtain grade C or better
$ Math 230 can be substituted for 220 & 231
‡ Can be used to satisfy SHA simultaneously
# SHA can be also split into a 3-6-9 sequence

Polymer Science and Engineering Curriculum
(effective FA 2003)

SEMESTER 5 16 Credits

- MATSE 400 3 CRYSTAL CHEMISTRY
- MATSE 401 3 THERMODYNAMICS OF MATERIALS
- MATSE 441 3 POLYMERIC MATERIALS I #
- MATSE 443 3 INTRO TO THE MATERIALS SCIENCE OF POLYMERS #
- MATSE 460 1 INTRODUCTORY LABORATORY IN MATERIALS
- IE 424 3 PROCESS QUALITY ENGINEERING **

SEMESTER 6 15 Credits

- MATSE 436 3 MECHANICAL PROPERTIES OF MATERIALS #
- MATSE 445 3 THERMODYNAMICS, MICROSTRUCTURE, AND CHARACTERIZATION OF POLYMERS #
- ENGL 202C 3 TECHNICAL WRITING
- TECH EL-1 3 TECHNICAL ELECTIVE 1 €
- SHA-4 3 SHA ELECTIVE €

SEMESTER 7 17 Credits

- MATSE 430 3 MATERIALS CHARACTERIZATION
- MATSE 444 3 SOLID STATE PROPERTIES OF POLYMERIC MATERIALS #
- MATSE 447 3 RHEOLOGY AND PROCESSING OF POLYMERS
- MATSE 490 1 SENIOR FIELD TRIP AND SEMINAR
- MATSE 493W 1 SENIOR RESEARCH
- TECH EL-2 3 TECHNICAL ELECTIVE 2 €
- SHA-5 3 SHA ELECTIVE €

SEMESTER 8 15 Credits

- MatSE 446 3 MECHANICAL AND ELECTRICAL PROPERTIES OF POLYMERS AND COMPOSITES
- MATSE 473 1 POLYMERIC MATERIALS LAB - SYNTHESIS #
- MATSE 448 3 ADVANCED PROCESSING TECHNOLOGY
- MATSE 494W 2 RESEARCH AND DESIGN SENIOR PROJECT
- TECH EL-3 3 TECHNICAL ELECTIVE 3 €
- SHA-6 3 SHA ELECTIVE €

TOTAL CREDITS 126

Polymer Science and Engineering Curriculum Check List

Name _____ Advisor_____

For BS. degree in Materials Science & Engineering (PLMSE Option), 126 credits are required

Gen. Ed. Requirements (48 credits) Requirements for the Major (65-66 credits)

Communication	**(9 credits)**
Engl 15	3
Engl 202C	3
EMSC 100S	3

Quantification	**(8 credits)**
Math 140	4
Math 141	4

Natural Sciences	**(10 credits)**
Chem 12	3
Chem 13	3
Physics 211	4

Arts#	**(6 credits)**

Humanities #	**(6 credits)**

Social-Behavioral#	**(6 credits)**

Health & Physical Activities	**(3 credits)**

Intercultural & International Competence‡	**Supporting Courses and (3 credits)**

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Advisor Signature

Prescribed Courses	**(65 credits)**
Chem 14	1
Chem 15	1
Math 220$	2
Math 231$	2
Math 251	3
CompSc 201	3
MatSE 201¢	3
MatSE 400¢	3
MatSE 401¢	3
Chem 36	2
Chem 38	3
Chem 39	3
MatSE 430¢	3
MatSE 436	3
Phys 212	4
Phys 214	2
MatSE 441	3
MatSE 443	3
MatSE 444	3
MatSE 436	3
MatSE 445	3
MatSE 446	3
MatSE 447	3
MatSE 448	3
MatSE 460	1
MatSE 473	1
MatSE 490	1
MatSE 493W	1
MatSE 494W	2

Additional Courses	**(8-9 credits)**
IE 424	3
E Mch 210 **OR**	
E Mch 11 and E Mch 13	5-6

Related Areas*	**(9 credits)**
Tech El-1	3
Tech El-2	3
Tech El-3	3

*6 credits of ROTC can be applied here.
See advisor for Tech El approval.

¢ Must obtain grade C or better
$ Math 230 can be substituted for 220 & 231
‡ Can be used to satisfy SHA simultaneously
# SHA can be also split into a 3-6-9 sequence

Appendix D. Suggested courses to satisfy SHA requirements

The following list is of sequences which simultaneously satisfy University, E&MS College and ABET requirements.

THE ARTS

Subject Area	Introductory Courses	Intermediate and Advanced courses
Architecture	**ARCH** 210	**ARCH** 211, 315, 316
Art	**ART** 001, 010, 017, 020, 030, 040, 050, 080	**ART** 100, 190, 270, 290
Art History 112, 120*, 130*	**ART H** 100, 111, 307, 311-314, 320, 324	**ART H** 211-214, 301, 303-325, 330, 340
Communications	**COMM** 150	**COMM** 250
Theatre Arts	**THEA** 100, 109, 115	**THEA** 189

THE HUMANITIES

African/African American Studies	**AAA S** 101*	**AAA S** 145*, 146*
American Studies	**AM ST** 050	**AM ST** 100, 105*
Comparative Literature	**CMLIT** 001, 002, 003*, 004*, 005*, 010*, 011	**CMLIT** 100, 101*, 105-107, 108*, 110*, 111, 141, 184, 185, 189
English	**ENGL** 001, 002, 003, 088	**ENGL** 104, 129, 133, 134, 135*, 139*, 140, 184, 185, 189, 191, 194*, 262-265, 268
French	**FR** 139*	**FR** 142
German	**GER** 100*, 120, 150, 157*, 175*, 180, 190, 195	**GER** 200*, 245*
History	**HIST** 001, 002, 003, 010*, 012, 020, 021, 153*, 174*, 175*, 176*, 178	**HIST** 100, 101, 102*, 105, 107, 108, 117, 141, 143, 152, 179, 181*, 191

* Diversity focused courses.

Italian	**IT** 130*	**IT** 230
Jewish Studies **J ST** 010*	**J ST** 102*	
Philosophy 004†, 010	**PHIL** 001†, 003, 111*, 124, 205-207, 218	**PHIL** 100, 102-104, 107-110
Religious Studies 004* 137*, 140W, 145*, 146*	**RL ST** 001*, 003*, 110*, 111*, 114, 120, 124*, 125	**RL ST** 101*-104*, 106*, 107*, 125W, 130
Russian	**RUS** 100*	**RUS** 110*, 120
Spanish	**SPAN** 130*, 131*	**SPAN** 230, 231
Women's Studies	**WMNST** 003*	**WMNST** 101*, 117, 137*, 194

SOCIAL AND BEHAVIORAL SCIENCES

African/African American Studies	**AAA S** 100*, 110	**AAA S** 409*
Anthropology	**ANTH** 001, 002, 008*, 009, 011*, 045	**ANTH** 146*
Economics	**ECON** 002, 004, 014††, 342, 370, 372	**ECON** 302, 304, 315, 323, 333
Geography	**GEOG** 020, 030	**GEOG** 100, 103*, 120, 124, 128*
History	**HIST** 116, 120	**HIST** 142, 151, 155, 173
Human Development and Family Studies	**HD FS** 129†††	**HD FS** 229, 239, 249
Labor and Industrial Relations	**L I R** 100, 101	**L I R** 104
Political Science	**PL SC** 001, 003	**PL SC** 014
Psychology 220, 221, 231, 236-238, 243	**PSY** 002	**PSY** 170*, 202, 204, 213, 217
Sociology	**SOC** 001, 003, 005, 012, 013, 015, 023, 030†††, 055	**SOC** 110*, 119*, 409*
Women's Studies	**WMNST** 001	**WMNST** 110*, 116

* Diversity focused courses.
† Cannot use both PHIL 001 and PHIL 004 for general studies
†† Cannot use ECON 014 after either ECON 002 or ECON 004
††† Cannot use both HDST 129 and SOC 030 for general studies

ART COURSES

ARCH	210 GA	ART H	311 GA	KEYBD*	110J GA	MUSIC*	192 GA
ARCH	211 GA	ART H	312 GA	KEYBD*	111J GA	PERCN*	100J GA
ARCH	315 GA	ART H	313 GA	KEYBD*	112J GA	PERCN*	110J GA
ARCH	316 GA	ART H	314 GA	LARCH***	003 GA	STRNG*	100J GA
ART	001 GA	ART H**	320 GA	LARCH***	060 GA	STRNG*	101J GA
ART*	010GA	ART H	324 GA	MUSIC	005 GA	STRNG*	102J GA
ART*	017 GA	ART H	325 GA	MUSIC**	007 GA	STRNG*	103J GA
ART*	020 GA	ART H	330 GA	MUSIC	008 GA	STRNG*	110J GA
ART*	030 GA	ART H**	340 GA	MUSIC**	009 GA	STRNG*	111J GA
ART*	040 GA	BRASS*	100J GA	MUSIC*	050 GA	STRNG*	112J GA
ART*	050 GA	BRASS*	101J GA	MUSIC*	051 GA	STRNG*	113J GA
ART*	080 GA	BRASS*	102J GA	MUSIC*	052 GA	STRNG*	114J GA
ART	100 GA	BRASS*	103J GA	MUSIC*	054 GA	THEA	100 GA
ART	190 GA	BRASS*	104J GA	MUSIC*	077 GA	THEA*	102 GA
ART*	270 GA	BRASS*	110J GA	MUSIC*	078 GA	THEA	109 GA
ART*	290 GA	BRASS*	111J GA	MUSIC*	080 GA	THEA*	189 GA
ART H	100 GA	BRASS*	112J GA	MUSIC*	081 GA	THEA**	207 GA
ART H	111 GA	BRASS*	113J GA	MUSIC*	082 GA	VOICE*	100J GA
ART H	112 GA	BRASS*	114J GA	MUSIC*	084 GA	VOICE*	110J GA
ART H**	120 GA	COMM	150 GA	MUSIC*	085 GA	WWNDS*	100J GA
ART H**	130 GA	COMM	250 GA	MUSIC*	086 GA	WWNDS*	101J GA
ART H	211 GA	EBGL	050 GA	MUSIC*	089 GA	WWNDS*	102J GA
ART H	212 GA	EXSCI	273 GA	MUSIC*	090 GA	WWNDS*	103J GA
ART H	213 GA	INART	001 GA	MUSIC*	091 GA	WWNDS*	104J GA
ART H	214 GA	INART	005 GA	MUSIC*	092 GA	WWNDS*	110J GA
ART H	301 GA	INART	010 GA	MUSIC*	103 GA	WWNDS*	110J GA
ART H	303 GA	INART	015 GA	MUSIC*	104 GA	WWNDS*	111J GA
ART H	304 GA	INART	100W GA	MUSIC*	106 GA	WWNDS*	112J GA
ART H	305 GA	KEYBD*	100J GA	MUSIC*	190 GA	WWNDS*	113J GA
ART H	306 GA	KEYBD*	101J GA	MUSIC*	191 GA	WWNDS*	114J GA
ART H	307 GA	KEYBD*	102J GA				

* NOT ACCEPTABLE TO ABET AS AN ARTS COURSE
** DIVERSITY FOCUSED COURSES
*** CAN USE EITHER LARCH 003 OR LARCH 060 BUT NOT BOTH TO SATISFY ARTS REQUIREMENTS

HUMANITIES

AAA S*	101 GH	CMLIT*	101 GH	ENGL*	139 GH	GER	190 GH
AAA S*	145 GH	CMLIT	105 GH	ENGL	140 GH	GER	195 GH
AAA S*	146 GH	CMLIT	106 GH	ENGL	184 GH	GER*	200 GH
AM ST	050 GH	CMLIT	107 GH	ENGL	185 GH	GER*	245 GH
AM ST	100 GH	CMLIT*	108 GH	ENGL	189 GH	HEBR*	010 GH
AM ST*	105 GH	CMLIT*	110 GH	ENGL	191 GH	HIST	001 GH
CAMS	140 GH	CMLIT	111 GH	ENGL*	194 GH	HIST	002 GH
CAMS	150 GH	CMLIT	141 GH	ENGL	262 GH	HIST	003 GH
CLASS	001 GH	CMLIT	184 GH	ENGL	263 GH	HIST*	010 GH
CLASS	025 GH	CMLIT	185 GH	ENGL	265 GH	HIST	012 GH
CLASS	033 GH	CMLIT	189 GH	ENGL	268 GH	HIST	020 GH
CLASS*	045 GH	ENGL	001 GH	FR*	139 GH	HIST	021 GH
CMLIT	001 GH	ENGL	002 GH	FR	142 GH	HIST	100 GH
CMLIT	002 GH	ENGL	003 GH	GEOG	102 GH	HIST	101 GH
CMLIT*	003 GH	ENGL	088 GH	GER*	100 GH	HIST*	102 GH
CMLIT*	004 GH	ENGL	104 GH	GER	120 GH	HIST	105 GH
CMLIT*	005 GH	ENGL	129 GH	GER	150 GH	HIST	107 GH
CMLIT*	010 GH	ENGL	133 GH	GER*	157 GH	HIST	108 GH
CMLIT	011 GH	ENGL	134 GH	GER*	175 GH	HIST	117 GH
CMLIT	100 GH	ENGL*	135 GH	GER	180 GH	HIST	141 GH

HIST	143 GH	PHIL	001 GH	PHIL	221 GH	RL ST*	145 GH
HIST	152 GH	PHIL	003 GH	RL ST*	001 GH	RL ST*	146 GH
HIST*	153 GH	PHIL	004 GH	RL ST*	003 GH	RUS*	100 GH
HIST*	174 GH	PHIL	010 GH	RL ST*	004 GH	RUS*	110 GH
HIST*	175 GH	PHIL	100 GH	RL ST*	101 GH	RUS	120 GH
HIST*	176 GH	PHIL	102 GH	RL ST*	102 GH	S T S	100 GH
HIST	178 GH	PHIL	103 GH	RL ST*	103 GH	S T S	101 GH
HIST	179 GH	PHIL	104 GH	RL ST*	104 GH	S T S	107 GH
HIST*	181 GH	PHIL	107 GH	RL ST*	106 GH	SPAN*	130 GH
HIST	191 GH	PHIL	108 GH	RL ST*	107 GH	SPAN*	131 GH
HSTRY*	109 GH	PHIL	109 GH	RL ST*	110 GH	SPAN	230 GH
HUMAN	001 GH	PHIL	110 GH	RL ST*	111 GH	SPAN	231 GH
IT*	130 GH	PHIL*	111 GH	RL ST	114 GH	SPCOM	220 GH
IT	230 GH	PHIL	124 GH	RL ST	120 GH	WMNST*	003 GH
J ST*	010 GH	PHIL	205 GH	RL ST*	124 GH	WMNST*	101 GH
J ST*	102 GH	PHIL	306 GH	RL ST	125W GH	WMNST	117 GH
LING	102 GH	PHIL	207 GH	RL ST	130 GH	WMNST*	137 GH
MEDVL	107 GH	PHIL	212 GH	RL ST*	137 GH	WMNST*	195 GH
MEDVL	108 GH	PHIL	218 GH	RL ST	140W GH		

SOCIAL AND BEHAVIORAL SCIENCES

AAA S*	100 GS	ECON	333 GS	L I R	101 GS	RL ST	236 GS
AAA S	110 GS	ECON	342 GS	L I R	104 GS	RL ST	237 GS
AAA S*	409 GS	ECON	370 GS	MN EC	100 GS	S T S	151 GS
ADM J	012 GS	ECON	372 GS	PL SC	001 GS	S T S	200 GS
ADM J	013 GS	GEOG*	103 GS	PL SC	003 GS	SO SC	001 GS
AG EC	101 GS	GEOG	120 GS	PL SC****	014 GS	SOC***	001 GS
ANTH	001 GS	GEOG	124 GS	PSY	002 GS	SOC	003 GS
ANTH	002 GS	GEOG*	128 GS	PSY*	170 GS	SOC	005 GS
ANTH*	008 GS	HD FS**	129 GS	PSY	202 GS	SOC	012 GS
ANTH	009 GS	HD FS	229 GS	PSY	204 GS	SOC	013 GS
ANTH*	011 GS	HD FS	239 GS	PSY	213 GS	SOC	023 GS
ANTH*	045 GS	HD FS	249 GS	PSY	217 GS	SOC**	030 GS
ANTH*	146 GS	HIST	120 GS	PSY	220 GS	SOC	055 GS
COMM	100 GS	HIST	142 GS	PSY	221GS	SOC*	110GS
ECON	002 GS	HIST	151 GS	PSY	231 GS	SOC*	119 GS
ECON	004 GS	HIST	155 GS	PSY	236 GS	SOC*	409 GS
ECON*	014 GS	HIST	173 GS	PSY	237 GS	WMNST*	001 GS
ECON	302 GS	INT U****	200 GS	PSY	238 GS	WMNST*	119 GS
ECON	304 GS	INTAG*	100 GS	PSY	243 GS	WMNST	116 GS
ECON	315 GS	INTST*	100 GS	R SOC***	011 GS		
ECON	323 GS	L I R	100GS				

* Cannot use ECON 014 after either ECON 002 or ECON 004
** Can use either HD FS 129 or SOC 30 but not both to satisfy Gen. Ed. Requirements
*** Can use either R Soc 001 or SOC 001 but not both to satisfy Gen. Ed. Requirements
**** Cannot receive credit for both PL SC 014 GS and INT U 200 DS.

CULTURAL DIVERSITY COURSES

Diversity Focused (DF)

AAA S	100 DF	ENGL	235 DF	INST	100 DF	RL ST	483 DF
AAA S	101 DF	ENGL	431 DF	INTST	400W DF	RUS	100 DF
AAA S	103 DF	ENGL	461 DF	IT	130 DF	RUS	110 DF
AAA S	132 DF	ENGL	462 DF	J ST	010 DF	RUS	130 DF
AAA S	145 DF	ENGL	463 DF	J ST	102 DF	S T S	005 DF
AAA S	146 DF	ENGL	466 DF	J ST	401 DF	S T S	430 DF
AAA S	200 DF	ENGL	466 DF	L I R	136 DF	S T S	457 DF
AAA S	409 DF	ENGL	467 DF	LING	200 DF	SOC	103 DF
AAA S	422 DF	ENGL	468 DF	MANGT	340 DF	SOC	110 DF
ADM J	423 DF	ENGL	469 DF	MANGT	480 DF	SOC	119 DF
ADM J	453 DF	ENGL	490 DF	MKTG	445 DF	SOC	287W DF
AG EC	450 DF	FR	139 DF	MKTG	470 DF	SOC	409 DF
AM ST	104 DF	FR	270 DF	MUSIC	007 DF	SPAN	130 DF
AM ST	105 DF	FR	458 DF	MUSIC	009 DF	SPAN	131 DF
ANTH	008 DF	FR	470 DF	NURS	415 DF	SPAN	132 DF
ANTH	011 DF	FR	471 DF	NUTR	421 DF	SPCOM	422 DF
ANTH	045 DF	GEOG	103 DF	NUTR	430 DF	SPCOM	455 DF
ANTH	146 DF	GEOG	128 DF	PHIL	111 DF	SPCOM	471 DF
ANTH	201 DF	GEOG	415 DF	POL	100 DF	THEA	207 DF
ANTH	425 DF	GER	100 DF	PSY	170 DF	THEA	406 DF
ANTH	447 DF	GER	157 DF	PSY	471 DF	THEA	407 DF
ART H	120 DF	GER	175 DF	PSYCH	472 DF	UKR	100 DF
ART H	130 DF	GER	200 DF	R P M	277 DF	WMNST	001 DF
ART H	320 DF	GER	245 DF	R SOC	420 DF	WMNST	003 DF
ART H	340 DF	HD FS	250 DF	RL ST	001 DF	WMNST	005 DF
ASTRO	110 DF	HD FS	315 DF	RL ST	003 DF	WMNST	101 DF
CLASS	045 DF	HD FS	315W DF	RL ST	004 DF	WMNST	103 DF
CMDIS	369 DF	HEBR	010 DF	RL ST	101 DF	WMNST	104 DF
CMLIT	003 DF	HIST	010 DF	RL ST	102 DF	WMNST	110 DF
CMLIT	004 DF	HIST	102 DF	RL ST	103 DF	WMNST	130 DF
CMLIT	005 DF	HIST	153 DF	RL ST	104 DF	WMNST	136 DF
CMLIT	010 DF	HIST	154 DF	RL ST	105 DF	WMNST	137 DF
CMLIT	101 DF	HIST	172 DF	RL ST	106 DF	WMNST	194 DF
CMLIT	108 DF	HIST	174 DF	RL ST	107 DF	WMNST	205 DF
CMLIT	110 DF	HIST	175 DF	RL ST	110 DF	WMNST	400W DF
COMM	205 DF	HIST	181 DF	RL ST	111 DF	WMNST	407 DF
COMMU	402 DF	HIST	401 DF	RL ST	124 DF	WMNST	412 DF
ECON	436 DF	HIST	419 DF	RL ST	137 DF	WMNST	419 DF
EDTHP	411 DF	HIST	421 DF	RL ST	145 DF	WMNST	420 DF
EDTHP	412 DF	HIST	457 DF	RL ST	146 DF	WMNST	421 DF
ELISH	443 DF	HIST	475W DF	RL ST	181 DF	WMNST	423 DF
ELISH	485 DF	HIST	481 DF	RL ST	401 DF	WMNST	453 DF
ELISH	487 DF	HL ED	302 DF	RL ST	408 DF	WMNST	455 DF
ENGL	135 DF	HSTRY	109 DF	RL ST	409 DF	WMNST	457 DF
ENGL	139 DF	I B	445 DF	RL ST	411 DF	WMNST	471 DF
ENGL	194 DF	INTAG	100 DF	RL ST	481 DF	WMNST	490 DF

Appendix E. Suggested technical electives

COMPUTER SCIENCE AND ENGINEERING

CMPSC 403	Advanced Programming for Non-Majors
CMPSC 408	Computer Applications in Chemistry
CMPSC 481, 482	Introduction to Artificial Intelligence I & II
CMPEN 271	Introduction to Digital Systems
CMPEN 331	Computer Organization and Design
CMPEN 415	Computer Systems Architecture
CMPEN 431	Introduction to Computer Architecture

ELECTRONIC MATERIALS

EE 305	Introduction to Electronic Measuring Systems
EE 320	Introduction to Electro-optical Engineering
EE 368	Introduction to Electronic Devices & Circuits
EE 418	Solid State Device Technology
EE 419	Solid State Devices
E.SC 314	Electronic Materials
MATSE 417	Electrical and Magnetic Properties
PHYS 237	Introduction to Quantum Physics (not for CerSE or EPM)
PHYS 400	Intermediate Electricity and Magnetism
PHYS 402	Electronics for Scientists
PHYS 410	Introduction to Quantum Mechanics
PHYS 412	Solid State Physics I
PHYS 413	Solid State Physics II
PHYS 420	Thermal Physics
PHYS 421	Kinetic Theory and Statistical Mechanics
PHYS 467	Intermediate Electricity and Magnetism

PROCESSING SCIENCE

CH E 301	Principles of Chemical Engineering
CH E 302	Principles of Chemical Engineering II
CH E 303	Principles of Chemical Engineering III
CH E 413	Mass Transfer Operations
CH E 441	Polymer Processing
CH E 446	Introduction to Transport Phenomena
CH E 460	Chemical Engineering
CHEM 034 or 038	Organic Chemistry
CHEM 408	Computer Applications in Chemistry
CHEM 410, 411	Inorganic Chemistry
CHEM 439	Structural, Analysis of Organic Compounds
CHEM 448	Surface Chemistry
CHEM 451, 452	Physical Chemistry
CHEM 453	Thermodynamics of Chemical Systems
CHEM 454	Introduction to Quantum Chemistry
CHEM 455	Physical Chemistry of High Polymers
CHEM 463	Chemical Kinetics
IE 310	Principles of Deformation Processing

IE 311	Principles of Solidification Processing
IE 414	Materials Joining Processes and Principles
IE 426	Industrial Automation
IE 428	Metal Casting
IE 438	Metal Cutting Principles and Practice
MATSE 410	Phase Relations in Materials Systems
MATSE 411	Ceramic Processing
MATSE 412	Thermal Properties and Refractories
MATSE 415	Introduction to Glass Science
MATSC 416	Materials Preparation
MATSE 425	Processing of Metals
MATSE 426	Aqueous Processing
MATSE 422	Thermochemical Processing
MATSE 442	Polymer Synthesis
MN PR 301	Elements of Mineral Processing
MN PR 401	Mineral Process Engineering
MN PR 413	Mineral Processing Laboratory
MN PR 421	Particle Technology Laboratory
MN PR 425	Interfacial Phenomena and Flotation

STRUCTURAL MATERIALS

E MCH 215	Mechanical Response of Materials
E MCH 400	Advanced Strength of Materials and Design
E MCH 402	Applied and Experimental Stress Analysis
E MCH 403	Strength Design in Materials and Structures
E MCH 407	Computer Methods in Engineering Design
E MCH 408	Elasticity and Engineering Applications
E MCH 415	Fracture Mechanics
E MCH 440	Nondestructive Evaluation of Flaws
E MCH 446	Mechanics of Viscoelastic Materials
E MCH 461	Applied Finite Element Analysis
E MCH 471	Engineering Composite Materials
E MCH 473	Composite Processing
E MCH 496A	Ultrasonic Nondestructive Evaluation
E MCH 497A	Engineering Plastics Selection and Design
E SC 261M	Computational Methods in Engineering
E SC 314	Engineering Applications of Materials
MATSE 436	Mechanical Properties of Materials
MATSE 420	Corrosion and Degradation of Engineering Materials
MATSE 421	Corrosion Engineering
MATSE 424	Deformation, Fracture and Alloy Design
MATSE 446	Mechanical Properties of Polymers and Composites

MISCELLANEOUS

CE 270	Introduction to Environmental Engineering
IE 302	Engineering Economy
IE 426	Industrial Automation
MATH 405, 406	Advanced Calculus for Engineers and Scientists I & II
NUC E 401	Introduction to Nuclear Engineering
NUC E 497F	Nuclear Materials Engineering
PHYS 454	Atomic and Nuclear Physics
STAT 401	Experimental Methods
STAT 414	Introduction to Probability Theory
STAT 415	Introduction to Mathematical Statistics
STAT 451	Introduction to Applied Statistics
MATH 405	Advanced Calculus for Engineers and Scientists
MATH 406	Advanced Calculus for Engineers and Scientists II
MATH 411	Ordinary Differential Equations
MATH 414	Introduction to Probability Theory
MATH 416	Stochastic Modeling
MCB 474	Physical Properties of Biological Macromolecules

MATERIALS SCIENCE

MATSE 403	Biomaterials
MATSE 5xx	Graduate Level Courses
F SC 401	Introduction to Fuel Technology
F SC 422	Combustion Engineering
MATSE 423	Phase Transformations in Metals and Alloys
MATSE 441	Polymeric Materials
MATSE 442	Polymer Synthesis
MATSE 443	Introduction to Materials Science of Polymers
MATSE 444	Polymer Science I
MATSE 445	Polymer Science II

MINORS

Foreign Language
Engg
Engineering Mechanics
Computer Science
Earth Systems
Polymer Science

SHA ELECTIVES (ENGG RELATED)

STS 005	Women in Science, Technology and
STS 107	Philosophy of Technology
STS 120	The Finite Earth
STS 135	Politics of Scarcity
STS 420	Energy and Modern Society
STS 433	Ethics in Science and Engineering
STS 489	Technology and Human Values
MN EC 100	Global Aspects Minerals, Materials & Energy

Appendix F. Honors studies in Materials Science and Engineering

H-option Courses

Most 400-level courses can be taken with an H-option (honors option). The H-option requires that the course coverage contains:

(a) Advanced information/knowledge
(b) Additional in-depth material
(c) An integration with other courses in general topic area

MATSE 4XXH H-option courses are structured as follows:

1. An honors student takes the normal MATSE 4XX course, with the following additions/changes making it an H-option course.
2. At the beginning of the course, the honors student is given a listing of several (2-4) advanced topic areas related to the course, along with handout/reading materials related to each of these areas.
3. The faculty member meets one-on-one with the student for 1 to 2 hour tutorial discussions of these advanced topic areas on at least 3 occasions during the semester.
4. The honors student takes each normal class exam at its designated time, but with the following changes in to make them H-option exams. At least one normal exam question, which is related to one of the H-option advanced topic areas, is replaced by a more challenging question.

Honors Thesis

The honors thesis is an extremely important part of the honors program at Penn State. The honors thesis in Materials Science & Engineering, is structured as follows:

Junior Year (5th and 6th semesters)

Fall Choice of Thesis Topic: Discussions with the honors advisor will outline plan of action for learning about possibilities of thesis topic choices. The student will make appointments and talk with several possible faculty advisors about thesis topics. The student will make a choice of topics, and then do a more detailed literature search and write a proposal for thesis research which will be turned in to the honors advisor and the chosen thesis advisor. The proposal may also be presented orally.

Spring MATSE 496H – 1-credit – Thesis Research: The student will begin research, handing in progress reports to both the honors and thesis advisors at 8 weeks and at the end of the semester. The final progress report will also contain a revision of the original proposed research plans based on the accomplished research.

Senior Year (7th and 8th semesters)

Fall MATSE 490H – 1 credit – Senior Seminar and Field Trip

MATSE 493WH – 1-credit – Thesis Research: Continued thesis research with progress reports at 8 weeks and the end of the semester.

Spring MatSE 494WH – 2-credits – Thesis Research: Complete thesis research and write honors thesis according to format of honors program.

HONORS COURSE GUIDELINES

Subject Matter

1. The subject matter should be as advanced as the student is prepared for.
2. The subject matter should be explored with the sophistication, depth, and intensity appropriate to Penn State's ablest students and thus greater than is possible in a non-honors course. It should lead the student towards scholarship in the area.
3. The interconnectedness of ideas and topics, both within and outside the area of study, should be explored.
4. The subject matter should represent significant intellectual concerns, central to the intellectual enterprise. Honors should not be an adjunct to education or a peripheral embellishment.
5. Greater volume of work is not, in itself, a characteristic of an honors course, and honors credit should not be awarded simply for doing additional work.

Method

1. Students should be engaged in active learning. They should be led out of the passivity to which many have grown accustomed.
2. Techniques of exploration, participation, thinking on one's own, and questioning should be taught and encouraged so that students learn to learn and know what it means to know.

Evaluation

1. The evaluation of a student's work must, of course, include letter grades. They should be assigned by a standard which does not penalize the student for having chosen an honors course.
2. A finer scale, more detailed evaluation than is possible with letter grades, should be provided to the student.

Format

1. Honors classes should be small. The maximum should not exceed 25 students.
2. An honors class should be an entirely separate class and not merely a separate recitation or lab section.
3. In rare cases (for example, where it may not be possible to duplicate costly demonstrations for a small group) there may be an honors recitation section. It must, however, be taught by the lecturer and be given sufficient time to pursue the goals and methods described under the first two headings.

INSTRUCTORS OF HONORS SECTIONS

1. The instructor must be a regular faculty member. Specific exceptions may be made.

2. The instructor must be committed to students' intellectual development and be skilled in promoting such development among students of high ability.

3. The instructor must be a scholar with research accomplishments.

APPROVAL OF HONORS COURSES

1. Honors courses should be approved by each department according to standard procedures and the approval conveyed to the Schreyer Honors College. All approved courses will be reviewed and evaluated for offering by the College.

2. The continuation of an honors course should be subject to consultation with the Schreyer Honors College.

APPENDIX G Format for bachelor's thesis in Materials Science and Engineering

(EXAMPLE)

The Pennsylvania State University
College of Earth and Mineral Sciences
Department of Materials Science and Engineering (14 point)

Proper Thesis Title/Signatory Page Format for Bachelor of Science Degree in Materials Science and Engineering (16 point/bold)

A Thesis in Materials Science and Engineering

By

Josephine Q. Author

Submitted in Partial Fulfillment of the Requirements for the Degree of Bachelor of Science in Materials Science and Engineering (XXXXX Option)

Date (14 Point)

I (we approve this thesis: (14 point) Date of Signature:

_____ _____

Joe Q. Advisor, Academic Title
Thesis Advisor (14 point)

Add other co-advisor signatures as needed

(*EXAMPLE)*

TABLE OF CONTENTS

LIST OF FIGURES

And so on.

Then go to a separate page for:

LIST OF TABLES

REFERENCES

Follow the citation format from the most prestigious Journal in your subdiscipline.

If you can't find a good description of the proper citation format, then use the Journal of the American Ceramic Society format

For an excellent example of how to build figures, tables, citations, use of SI units, etc., see:

J. Am. Ceram. Soc., 83(12)3235-3238(2000)

Appendix H. Suggested curricula for students participating in Cooperative Education

There are numerous ways to organize curricula for students participating in Cooperative Education. Several ways for each option are presented in this Appendix. Students are strongly urged to discuss the possibilities with their academic advisor for their option.

Ceramic Science and Engineering:

PLAN "A"

Summer (5)	Fall (6)	Spring (7)	Summer (8)
Stat 301/401	MatSE 400	COOP	SHA-5
Engl 202C	MatSE 401	Eng 295	SHA-6
SHA-4	MatSE 430		
	MatSE 460		
	IE 424		
	TechElec*		
6 credits	16 credits	1 credit	6 credits

Fall (9)	Spring (10)	Summer (11)	Fall (12)
COOP	MatSE 402	COOP	MatSE 412
Eng 395	MatSE 410	Eng 495	MatSE 411
	MatSE 413		MatSE 467
	MatSE 417		MatSE 468
	MatSE 436		MatSE 490
	MatSE 466		MatSE 493W
	MatSE 469		MatSE 494 W
1 credit	16 credits	1 credit	16 credits

PLAN"B"

Summer (5)	Fall (6)	Spring (7)	Summer (8)
COOP	MatSE 400	MatSE 402	COOP
Eng 295	MatSE 401	MatSE 410	Eng 395
	MatSE 430	MatSE 413	
	MatSE 460	MatSE 466	
	IE 424	SHA 5	
	SHA4*	Tech-Elec	
1 credit	17 credits	15.5 credits	1 credit

Fall (9)	Spring (10)	Summer (11)
MatSE 490	MatSE 436	COOP
MatSE 411	MatSE 417	Eng 495
MatSE 412	MatSE 469	
MatSE 415	MatSE 494W	
MatSE 467	MatSE 435	
MatSE 468	Engl 202C	
MatSE 493W		
SHA 6		
15 credits	15 credits	1 credit

* Commonwealth campus students will need to take MatSE 201

Electronic and Photonic Materials:

PLAN "A"

Summer (5)	Fall (6)	Spring (7)	Summer (8)
Engl 202C	MatSE 400	COOP	TechEl-1
SHA-3	MatSE 401	ENG 295	SHA-5
SHA-4	MatSE 430		SHA-6
	MatSE 450		
	MatSE 460		
	ESc 314 OR		
	EE 397E		
9 credits	16 credits	1 credit	9 credits

Fall (9)	Spring (10)	Summer (11)	Fall (12)
COOP	MatSE 402	COOP	MatSE 490
ENG 395	MatSE 417	ENG 495	IE424
	EE 418		TechEl-2
	MatSE 435		MatSE 455
	MatSE 469		MatSE 463
	MatSE 413		MatSE 493 & 494W
1 credit	16 credits	1 credit	14 credits

PLAN "B"

Summer (5)	Fall (6)	Spring (7)	Summer (8)
Engl 202C	COOP	ESc 314	COOP
SHA-3	ENG 295	MatSE 402	ENG 395
SHA-4		MatSE 413	
		EE 418	
		MatSE 417	
		MatSE 469	
9 credits	1 credit	15.5 credits	1 credit

Fall (9)	Spring (10)	Summer (11)	Fall (12)
MatSE 400	COOP	MatSE 493W	IE 424
MatSE 401	ENG 495	SHA-5	MatSE 455
MatSE 430		SHA-6	MatSE 463
MatSE 460			TechEl-1
MatSE 490			TechEl-2
MatSE 450			MatSE 494W
Phys 458			
17 credits	1 credit	7 credits	15 credits

Polymer Science and Engineering:

PLAN "A"

Summer (5)	Fall (6)	Spring (7)	Summer (8)
Stat 301/401	MatSE 400	COOP	SHA-5
Engl 202C	MatSE 401	Eng 295	SHA-6
SHA-4	MatSE 441		
	MatSE 443		
	MatSE 460		
	TechElec 1*		
9 credits	16 credits	1 credit	6 credits

Fall (9)	Spring (10)	Summer (11)	Fall (12)
COOP	MatSE 436	COOP	MatSE 430
ENGR 395	MatSE 444	ENGR 495	MatSE 447
	MatSE 445		TechElec 2
	MatSE 446		TechElec 3[#]
	MatSE 448		MatSE 473
			MatSE 490
			MatSE 493W
			MatSE 494 W
1 credit	15 credits	1 credit	17 credits

PLAN"B"

Summer (5)	Fall (6)	Spring (7)	Summer (8)
COOP	MatSE 400	MatSE 436	COOP
ENGR 295	MatSE 401	MatSE 444	ENGR 395
	MatSE 443	MatSE 445	
	MatSE 447	TechElec 1	
	MatSE 460	Engl 202C	
	IE 424		
1 credit	16 credits	15 credits	1 credit

Fall (9)	Spring (10)	Summer (11)
MatSE 430	MatSE 446	COOP
MatSE 441	MatSE 448	ENGR 495
MatSE 473	MatSE 494W	
MatSE 490	TechElec 2	
MatSE 493W	TechElec 3[#]	
SHA-4	SHA-6	
SHA-5		
15 credits	17 credits	1 credit

* Commonwealth campus students will need to take MatSE 201

[#] Technical Elective 3 can be substituted by 3 Credits of ENGR X95

Metals Science and Engineering:

PLAN"A"

Spring (6)	**Summer (7)**	**Fall (8)**
MatSE 402	COOP	COOP
MatSE436	Eng 295	Eng. 395
MatSE 423		
MatSE 310W		
MatSE 471		
Engl 202C		
16 credits	1 credit	1 credit

Spring (9)	**Summer (9)**	**Fall (10)**
MatSE 426	COOP	MatSE 421
MatSE 417	Eng 495	MatSE 422
MatSE 494W		MatSE 425
Tech El-1		MatSE 472
SHA-6		MatSE 490
		MatSE 493
		Tech El-2
13 credits	1 credit	15 credits

* Commonwealth campus students will need to take MatSE 201

Note: Other plans can be devised, but the plan above has been used by nearly all of our COOP students in the past.

Appendix I. Application forms for Department and College scholarships

PENNSTATE

DEPARTMENT OF MATERIALS SCIENCE AND ENGINEERING
COMMITTEE ON SCHOLARSHIPS

STUDENT APPLICATION

PERSONAL

Name _____ **Student Number** _____

Home Address _____

Home Telephone _____

ACADEMICS

Grade Point Average _____ **Class Rank** _____

Option _____

Advisor _____

GRADUATION (When do you expect to graduate)

Semester/Year_____

ANY OTHER SIGNIFICANT INFORMATION, ESPECIALLY INDICATING NEED

_____

_____

_____

Due to Undergraduate Studies Office by April 1st each year.

COLLEGE OF EARTH AND MINERAL SCIENCES
COMMITTEE ON SCHOLARSHIPS AND AWARDS

STUDENT APPLICATION

A.PERSONAL

1. Name_____Student Number_____
2. Home Address _____
3. University Address_____
4. Home Telephone_____ University Telephone_____

B. UNIVERSITY RECORD

5. How many semesters have you completed (including this one)?_____
6. Number of credits completed (including this semester)_____
7. Major_____ 8. Campus_____
9. Cumulative GPA_____ 10. GPA for Latest Semester_____
11. Advisor's Name_____
12. Did you receive an EMS scholarship last year? Yes_____ No_____
13. Number of semesters for which you will register for the next academic year_____
14. When do you expect to graduate? (Semester and Year)_____
15. Were you enrolled full-time___ or part-time____in the last year? (Check one or explain.)
16. Do you intend to enroll full-time___ or part-time___ in the next year? (Check one or explain.)
17. Have you filed a financial need form with the University?_____
18. Do you wish to be considered for departmental scholarships that take into account financial need ___ or minority status___? (Check appropriate category.)

SIGNATURE_____**DATE**_____

C. PART-TIME STUDENTS ONLY

If you answered "part-time" to questions 15 or 16, please attach a one-page statement that gives:

1. A list of courses and credits completed in the last two semesters and the grades received;
2. A plan of study for the next two semesters (i.e., a list of courses and credits in which you plan to enroll); and
3. A brief comment on what circumstances have led you to choose part-time studies.

Appendix J

MatSE Student Branch Groups

MatSE Student Branch listings					
Student Activity	**Program Chair/Advisor**	**President**	**Vice President**	**Secretary**	**Treasurer**
ACERS Student Branch	Hellmann/Adair	TBA	TBA	TBA	TBA
	Ox-Roast Chair				
	TBA				
Keramos Student Branch	Hellmann	Jane Howell	TBA	TBA	TBA
	hellmann@matse.psu.edu	Jah956@psu.edu			
ASM	Koss	Brian Marx	Andrew Glendening	Mary Horsey	Murray Small
	koss@ems.psu.edu	Bmm114@psu.edu	andyg@psu.edu	mah309@psu.edu	Jms821@psu.edu
Polymers Club	Painter	TBA	TBA	TBA	TBA
	painter@matse.psu.edu				
MRS	Schlom	TBA	Josh Robinson	Christie Skrip	Nays Baser Garb
	schlom@matse.psu.edu		jrobinson@psu.edu	ces199@psu.edu	nzb102@psu.edu