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 2005

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

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Table of Contents

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 Allison Albinski (814-865-5766; ava10@psu.edu), or 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. 14) 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. Students typically declare their option at the end of their fourth semester, but may do so as early as the start of semester two. The Ceramics, Metals, Electronic and Photonic Materials and Polymer Science and Engineering study tracks are fully accredited by the Accreditation Board for Engineering and Technology (ABET) of the Engineering Accreditation Commission.

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. The option is fully accredited by the Accreditation Board for Engineering and Technology (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 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, or 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 teamwork, 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.24). 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, 401, 430, 436, 441, 443, 444, 445, and 492W); Ceramics Science and Engineering (MatSE 201, 401, 402, 430 and 492W); Electronic and Photonic Materials (MatSE 201, 401, 402, 430, and 492W); Metals (MatSE 201, 401, 402, 423, 430 and 492W).

7.3.2 General Course Requirements

The Baccalaureate Degree General Education Program
The baccalaureate degree General Education program consists of 45 credits that are distributed among two General Education components: (1) Skills (15 credits) and (2) Knowledge Domains (30 credits) in the Natural Sciences, Arts, Humanities, Social and Behavioral Sciences, and Health and Physical Activity. Every baccalaureate degree student also completes the First-Year Seminar, Intercultural and International Competence, and Writing Across the Curriculum requirements.

A restriction is placed on students in majors that are closely linked to the Knowledge Domains of Natural Sciences, Arts, Humanities, and Social and Behavioral Sciences to ensure that they participate in the full breadth of General Education. These students may not use a course in their academic major to satisfy one of the Knowledge Domains requirements. For example, an Economics major may not use an economics course to fulfill his/her social and behavioral sciences requirement. Also, students may not count courses cross-listed with courses in their major to fulfill one of the General Education Knowledge Domain, e.g., a Theatre major may not register for THEA 208 (GA, GI) / AAAS 208 (GA, GI) and have it count in the Arts requirement.

SKILLS (15 credits)

Writing/Speaking (9 credits)
Courses designated with the suffix GWS satisfy this component.

Quantification (6 credits)
Courses with the suffix GQ satisfy this component. (3-6 credits are selected from mathematics, applied mathematics, and statistics; 3 credits may be selected from computer science or symbolic logic.)

KNOWLEDGE DOMAINS (30 credits)

Health and Physical Activity (3 credits)
Courses with the suffix GHA satisfy this component.

Natural Sciences (9 credits)
Courses with the suffix GN satisfy this component.

Arts (6 credits)
Courses with the suffix GA satisfy this component.

Humanities (6 credits)
Courses with the suffix GH satisfy this component.

Social and Behavioral Sciences (6 credits)
Courses with the suffix GS satisfy this component.

ADDITIONAL REQUIREMENTS
Baccalaureate degree students must complete one First-Year Seminar (S, T, or X suffix, or PSU abbreviation), 3 credits of Intercultural and International Competence (GI), and 3 credits of Writing Across the Curriculum (W, M, X, and Y). These requirements may be completed by designated courses that also meet other degree or General Education requirements.

FLEXIBILITY OF THE BACCALAUREATE DEGREE GENERAL EDUCATION REQUIREMENTS
Penn State wants students to use General Education to experiment and explore, to take academic risks, to discover things they did not know before, and to learn to do things they have not done before. To that end, the General Education program extends the concept of flexibility to all aspects of the degree program.

Students may, with the permission of their adviser and Dean's representative:

1. substitute a 200- to 499-level course in an area of General Education for a course found on the General Education list. For example, a student may take a 400-level course in history and use it to meet the General Education requirement satisfied by a comparable lower- level history course.

2. substitute a foreign language at the twelfth credit level of proficiency, as measured by the Penn State foreign language offerings, for 3 credits in any of the categories of General Education. Baccalaureate degree students may substitute study in a foreign/second language at the twelfth credit level of proficiency or higher for any three credits in any of the categories of general education only if those three credits are in language study beyond their degree requirements.*

3. substitute a third course in one of the Knowledge Domains areas of Arts, Humanities, or Social and Behavioral Sciences for a second course in one of the other areas. For example, a student might take 3 courses in the Arts, two courses in the Humanities, and only one course in the Social and Behavioral Sciences. This substitution is often referred to as the 9-6-3 sequence, representing the 9 credits, 6 credits, and 3 credits completed in place of the specified 6-6-6.*

4. meet the Intercultural and International Competence requirement through completion of a one-semester or year-long education abroad experience approved through the Penn State Office of Education Abroad.

5. meet the First-Year Seminar (FYS) requirement through completion of a FYS course offered by any unit of the University. Thus, a student who successfully completes a FYS course in one college, prior to transferring to another college, will not be required to complete another FYS. However, since there are various modes of offering a FYS throughout the University, students transferring to a new college may find that a required course that is also a FYS must still be taken.

*Please note: The use of these two substitutions (#2 and #3 above), either alone or in combination, may not lead to the complete elimination of any area in the skills or knowledge domains categories in the student?fs general education program.

Students have freedom of choice regarding Social Sciences, Humanities and Arts courses to satisfy General Education course requirements (*). Students are encouraged to use General Education courses to sample other interests or to explore the possibility of a minor. For information on GenEd courses go to www.psu.edu/dus/handbook/gened.html

***Not all General Education courses satisfy ABET requirements. Please consult your advisor.**

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 D (p. 30) 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 E (p.35). Students interested in taking an honors course should consult the honors advisor for their option.

7.3.6.1.1.1 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 typically 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 F (p. 39). 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 G (p. 45).

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. Contact Scott Henninger (henninger@matse.psu.edu) to schedule your safety exam.

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 electronically on the College website. Scholarships with financial need criteria are only available to students who have filed the necessary financial aid disclosure forms (FAFSA) with the University.

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 to be active in their respective societies, and to apply promptly whenever such scholarship announcements are made.

Application Link: http://www.ems.psu.edu/students/application.html

11.0 International Internship In Materials

The goal of the Materials Study Abroad experience is to enrich the learning experience of undergraduates by immersing them in an international research activity. Likewise, by providing reciprocal opportunities for undergraduates from host institutions at Penn State, our students will benefit from international students' perspectives and cultures.

The students selected for the program will be offered research internships based on collaborations of Materials Science and Engineering faculty with faculty at host institutions such as the ones listed below. Because the internships will be highly structured research programs, students may be able to use their research in support of technical electives and/or senior thesis; a requirement for all MatSE students.

Please note the criteria for our students to participate:

- GPA 3.0 or above
- Language capability or reasonable plan to gain
- Financial plan to pay for expenses associated with program
- Sufficient laboratory experience
- Safety training
- Completed MatSE 201 and MatSE 460
- Semester 5 standing or above
- Statement of interest letter
- If approved student will attend cultural class from OEA

Locations:

Darmstadt, Germany (www.tu-darmstadt.de)
Erlangen, Germany (www.uni-erlangen.de)
Leeds, England (www.leeds.ac.uk)
Limoges, France (www.ensci.fr)
Padua, Italy (www.unipd.it)
Sheffield, England (www.shef.ac.uk)
Zurich, Switzerland (www.ethz.ch)

Contact Stacy Davidson (Davidson@matse.psu.edu) for more information

12.0 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!

12.1 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.

12.2 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. Please refer to section 7.3.7 (p. 9) of this handbook for more information.

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).

12.3 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.

12.4 Penn State Career Days

Career Days is a networking and recruiting event for all Penn State students of all standings, in all majors at all campuses. It is jointly sponsored by Career Services and the academic and colleges at Penn State's University Park campus. Career Days invites organizations to visit campus, set up a booth in the Bryce Jordan Center where representatives share information about their organizations.

Students then have the opportunity to talk with company representatives, hand out resumes and possibly schedule interviews and for full-time, co-op or internship employment. This event has become one of the largest university-run career fairs in the country with nearly 500 employers participating, and more than 8,000 students attending. Preparation workshops are offered to aid students in preparing a resume, interview skills and networking at the career fair. It is your first (and largest) opportunity to explore career opportunities, network and begin your full-time, internship or co-op job search.

For more information on Penn State Career Days visit http://www.fairs.sa.psu.edu/

12.5 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!

The student-run chapters of professional societies are organized under the Material Advantage program run by the American Ceramic Society, ASM International, The Metallurgical Society (TMS), and the Association for Iron and Steel Technology (AIST). As members of the Material Advantage chapter, students receive membership in each of these professional societies, copies of their monthly technical publications, notification of upcoming technical meetings nation-wide, eligibility for academic and professional development scholarships, discounts on books and publications etc. More information can be found at www.materialadvantage.org. The department subsidizes the annual membership fee for undergraduates who are active in the Material Advantage chapter.

In addition to Material Advantage, there are several honorary and professional fraternities active within the Department: Keramos National Professional Ceramic Engineering Fraternity, Alpha Sigma Mu, and 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 H (p.50).

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 2005/Spring 2006

Advisors for Freshman and students who have not selected an Option:
Dr. Paul Howell: Howell@matse.psu.edu 863-3363
Dr. Allen Kimel: Kimel@matse.psu.edu 865-5397

Advisors for students who have declared an option including honors students:

CERAMICS	EPM	METALS	POLYMER
Dr. David Green Green@matse.psu.edu 863-2011	Dr. Joan Redwing Redwing@matse.psu.edu 865-8665	Dr. Paul Howell Howell@matse.psu.edu 863-3363	Dr. Paul Painter Painter@matse.psu.edu 865-5767

Appendix B: Faculty in the Department of Materials Science and Engineering

(See http://www.matse.psu.edu/)

MatSE Faculty

JAMES ADAIR, Professor of Materials Science and Engineering
adair@matse.psu.edu, 249A Materials Research Building, 863-6047
Research Interests: • Nanoscale materials and phenomena • Electronic, optical and structural property determinations for designer particles and materials • Colloid and interfacial chemistry • Material synthesis and chemistry • Powder characterization and powder processing

DAVID L. ALLARA, Professor of Materials Science and Chemistry
allara@matse.psu.edu, 104 Chemistry Building, 865-2254
Research Interests: • Surface chemistry and physics involving preparation, properties, and characterization of molecular and polymeric thin films, modified surfaces, and materials interfaces • Transport, thermodynamic, bio-response, electronic, electromagnetic and energy conversion properties of thin films and nanoscale structures, including carbon nanotubes • Complex architectures by self-and directed assembly at surfaces • Applications include microelectronics processing, molecular electronics, quantum computing, chem.-bio sensors, energy production and conversion, nanolithography and biocompatibility

PAUL W. BROWN, Professor of Materials Science and Engineering
brown@matse.psu.edu, 136 Materials Research Laboratory Building, 865-5352
Research Interests: • Low Temperature Formation of Advanced Ceramics and Composites

LONG-QING CHEN, Professor of Materials Science and Engineering
chen@matse.psu.edu, 102 Steidle Building, 863-8101
Research Interests: • Thermodynamics and kinetics of phase transformations • Phase-field simulation of domain structure and microstructure evolution • Ferroelectric thin films • Alloy precipitations • Martensitic transformations • Interactions between defect and phase microstructures • Multiscale modeling

T. C. (MIKE) CHUNG, Professor of Materials Science and Engineering
chung@matse.psu.edu, 325 Steidle Building, 863-1394
Research Interests: • Functionalization of polyolefins via the combination of metallocene catalysts and reactive chain transfer agents • Functionalization of fluoropolymers using borane-mediated radical polymerization • Living radical polymerization based on new borane/oxygen initiators • Electric-active fluoropolymers with high dielectric constant and large and fast electromechanical response at ambient temperature • B/C/M graphitic materials for hydrogen storage

RALPH COLBY, Professor of Materials Science and Engineering
colby@matse.psu.edu, 309 Steidle Building, 863-3457
Research Interests: • Proteins • Polyelectrolytes • Ionomers • Liquid crystalline polymers • Block copolymers • Miscible polymer blends • Branched polymers • Networks • Glass-forming liquids • Surfactants and colloidal suspensions

TARASANKAR DEBROY, Professor of Materials Science and Engineering
debroy@matse.psu.edu 115 Steidle Building, 865-1974
Research Interests: • Fusion Welding Processes

ELIZABETH C. DICKEY, Associate Professor of Materials Science and Engineering
dickey@matse.psu.edu, 223 Materials Research Laboratory Building, 865-9067
Research Interests: • Interface Materials Science • Nanomaterials • Electron Microscopy • Residual Stresses

JOSEPH FLEMISH, Senior Scientist and Professor of Materials Science and Engineering
joeflemish@psu.edu, 314 Applied Science Building, Applied Research Laboratory, 865-0942
Research Interests: • Processing and characterization of electronic materials and devices • Plasma-assisted deposition and etching techniques • Wide bandgap semiconductor technology • Process development and integration for high-power and high-frequency devices.

VENKATRAMAN GOPALAN, Associate Professor of Materials Science and Engineering
gopalan@matse.psu.edu, 253 Materials Research Laboratory Building, 865-2910
Research Interests: • Optical materials • Electro-optics • Ultrafast nonlinear optics • Scanning probe microscopy • Near-field optical imaging • Ferroelectrics • Ferromagnets • Semiconductors • Photonic crystals structures • Electromagnetic wave modeling • Phenomenological modeling

DAVID J. GREEN, Professor of Ceramic Science and Engineering
green@matse.psu.edu, 230 Steidle Building, 863-2011
Research Interests: Relationships between fabrication, microstructure and the properties of brittle materials; including:
• microcracking in ceramics • reliability of ceramics in structural design • failure analysis • micromechanical theory
• fabrication and evaluation of transformation-toughened ceramics • surface stresses • toughening mechanisms • indentation and fatigue of glasses • mechanical behavior of porous ceramics

RONALD HEDDEN, Assistant Professor of Materials Science and Engineering
hedden@matse.psu.edu, 325C Steidle Building 863-2325
Research Interests: • Liquid crystalline polymers and networks; hydrogel scaffolds for • Tissue engineering; polymer gel electrolytes for lithium ion batteries • Dendrimers, dendrimer-gels, and dendrimer-star polymers • Characterization of nanoporous low-k dielectric thin films

JOHN R. HELLMANN, Professor of Ceramic Science and Engineering, Associate Head of Undergraduate Studies
hellmann@matse.psu.edu, 124 Steidle Building, 865-0163
Research Interests: • Thermal, elastic, mechanical properties of ceramic, metal, intermetallic, and composite materials for high temperature applications • Processing/structure/properties/performance relationships • Metastable and equilibrium phase relationships • Polymer precursor routes to fabrication of ceramics and composites via direct foaming and infiltration • Slow crack growth and fracture behavior of glasses and ceramics • Thermal fatigue behavior of monolithic and composite materials

PAUL R. HOWELL, Professor of Metallurgy
howell@matse.psu.edu, 231 Steidle Building, 863-3363
Research Interests: • Materials Science Education • Computers in Education • Materials Archeology • Metallic Materials: Steels and Aluminum-Based Alloys • Phase Transformations

R. ALLEN KIMEL, Assistant Professor of Materials Science and Engineering
kimel@matse.psu.edu, 212A Steidle Building 865-5397
Research Interests: • Ceramic processing • Synthesis and processing of nanoparticles in aqueous environments • Undergraduate Education • Colloidal and interfacial chemistry • General materials chemistry

ZI-KUI LIU, Associate Professor of Materials Science and Engineering
liu@matse.psu.edu, 209 Steidle Building, 865-1934
Research Interests: • First-principles calculations • Computational thermodynamics • System materials design • Aluminum alloys
• Hydrogen storage materials • Magnesium alloys • Nickel alloys • Perovskites • Steels

DIGBY D. MACDONALD, Professor of Materials Science and Engineering, Director of the Center for Electrochemical Science and Technology
macdonald@matse.psu.edu, 201 Steidle Building 863-7772
Research Interests: • Passivity and passivity breakdown on metals • Deterministic prediction of corrosion damage • Advanced batteries and fuel cells • Chemistry and electrochemistry of supercritical aqueous systems • Nuclear power generation
• Electrocatalysis

EVANGELOS MANIAS, Associate Professor of Materials Science and Engineering
manias@matse.psu.edu, 325D Steidle Building 863-2980
Research Interests: • Polymers at surfaces, interfaces, and confinements; structure and dynamics of nano-confined polymers
• Atomic Force Microscopy (AFM) studies of polymer surfaces • Polymer/Inorganic nanocomposite materials • Smart/Responsive polymers and soft-condensed matter systems

GARY L. MESSING, Professor of Ceramic Science and Engineering, Head, Department of Materials Science and Engineering
messing@matse.psu.edu, 121 Steidle Building 865-2262
Research Interests: • Solution synthesis of powders and films • Seeding phase formation • Sintering • Grain Growth • Templated Grain Growth • Optical materials • Ferroelectric materials

SUZANNE E. MOHNEY, Professor of Materials Science and Engineering
mohney@matse.psu.edu 202A Steidle Building 863-0744
Research Interests: • Electronic materials • Metals in electronics • Compound semiconductors • Wide band gap semiconductors

CHRISTOPHER MUHLSTEIN, Assistant Professor of Materials Science and Engineering
muhlstein@matse.psu.edu, 202B Steidle Building 865-1523
Research Interests: • Mechanical behavior • Fracture • Fatigue • MEMS • Thin films

KWADWO OSSEO-ASARE, Professor of Metallurgy and Energy and Geo-Environmental Engineering
asare@matse.psu.edu, 208 Steidle Building 865-4882
Research Interests: • Aqueous Processing: Materials Synthesis & Processing • Nanoparticle Synthesis, Purification, and Assembly • Wet Processing in Semiconductor Fabrication • Chemical-Mechanical Polishing, Surface Cleaning & Finishing • Hydrometallurgy • Separation Science & Technology • Environmental Systems • Applied Aqueous Chemistry: Interfacial and Colloidal Phenomena • Surfactant Science • Semiconductor Electrochemistry • Thermodynamic Modeling

PAUL C. PAINTER, Professor of Polymer Science
painter@matse.psu.edu, 321 Steidle Building 865-5767
Research Interests: • Vibrational Spectroscopy of Polymers • Phase Behavior of Polymer Blends • Coal Structure

CARLO G. PANTANO, Distinguished Professor of Materials Science and Engineering; Director of the Materials Research Institute, Director, Materials Characterization Lab
pantano@matse.psu.edu, 198 Materials Research Institute Building 863-2071
Research Interests: • Glass surfaces, interfaces, and coatings • Computer modeling of surface structure and water adsorption • Silane monolayers and polymer coatings on glass • (stress) corrosion, weathering and strength • Wet and dry etching • Silica, silicates, phosphates and germinates • Melting, sol/gel, sputtering, EBPVD, CVD • Surface and thin film characterization with XPS, SIMS, AFM, FTIR and IGC • Nano-mechanical properties of surfaces and coatings

HOWARD W. PICKERING, Distinguished Professor of Metallurgy
pickering@matse.psu.edu, 326 Steidle Building 863-2640
Research Interests: • Corrosion Mechanisms • Electrodeposition • Hydrogen Absorption in Metals • Coatings and Inhibitors for Corrosion Prevention • Failure Analysis.

CLIVE A. RANDALL, Professor of Materials Science and Engineering, Director of the Center for Dielectric Studies
randall@matse.psu.edu, 144 Materials Research Laboratory Building 863-1328
Research Interests: • Electronic Materials

JOAN REDWING, Associate Professor of Materials Science and Engineering
redwing@matse.psu.edu, 108 Steidle Building 865-8665
Research Interests: • Electronic materials synthesis and characterization • Metalorganic vapor phase epitaxy of compound semiconductors • Wide bandgap materials (Group III-Nitrides and SiC) • Semiconductor nanowire fabrication • Gas phase and surface chemistry of epitaxial growth

JAMES P. RUNT, Professor of Polymer Science and Associate Head for Graduate Studies
runt@matse.psu.edu, 101 SteidleBuilding 863-2749
Research Interests: • Broadband dielectric spectroscopy as applied to dynamics of complex polymer systems: H-bonded blends and solutions, ion-containing polymers • Crystalline polymers: polylactides, self-assembly of carbohydrate polymers • Polyurethane block copolymers in blood-contacting applications (cardiac assist devices): nanodomain structure and segment demixing; permeability

JERZY RUZYLLO, Professor of Electrical Engineering and Materials Science and Engineering
ruzyllo@matse.psu.edu, 214 Electrical Engineering West 865-5193
Research Interests: Semiconductor electronics and photonics: • Manufacturing methods • Surface processing • Surface and material characterization • Novel thin film deposition techniques • Large-area semiconductor structures

EARLE R. RYBA, Associate Professor of Metallurgy
ryba@matse.psu.edu), 122 Steidle Building 865-3760
Research Interests: • Phase relations and heat treatment of Ti-Ru-Al alloys • Hydrogen storage in intermetallic compounds • Structure of polymer/metal interfaces

DARRELL G. SCHLOM, Professor of Materials Science and Engineering
schlom@matse.psu.edu, 108 Materials Research Institute Building 863-8579
Research Interests: • Oxide Thin Films • Electronic Materials • Ferroelectrics • Dielectrics • Epitaxial Thin Films • Molecular-Beam Epitaxy (MBE) • Pulsed-Laser Deposition (PLD)

SUSAN TROLIER-MCKINSTRY, Professor of Ceramic Science and Engineering
stmckinstry@matse.psu.edu, 151 Materials Research Laboratory Building 863-8348
Research Interests: • Ferroelectric Materials • Piezoelectric and dielectric films • Microelectromechanical systems • Spectroscopic ellipsometry • Templated grain growth

ERWIN A. VOGLER, Associate Professor of Materials Science and Engineering and Bioengineering
vogler@matse.psu.edu, 103 Steidle Building 863-7403
Research Interests: • Biomaterials Surface Science

QING WANG, Assistant Professor of Materials Science and Engineering
wang@matse.psu.edu, 319 Steidle Building 863-0042
Research Interests: • Functional polymers • Semiconducting polymers • Metal-containing polymers • Nanocomposites • Dielectric polymers • Organic thin films • Self-assembly • Molecular recognition • Supramolecular chemistry • Micro/nano-patterning • Optoelectronics • Molecular electronics • Sensors

Courtesy Faculty

ANDRE L. BOEHMAN, Associate Professor of Fuel Science and Materials Science and Engineering
boehman@ems.psu.edu 114B Hosler Building 865-7839
Research Interests: • Alternative and reformulated fuels • Combustion • Pollution Control

MILTON W. COLE, Professor of Physics, Distinguished Professor of Materials Science and Engineering
mwc@psu.edu 341 Davey Lab 863-0165
Research Interests: • Wetting transitions of thin films • Ultraweak forces binding atoms to surfaces • Superfluidity in films • Quasi-one dimensional fluids within nanotubes Tools are statistical mechanics and computer simulation.

VINCENT H. CRESPI, Professor of Physics, Professor of Materials Science and Engineering
326 Davey Lab 863-0163
Research Interests: • Adsorption onto Carbon Nanotubes • Beowulf Commodity Supercomputers: Sherwood • Electronic Properties of Carbon Nanotubes • Metastable Semiconductor Alloys • Electronic Properties, Optical Properties, Semiconductors • Optimization of Photonic Structures • Structural Properties of Carbon Nanotubes

QIANG DU, Professor of Mathematics and Materials Science and Engineering
qdu@math.psu.edu 238 McAllister Building 865-3674
Research Interests: • Numerical Algorithms • Partial Differential Equations • Parallel Computation • Scientific computation applications in physical, biological and materials sciences • data and image analysis

PETER EKLUND, Professor of Physics and Materials Science and Engineering
pce3@psu.edu 104 Davey Lab 865-5233
Research Interests: • Nano-materials, e.g., carbon nanotubes, semiconducting nanowires and nanoparticles • The materials are studied for fundamental and applied objectives (chemical sensors, hydrogen storage, other energy related applications) • His group is deeply involved in synthesis and characterization of fundamental materials properties, e.g., optical and electrical transport properties

CRAIG GRIMES, Associate Professor of Electrical Engineering and Materials Science and Engineering
cgrimes@engr.psu.edu 208 Materials Research Laboratory Building 865-9142
Research Interests: • Physical and chemical sensor platforms • Metal-oxide nanotubes and nanowires • Thin films

MICHAEL LANAGAN, Associate Professor of Engineering Science and Mechanics and Materials Science and Engineering
lanagan@matse.psu.edu, 278 Materials Research Laboratory Building, 865-6992
Research Interests: • Electronic Materials • Microwave Materials Interactions • Dielectrics • High-energy dielectrics for pulsed power applications

TAO LU LOWE, Assistant Professor of Surgery, Bioengineering and Materials Science and Engineering
tlowe@psu.edu Department of Surgery, College of Medicine Pennsylvania State University Mail Code H151,
500 University Drive, Hershey, PA 17033 (717) 531-8602
Research Interests: • Targeted and sustained drug delivery • Gene Therapy • Tissue engineering • Biodegradable and bioresponsive polymers • Polymer solution, dendrimers, nanoparticles, nanogels and macroscopic hydrogels • Polymer-protein-cell interactions • Micropatterning • Transport across the blood-brain barrier • Alzheimer's disease • Neurological Disorders • Biomaterials for artificial heart • Breast Cancer, Bone, Cartilage and Lung repair • Diabetic Retinopathy, Melanoma, Stroke, Brain Tumors

ARTHUR T. MOTTA, Professor of Nuclear Engineering and Materials Science
atm2@psu.edu 227 Reber Building 865-0036
Research Interests: • Radiation damage and environmental degradation of materials in nuclear powe plants with specific emphasis on Zr alloys

MICHAEL PISHKO, Associate Professor of Chemical Engineering and Materials Science and Engineering
mpishko@engr.psu.edu 104 Fenske Laboratory 863-4810
Research Interests: • Microfabricated biosensors • Neovascularization of implanted biomaterials • drug delivery vehicles for peptides and oligonucleotides

HAROLD SCHOBERT, Director, The Energy Institute Professor of Fuel Science and Materials Science and Engineering
schobert@ems.psu.edu C207 Coal Utilization Laboratory 863-1337
Research Interests: • Carbon materials, particularly graphitic carbons and applications of carbons as catalysts • Synthetic liquid fuels, principally development of the next generation of jet fuels • Carbon dioxide capture, including reactions with naturally occurring or chemically treated minerals, and development of novel photocatalysts for CO2 reactions • Phase relationships and viscosity-temperature behavior in complex silicate coal ash slags

JORGE O. SOFO, Associate Professor of Physics, Associate Professor of Materials Science and Engineering, Director of Materials Simulation Center
sofo@psu.edu 111B Osmond Lab 777-3450
Research Interests: • Computational Materials Science • Electronic Structure of molecules, surfaces, and solids • Fuel cells, hydrogen storage, corrosion, wetting

CHAO-YANG WANG, Professor of Mechanical Engineering and Materials Science and Engineering
cxw31@psu.edu 338A Reber Building 863-4762
Research Interests: • Fuel cells, batteries and their materials • Multiphase and interfacial transport • Direct numerical simulation of microstructures

XIAXING XI, Professor of Physics and Materials Science and Engineering
xxx4@psu.edu 316 Davey Lab 863-5350,
Research Interests: • Ferroelectric thin films • Lattice dynamics in ferroelectric thin films, • Boride superconductors • Condsensed matter

QIMING ZHANG, Professor of Electrical Engineering and Materials Science and Engineering
qxz1@psu.edu 187 Materials Research Laboratory Building 863-8994
Research Interests: • Electromechanical materials and devices: actuators and sensors, transducers, and micro-electromechanical systems, energy harvesting • Dielectric materials and devices: electronic packaging, capacitors, electric energy storage, microwave dielectrics. Photonic structures, electro-optic and acousto-optic materials and devices • Pyroelectric materials and devices • Ferroelectric polymer thin and ultrathin films, nano-materials and devices based on functional polymers, for memory devices, MEMS, high energy storage, and sensors

Adjunct Faculty

PAOLO COLOMBO, Associate Professor of Materials Science, Universities of Bologna and Padua, Italy, Adjunct Professor of Materials Science and Engineering
Paulo.colombo@unipd.it
Research Interests: • Porous ceramics • Preceramic polymers • Waste glass • Ceramic microcomponents

JOHN W ELMER, Deputy Program Element Leader, Lawerence Livermore National Laboratory and Adjunct Professor of Materials Science and Engineering
elmer1@llnl.gov, 925-648-3428
Research Interests: • Materials joining • Microstructural evolution during thermal processing of metals and alloys • Kinetics of non-isothermal phase transformations • Electron-beam and laser-beam joining • Rapid solidification processing

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

S. V. KRISHNASWAMY, Fellow Scientist, Northrup Grumman Science and Technology Center and Adjunct Professor of Materials Science and Engineering,
SV.Krishnaswamy@ngc.com

Dual Title Faculty

VICTOR BAKAEV, Research Associate and Assistant Professor of Materials Science and Engineering
vab2@psu.edu 225 Materials Research Laboratory Building 865-0065
Research Interests: • Heterogeneous surfaces • Inverse gas chromatography

THOMAS D. JUSKA, Research Associate and Assistant Professor of Materials Science and Engineering
tdj2@psu.edu 165 Applied Research Laboratory Building 865-3058
Research Interests: • Composite Materials

RICHARD J. MEYER, JR., Senior Research Associate and Associate Professor of Materials Science and Engineering
rmeyer@psu.edu Applied Research Lab 865-9607
Research Interests: • Development of active materials for use in underwater acoustic and biomedical ultrasonic transducers

JOGENDER SINGH, Chief Scientist and Professor of Materials Science and Engineering
singh@matse.psu.edu, 115 Materials Research Institute Building 863-9898
Research Interests: • Designing and developing coatings for high temperature applications, including thermal barrier coatings, environmental protection coatings against wear, oxidation, and corrosion, by electron beam physical vapor deposition (EB-PVD) and sputtering processes

DOUGLES WOLFE, Assistant Professorof Materials Science and Engineering Advanced Coatings Department Head
dew125@psu.edu 119 Materials Research Institute Building 865-0316
Research Interests: • Synthesis, processing, and characterization of thin film coatings • Monolithic, multilayer, and functional graded ceramic-metallic coatings • Advanced high temperature coatings • Wear resistant materials and coatings • Corrosion resistance coating materials • Residual stress/strain • Material Microstructure-Property relationships • Materials Evaluation/Characterization

Emeritus Faculty

WILLIAM BITLER, Professor Emeritus of Metallurgy
wrb1@psu.edu , 123 Steidle Building, 863-0624
Research Interests: • Solid state diffusion • Solid-solid reaction kinetics • Diffusion induced grain boundry motion • Magnetic properties of ferromagnetic alloys

MICHAEL COLEMAN, Professor Emeritus of Polymer Science
coleman@matse.psu.edu**,** 330 Steidle Building, 865-3117
Research Interests: • Polymer Vibrational Spectroscopy • Polymer Blends • High Temperature Stable Jet Fuels

IAN HARRISON, Professor Emeritus of Polymer Science
irh1@psu.edu, 325 Steidle Building, 865-3130

JOHN H. HOKE, Professor Emeritus of Metallurgy
208 Steidle Building 865-5446

DONALD A. KOSS, Professor Emeritus of Materials Science and Engineering
koss@matse.psu.edu, 310 Steidle Building 865-5447
Research Interests: • Deformation and fracture of structural materials • Microstructure-property relationships and the influence of processing • Failure analysis

ROBERT NEWNHAM, Professor Emeritus of Solid State Science, Alcoa Professor of Solid State Science (Emeritus)
ren1@psu.edu 251 Materials Research Laboratory Building 865-1612
Research Interests: • Crystal Physics • Crystal Chemistry • Composite Transducers

GUY RINDONE, Professor Emeritus of Ceramic Science and Engineering
ger1@psu.edu 110 Steidle Building 238-6292
Research Interests: • Optical Glasses, gradient indices of refraction, fiber collimators, retroreflecting glass beads • Glass microstructure • Glass galvanic cells (fuel cells) • Luminescence and electroluminescence • Solarization • Composition vs. properties • Microgravity materials research • Melting history effects • Ion exchange • Phase separation • Opal glasses
• Encapsulation of nuclear waste

DELLA ROY, Professor Emeritus of Materials Science and Engineering
dmr6@psu.edu 110 Materilas Research Laboratory Building 865-1196

KARL E. SPEAR, Professor Emeritus of Materials Science and Engineering
spear@matse.psu.edu, 123 Steidle Building 863-0990

VLADIMIR STUBICAN, Professor Emeritus of Materials Science and Engineering
vxs4@psu.edu 328 Steidle Building 865-9921

RICHARD E. TRESSLER, Professor emeritus of Materials Science and Engineering
tressler@matse.psu.edu, 118A Steidle Building 865-7961
Research Interests: • Durability of ceramics, fibers, and composites • Applications for advanced ceramics and composites • Ceramic membranes

PHILIP L. WALKER, Professor Emeritus of Fuel Science
223 Academic Project Building 863-3895

WILLIAM O. WILLIAMSON, Professor Emeritus of Ceramic Science
122 Steidle Building 863-0624

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.

Undergraduate Curriculum in Materials Science and Engineering
(EFFECTIVE as of Fall 2004)

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 only)

SEMESTER 4 **15-17 Credits**

• EMCH 11	3	STATICS (required for CerSE)
• E MCH 210	5	STATICS AND STRENGTH OF MATERIALS (MetSE option) *****
• MATH 251	4	ORDINARY AND PARTIAL DIFERENTIAL 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)
• ENGL 202C	3	TECHNICAL WRITING (CerSE and EPM options only)
• SHA-3	3	SHA ELECTIVE **€**
• SHA-4	3	SHA ELECTIVE (EPM and MetSE options only) **€**

***** 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 CAS100A 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 as of Fall 2004)

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-4 3 SHA ELECTIVE€

SEMESTER 6 16 Credits

- MATSE 492W 3 MATERIALS ENGINEERING METHODOLOGY AND DESIGN #
- 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 462 1 GENERAL PROPERTIES LABORATORY IN MATERIALS

SEMESTER 7 14-16 Credits

- MATSE 411 3 PROCESSING OF CERAMICS
- MATSE 412 3 THERMAL PROPERTIES OF MATERIALS
- MATSE 4XX 3 MATSE ELECTIVE (Choose any MatSE course)
- MATSE 468 1 CERAMICS LABORATORY
- MATSE 494W 1-3 RESEARCH AND DESIGN SENIOR PROJECT (at advisor's discretion; must total 3 credits for graduation)
- TECH EL-1 3 TECH ELECTIVE **€**

SEMESTER 8 15-18 Credits

- MATSE 417 3 ELECTRICAL AND MAGNETIC PROPERTIES
- MATSE 435 3 OPTICAL PROPERTIES OF MATERIALS
- MATSE 494W 1-3 RESEARCH AND DESIGN SENIOR PROJECT (at advisor's discretion; must total 3 credits for graduation)
- TECH EL-2 3 TECHNICAL ELECTIVE **€**
- SHA -5 3 SHA ELECTIVE €
- SHA-6 3 SHA ELECTIVE €

TOTAL CREDITS 127

Electronic and Photonic Materials Curriculum
(EFFECTIVE as of Fall 2004)

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 16 Credits

- MATSE 492W 3 MATERIALS ENGINEERING METHODOLOGY AND DESIGN #
- MATSE 402 3 MATERIALS PROCESS KINETICS #
- MATSE 413 3 SOLID STATE MATERIALS

OR

- PHYS 237 3 INTRODUCTION TO QUANTUM MECHANICS
- MATSE 417 3 ELECTRICAL AND MAGNETIC PROPERTIES
- MATSE 436 3 MECHANICAL PROPERTIES OF MATERIALS
- MATSE 462 1 GENERAL PROPERTIES LABORATORY IN MATERIALS

SEMESTER 7 16-18 Credits

- MATSE 450 3 SYNTHESIS AND PROCESSING OF EPM
- MATSE 455 3 PROPERTIES AND CHARACTERIZATION OF EPM
- EE 418 3 SOLID STATE DEVICE TECHNOLOGY
- MATSE 494W 1-3 RESEARCH AND DESIGN SENIOR PROJECT (at advisor's discretion; must total 3 credits for graduation)
- TECH EL-1 3 TECH ELECTIVE €
- SHA-5 3 SHA ELECTIVE €

SEMESTER 8 13-16 Credits

- MATSE 435 3 OPTICAL PROPERTIES OF MATERIALS
- MATSE 463 1 CHARACTERIZATION AND PROCESSING OF EPM LAB
- MATSE 494W 1-3 RESEARCH AND DESIGN SENIOR PROJECT (at advisor's discretion; must total 3 credits for graduation)
- TECH EL-2 3 TECHNICAL ELECTIVE **€**
- TECH EL-3 3 TECHNICAL ELECTIVE **€**
- SHA-6 3 SHA ELECTIVE **€**

TOTAL CREDITS 127

Metals Science and Engineering Curriculum
(EFFECTIVE as of Fall 2004)

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 492W	3	MATERIALS ENGINEERING METHODOLOGY AND DESIGN #
• MATSE 402	3	MATERIALS PROCESS KINETICS #
• MATSE 436	3	MECHANICAL PROPERTIES OF MATERIALS
• MATSE 423	3	PHASE TRANSFORMATIONS IN METALS AND ALLOYS #
• MATSE 462	1	GENERAL PROPERTIES LABORATORY IN MATERIALS
• ENGL 202C	3	TECHNICAL WRITING

SEMESTER 7 14-16 credits

• MATSE 421	3	CORROSION ENGINEERING
• MATSE 422	3	THERMOCHEMICAL PROCESSING
• MATSE 471	1	METALLURGICAL LABORATORY I
• MATSE 494W	1-3	RESEARCH AND DESIGN SENIOR PROJECT (at advisor's discretion; must total 3 credits for graduation)
• TECH EL -1	3	TECHNICAL ELECTIVE
• SHA-6	3	SHA ELECTIVE

SEMESTER 8 12-15 credits

• MATSE 426	3	AQUEOUS PROCESSING
• MATSE 417	3	ELECTRICAL AND MAGNETIC MATERIALS
• MATSE 425	3	PROCESSING OF METALS
• MATSE 472	1	METALLURGY LABORATORY II
• MATSE 494W	1-3	RESEARCH AND DESIGN SENIOR PROJECT (at advisor's discretion; must total 3 credits for graduation)
• TECH EL -2	3	TECHNICAL ELECTIVE

TOTAL CREDITS: 127

Polymer Science and Engineering Curriculum
(EFFECTIVE as of Fall 2004)

SEMESTER 5 16 Credits

- 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 ******
- TECH EL-1 3 ENGINEERING TECHNICAL ELECTIVE **€**

  OR
- MATSE 430 3 MATERIALS CHARACTERIZATION #

SEMESTER 6 16 Credits

- MATSE 492W 3 MATERIALS ENGINEERING METHODOLOGY AND DESIGN #
- MATSE 436 3 MECHANICAL PROPERTIES OF MATERIALS #
- MATSE 445 3 THERMODYNAMICS, MICROSTRUCTURE, AND CHARACTERIZATION OF POLYMERS #
- MATSE 462 1 GENERAL PROPERTIES LABORATORY IN MATERIALS
- ENGL 202C 3 TECHNICAL WRITING
- SHA-4 3 SHA ELECTIVE **€**

SEMESTER 7 13-15 Credits

- MATSE 444 3 SOLID STATE PROPERTIES OF POLYMERIC MATERIALS #
- MATSE 447 3 RHEOLOGY AND PROCESSING OF POLYMERS
- MATSE 494W 1-3 RESEARCH AND DESIGN SENIOR PROJECT (at advisor's discretion; must total 3 credits for graduation)
- TECH EL-2 3 ENGINEERING TECHNICAL ELECTIVE **€**
- SHA-5 3 SHA ELECTIVE **€**

SEMESTER 8 15-17 Credits

- MatSE 446 3 MECHANICAL AND ELECTRICAL PROPERTIES OF POLYMERS AND COMPOSITES
- MATSE 473 1 POLYMERIC MATERIALS LAB - SYNTHESIS
- MATSE 474 1 POLYMERIC MATERIALS LAB - CHARACTERIZATION
- MATSE 448 3 ADVANCED PROCESSING TECHNOLOGY
- MATSE 494W 1-3 RESEARCH AND DESIGN SENIOR PROJECT (at advisor's discretion; must total 3 credits for graduation)
- TECH EL-3 3 TECHNICAL ELECTIVE **€**
- SHA-6 3 SHA ELECTIVE **€**

TOTAL CREDITS: 127

Appendix D. Suggested technical electives

Reminder: At least 37.5% of the student's prescribed coursework must be engineering courses to satisfy graduation requirement in MatSE. Carefully select technical electives to ensure this requirement is met.

Some courses have pre-requisites; please consult your advisor before you enroll.

MATERIALS SCIENCE

MATSE 403	Biomaterials
MATSE 404	Surfaces and Biological (Host) Response to Materials
MATSE 417	Electrical and Magnetic Properties
MATSE 423	Phase Transformations in Metals and Alloys
MATSE 427	Ferrous Physical Metallurgy
MATSE 430	Materials Characterization
MATSE 435	Optical Properties of Materials
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
MATSE 447	Rheology and Processing of Polymers
MATSE 450	Synthesis and Processing of Electronic and Photonic Materials
MATSE 455	Properties and Characterization of EPM
MATSE 463	Characterization and Processing of EPM Laboratory
MATSE 466	Ceramics Lab I
MATSE 467	Ceramics Lab II
MATSE 468	Ceramics Lab III
MATSE 469	Ceramics Lab IV
MATSE 471	Metallurgy Lab II
MATSE 472	Metallurgy Lab III
MATSE 473	Polymeric Materials Laboratory-Synthesis
MATSE 474	Polymeric Materials Laboratory-Characterization
MATSE 5xx	Graduate Level Courses (consult advisor)

ELECTRONIC MATERIALS

E E 210	Circuits and Devices
E E 305	Introduction to Electronic Measuring Systems
E E 310	Electronic Circuit Design
E E 317	Signals and Systems
E E 320	Introduction to Electro-optical Engineering
E E 330	Engineering Electromagnetics
E E 340	Electronic Devices and Circuits
E E 350	Continuous Linear Systems
E E 418	Solid State Device Technology
E E 419	Solid State Devices
E SC 314	Electronic Materials
E SC 445	Semiconductor Optoelectronic Device Applications
E SC 456	Introduction to Neural Networks
E SC 481	Elements of Microelectromechanical Systems Processing and Design
PHYS 237	Introduction to Quantum Physics (not for CerSE or EPM)
PHYS 400	Intermediate Electricity and Magnetism

PHYS 401	Intermediate Electricity and Magnetism II
PHYS 402	Electronics for Scientists
PHYS 410	Introduction to Quantum Mechanics
PHYS 412	Solid State Physics I
PHYS 413	Solid State Physics II
PHYS 419	Theoretical Mechanics
PHYS 420	Thermal Physics
PHYS 421	Kinetic Theory and Statistical Mechanics
PHYS 443	Intermediate Acoustics
PHYS 458	Intermediate Optics
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 435	Industrial Organic Chemistry
CH E 438	Bioprocess Engineering
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
EGEE 301	Thermodynamics and Fluid Mechanics
I E 310	Principles of Deformation Processing
I E 311	Principles of Solidification Processing
I E 312	Product Design and Manufacturing Processes
I E 322	Quantitative Methods in Industrial Engineering I
I E 323	Quantitative Methods in Industrial Engineering II
I E 328	Production Engineering
I E 414	Materials Joining Processes and Principles
I E 426	Industrial Automation
I E 428	Metal Casting
I E 438	Metal Cutting Principles and Practice
MATSE 402	Materials Process Kinetics
MATSE 410	Phase Relations in Materials Systems
MATSE 411	Ceramic Processing
MATSE 412	Thermal Properties and Refractories
MATSE 415	Introduction to Glass Science
MATSE 422	Thermochemical Processing

MATSE 425	Processing of Metals
MATSE 426	Aqueous 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 SC 261M	Computational Methods in Engineering
E SC 314	Engineering Applications 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

BIOMATERIALS

BIOL 141	Physiology
BIOL 472	Mammalian Physiology
BIOE 201	Analysis of Molecules and Cells
BIOE 401	Introduction To Bioengineering
BIOE 406	Medical Imaging
BIOE 419	Artificial Organs and Prosthetic Devices
BMB 251	Molecular and Cell Biology

COMPUTER SCIENCE AND ENGINEERING

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

MISCELLANEOUS

ENGR x95	Engineering Internship and Cooperative Education
SC x95	Science Cooperative Education
BMB 474	Physical Properties of Biological Macromolecules
CE 370	Introduction to Environmental Engineering
F SC 401	Introduction to Fuel Technology
F SC 422	Combustion Engineering
IE 302	Engineering Economy
IE 426	Industrial Automation
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
NUC E 401	Introduction to Nuclear 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

Appendix E. 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 F. 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 G. 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)**
COOP	MatSE 400	MatSE 402	SHA 4
Eng 295	MatSE 401	MatSE 410	SHA 5
	MatSE 430	MatSE 413	
	MatSE 460	MatSE 492W	
	IE 424	MatSE 462	
1 credit	13 credits	13 credits	6 credits

Fall (9)	**Spring (10)**	**Summer (11)**	**Fall (12)**
COOP	MatSe 435	COOP	MatSE 411
Eng 395	Tech Elec	Eng 495	MatSE 412
	MatSE 494W		Tech Elec
	MatSE 417		MatSE 468
	MatSE 436		SHA 6
1 credit	15 credits	1 credit	13 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 492W	
	IE 424	MatSE 436	
	SHA-4	MatSE 462	
1 credits	16 credits	16 credits	1 credit

Fall (9)	**Spring (10)**	**Summer (11)**
MatSE 412	MatSe 435	COOP
MatSE 411	Tech Elec	Eng 495
MatSE 468	SHA 5	
MatSE 494W	MatSE 417	
Tech Elec	SHA 6	
13 credits	15 credits	1 credit

* Commonwealth campus students will need to take MatSE 201

Electronic and Photonic Materials:

PLAN "A"

Spring (4)	Summer (5)	Fall (6)	Spring (7)	Summer (8)
Math 251	Engl 202C	MatSE 400	COOP	TechEl-1
Phys 214	SHA-3	MatSE 401	ENG 295	SHA-6
MatSE 413 OR	SHA-4	MatSE 430		
Phys 237		MatSE 450		
MatSE 314		MatSE 460		
		SHA-5		
15 credits	9 credits	16 credits	1 credit	6 credits

Fall (9)	Spring (10)	Summer (11)	Fall (12)
COOP	MatSE 436	COOP	MatSE 490
ENG 395	MatSE 417	ENG 495	IE424
	MatSE 492W		TechEl-2
	MatSE 435		MatSE 455
	MatSE 462		MatSE 463
	MatSE 463		MatSE 494W (2cr)
	MatSE 494W (1cr)		
1 credit	15 credits	1 credit	14 credits

PLAN "B"

Spring (4)	Summer (5)	Fall (6)	Spring (7)	Summer (8)
Math 251	Engl 202C	COOP	MatSE 417	COOP
Phys 214	SHA-3	ENG 295	MatSE 435	ENG 395
MatSE 413 OR	SHA-4		MatSE 436	
Phys 237			MatSE 462	
MatSE 402			MatSE 463	
ESC 314			MatSE 492W	
15 credits	9 credits	1 credit	14 credits	1 credit

Fall (9)	Spring (10)	Summer (11)	Fall (12)
MatSE 400	COOP	MatSE 494W(3cr)	IE 424
MatSE 401	ENG 495	SHA-6	MatSE 455
MatSE 430			EE 418
MatSE 450			TechEl-1
MatSE 460			TechEl-2
SHA-5			
16 credits	1 credit	6 credits	15 credits

Polymer Science and Engineering:

PLAN "A"

Summer (5)	Fall (6)	Spring (7)	Summer (8)
IE 242/STAT 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 492W		MatSE 474
			MatSE 490
			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	MatSE 492W	
	MatSE 460	TechElec 1	
	IE 424	Engl 202C	
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 474	TechElec 2	
MatSE 490	TechElec 3[#]	
MatSE 494W	SHA-6	
SHA-4		
SHA-5		
15 credits	17 credits	1 credit

* Commonwealth campus students will need to take MatSE 201

[#] Requirements for Technical Elective 3 can be substituted by fulfilled 3 Credits of ENGR X95 ie. (295, 395 and 495)

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 H. MatSE Student Branch Groups

MatSE Student Branch listings					
Student Activity	**Program Chair/Advisor**	**President**	**Vice President**	**Secretary**	**Treasurer**
Material Advantage	Dr. Allen Kimel	Jen Rygel	Mark Burton	Alexana Cranmer	Trevor Buehl
	kimel@matse.psu.edu	Jlr414@psu.edu	Mtb157@psu.edu	Aec169@psu.edu	Teb188@psu.edu
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ASM	Dr. Zi-Kui Liu	Xueyong Guan	Becky Kirkpatrick	Balaji Soundarajan	Murray Small
	liu@matse.psu.edu	xxg106@psu.edu	Rzk105@psu.edu	Bxs157@psu.edu	Wms1@psu.edu
Student Representative	Mark Burton	Mtb157@psu.edu			
Polymers Club	Paul Painter	TBA	TBA	TBA	TBA
	painter@matse.psu.edu				