Department of Chemical and Materials Engineering

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Chemical engineering combines the science of chemistry with the discipline of engineering in order to solve problems and to increase process efficiency. One of the most attractive aspects of a chemical engineering future is the variety of work available. Chemical engineering is a blend of physics, chemistry, and mathematics; thus, a chemical engineer possesses a versatility that gives him or her many opportunities for employment in fields such as pulp and paper, environmental engineering, food products, nuclear power, petroleum and petrochemicals, semiconductors, synthetic fuels, radioisotope applications, plastics and polymers, pharmaceuticals, education, biomedical engineering, computer applications, alternate energy sources, steel, nano technology and textiles. A chemical engineer can choose work in any of the following areas: research and development, design and construction, operations, management, teaching, or technical sales.

The mission of the Department of Chemical and Materials Engineering is to provide quality educational programs firmly based in fundamental concepts and to perform and publish outstanding chemical engineering research. The goals of the Department of Chemical and Materials Engineering are (1) to prepare students with a broad-based education grounded in chemical engineering fundamentals, (2) to maintain an environment that promotes effective student/faculty involvement in teaching, research, and mentoring, (3) to promote an active interaction with regional industries, and (4) to graduate students capable of independent learning. In addition, the educational objective of the Department of Chemical and Materials Engineering is to prepare students who (1) are well grounded in the fundamentals of chemical engineering, (2) can understand, analyze, and design efficient processes, (3) are proficient in the oral and written communication of their work and ideas, (4) are able to work in multidisciplinary teams in conjunction with their design, formulation of problems, and conducting of experiments, (5) understand the safety and environmental consequences of their work, and (6) are instilled with a sense of social responsibility, ethics, and a commitment to life-long learning. Progress towards these goals and objectives is assessed by student performance on the nationally administered Fundamentals in Engineering Examination, exit interviews with graduating students, and surveys of graduated students and their employers.

The Chemical Engineering Program is accredited by the Engineering Accreditation Commission of Accreditation Board for Engineering and Technology (ABET), 111 Market Place, Suite 1050, Baltimore, MD 21202-4012, ph. 410-347-7700.

The faculty of the Department of Chemical and Materials Engineering is dedicated to excellence in teaching. It is the faculty's goal to provide the students with a strong, well-rounded background for immediate entry into the industrial workforce or for graduate study. This background includes the theoretical aspects of chemical engineering as well as practical work experiences. Thus, most of the equipment that is installed in the Chemical Engineering laboratory is on the scale of pilot plant equipment. Because much of the equipment is made of glass, students are able to see at a glance what processes occur and where the streams are flowing. The department has a two-story distillation column, a gas absorber, two types of evaporators, a two-stage chemical reactor, a catalytic reactor, liquid extraction equipment, membrane based gas separation, an Atomic Force Microscope (AFM) system, a multiple column micro gas chromatograph, process control lab, and supporting analytical equipment such as gas chromatographs. All of this equipment is used by undergraduate students. Proof that the departmental goals are being achieved is in the job-placement statistics for chemical engineers from UI. Most receive job offers before graduation and many graduates now hold high-level technical and management positions in industry, government, and academia.

The department has available a number of fellowships and assistantships for students. Support includes fellowships from industry and alumni; UI graduate assistantships; and research assistantships. Entering graduate students must normally hold a B.S. in chemical engineering.

Students entering the graduate program in the Department of Chemical and Materials Engineering can work towards an M.S. or Ph.D. degree. The graduate program also includes provisions for study leading to an M.S. in chemical engineering for students who have a B.S. degree in a related field. Students will be required to register as undergraduates for as many semesters as it takes to meet prerequisites to the courses required in the M.S.(Ch.E.) degree program.

Graduate studies in this department are highly diversified in order to accommodate the needs of most students who have a good basic background in the physical sciences, mathematics, and engineering. Areas of expertise include chemical reaction engineering; simulation, optimization and process design especially for the pulp and paper and food applications; hazardous waste characterization and bioremediation; membrane, nano-science, fluid mechanics, biochemical engineering; and mass transfer research. The graduate program in chemical engineering requires a total GRE score of at least (Analytical >500 and Quantitative >725), as well as a TOEFL score of at least 550 (paper based) or 225 (computer based).

Materials Science and Engineering Objectives and Mission Statement:

The educational objectives of our Materials Science and Metallurgical Engineering Programs are to educate graduates who will:

1. Use their mathematics and science background to formulate and solve engineering problems.

2. Remain current in modern technology and in tools of engineering practice.

3. Demonstrate an understanding of current economic and societal issues associated with engineering projects and their impacts.

4. Be able to communicate effectively with engineers and non-engineers while working independently or on teams to develop engineering solutions.

5. Demonstrate an understanding of their professional and ethical responsibilities as engineers and uphold their responsibility to the public and occupational health and safety.

6. Demonstrate the importance of life-long learning and continued professional growth.

Our Materials Science and Engineering Program's educational mission is to produce graduates who are equipped to begin competitive and productive careers in their engineering professions; who can define and solve material and metallurgical engineering problems to meet desired needs and produce societal benefits; and who understand the importance of working responsibly, acting ethically and pursuing professional growth.

Although the department emphasizes economics and technology, engineering training also includes environment concerns, ethical behavior, and safety concerns. As technological and engineering fields, these professional disciplines offer tremendous opportunities for the person who wishes to become involved in the application of material science and engineering, often in sophisticated designs, to the preservation and enhancement of our society. The department provides the technical training to prepare our graduates for productive and rewarding engineering careers.

The department continuously strives to improve our programs. For example, at the B.S. level surveying constituency groups such as current students, graduating seniors, alumni and their employees, and the department advisory board does this. The information gathered is then used in a feedback fashion to improve the quality of individual courses and the programs in general.

The laboratory facilities for materials science and engineering along with metallurgical engineering include: state of the art magnetic and thin film materials characterization, thin film sputtering and deposition, inductively coupled plasma processing, electron cyclotron resonance plasma dry etching, chemical mechanical planarization, mechanical alloying, vacuum arc furnaces, combustion synthesis, clean room, electron beam lithography, electrochemistry, computer chip and biochip design, micro-electromechanical systems (MEMS), and other state of the art technologies including optical and transmission electron microscopy, atomic force microscopy, scanning electron microscopy, x-ray diffraction, differential and thermogravimetric analysis, computational materials science, etc. These laboratories provide an understanding of nano scale technology, magnetic, electronic, bioactive, ceramic, polymeric, metallic and intermetallic materials.

Our faculty has proven their qualifications by their credentials in national and international professional societies. They are well known by their publications, research, and contract work. Most students find employment in the summer or on a cooperative basis, so that they can become more intimately involved in the disciplines that they are studying. Exposure to the department faculty members provides students with a one-to-one interaction and an expertise that enables them to be truly competitive when they enter the real world.

The program is designed to take advantage of the other excellent facilities of the university and other engineering disciplines. The program of study also includes involvement with practical aspects of professional practice by exposure to the regional industries and research groups through field trips, guest speakers, study problems, and work time during the summer. Materials/metallurgical operations in the Northwest are plentiful and modern.

The Materials Science and Engineering Program was reviewed and accredited by the Engineering Accreditation Commission of ABET, 111 Market Place, Suite 1050, Baltimore, MD 21202-4012, ph. 410-347-7700. An ABET review to extend accreditation of the Metallurgical Engineering Program was not requested and the accreditation for this program expired September, 2008.

The department offers the Master of Science (M.S.) degree in materials science and engineering, and metallurgical engineering, metallurgy, and the Doctor of Philosophy (Ph.D.) degree in materials science engineering. These programs include a mix of theoretical and practical study most appropriate to each student. Many studies include mathematical, statistical, and computer applications to specific processes or investigations; and excellent computer facilities are readily available. Some students prefer to work on applied problems that are presented by industry or research establishments in the area, generally with funding from outside sources. Studies can be tailored to individual interests.

These advanced studies are financed by research grants, an industry sponsor, or occasionally by departmental funding. They are designed to train the individual in research methods and investigative procedures that will later enhance his or her ability in industrial or research environments or in teaching. The master’s program involves both class work and research; the latter being designed to familiarize the student with research methods. In the doctoral program, the student is expected to break new ground and advance the field both scientifically and to maintain the competitive technological lead enjoyed in the U.S. for so many years. The master's program generally requires 12 to 18 months beyond the baccalaureate degree and the doctoral program usually entails at least three years beyond the baccalaureate degree.

Most students find employment in the summer or on a cooperative basis, so that they can become more intimately involved in the processes that they are studying. The total program enables the person to leave the university with confidence, either as a baccalaureate student or at the master's or doctoral level, with the capability of a truly competent professional. Metallurgical and materials engineers have a wide variety of career options. This ranges all the way from primary metals/ceramics/polymer production through advanced materials industries. There are opportunities in technological areas with names and processes not even dreamed of just a few decades ago: plasma extractive processing, ceramic powder synthesis, bio-corrosion, magnetic

recording media, and electron microscopy. The materials produced are formed into all of the products we use in our daily lives, such as our cars, home appliances, farm equipment, and electrical and electronic equipment. Some of our graduates are employed as engineering consultants or by government agencies. In fact, everything we touch, with the exception of agricultural or forestry products, has had its origin as a mineral in the earth. Metallurgical engineers and materials scientists also develop new products to fit specific demands, such as materials to withstand high stress, high temperature environments, or the extreme cold of outer space.

Courses

See Part 6 for courses in Chemical Engineering (ChE), Materials Science & Engineering (MSE), and Metallurgical Engineering (Met).

Undergraduate Curricular Requirements

CHEMICAL ENGINEERING (B.S.Ch.E.)

Required course work includes the university requirements (see regulation J-3) and:

ChE 110 Introduction to Chemical Engineering (1 cr)
ChE 123 Computations in Chemical Engineering (2 cr)
ChE 223 Material and Energy Balances (3 cr)
ChE 326 Chemical Engineering Thermodynamics (3 cr)
ChE 330 Separation Processes I (3 cr)
ChE 340-341 Transport and Rate Processes I-II (8 cr)
ChE 423 Reactor Kinetics and Design (3 cr)
ChE 433, 434 Chemical Engineering Lab I, II (2 cr)
ChE 444 Process Analysis and Control (3 cr)
ChE 445 Digital Process Control (3 cr)
ChE 453-454 Chemical Process Analysis and Design (6 cr)
ChE 491 Seminar (1 cr)
Chem 111-112 Principles of Chemistry I-II (9 cr)
Chem 277, 278 Organic Chemistry I and Lab (4 cr)
Chem 305, 307 Physical Chemistry and Lab (4 cr)
Chem 372, 374 Organic Chemistry II and Lab (4 cr)
Engr 210 Engineering Statics (3 cr)
Engr 240 Introduction to Electrical Circuits (3 cr)
Engr 320 Engineering Thermodynamics and Heat Transfer (3 cr)
Engr 335 Engineering Fluid Mechanics (3 cr)
Math 170 Analytic Geometry and Calculus (4 cr)
Math 175 Analytic Geometry and Calculus II (4 cr)
Math 275 Analytic Geometry and Calculus III (3 cr)
Math 310 Ordinary Differential Equations (3 cr)
Phys 211-212 Engineering Physics I-II (6 cr)
Chemical engineering electives (3 cr)
Chemical/bioscience electives (4 cr)
Computer science elective in a programming language (2 cr)
Economics elective (3 cr)
Humanities and social sciences electives (12 cr)
Communication electives (2 cr)
Mathematics electives (3 cr)
Technical electives (6 cr)

The minimum number of credits for the degree is 128, not counting Engl 101, Math 143, and other courses that might be required to remove deficiencies.

Students majoring in chemical engineering must earn a grade of C or better in each of the following courses before registration is permitted in upper-division chemical engineering courses: Chem 111 and 112; ChE 223; Engr 210, 320, and 335; and Math 275 and 310.

Students transferring ChE 223 or its equivalent from a university without an ABET accredited chemical engineering program must pass a test on the subject matter of this course before acceptance of the course for certification.

A passing grade (D or higher) is required in each of the following courses before registration is permitted in upper-division chemical engineering courses: ChE 123, computer science elective, Math 170 and 175, and Phys 211 and 212.

Any student majoring in chemical engineering may accumulate no more than four grades of D or F in UI mathematics, science, or engineering courses that are used to satisfy junior certification requirements. Included in this number are multiple repeats in a single class or single repeats in multiple classes. A warning will be issued in writing to students who have accumulated two grades of D or F in UI mathematics, science, or engineering courses used to satisfy curricular requirements.

An average GPA of at least 2.0 is required for all chemical engineering courses used to satisfy the curricular requirements.

MATERIALS SCIENCE AND ENGINEERING (B.S.M.S.E.)

Required course work includes the university requirements (see regulation J-3) and the following:

AmSt 301 Studies in American Culture or Phil 103 Ethics (3 cr)
Chem 111 Principles of Chemistry I (4 cr)
Chem 112 Principles of Chemistry II (5 cr)
Chem 305 Physical Chemistry (3 cr)
CS 112 Introduction to Problem Solving and Programming (3 cr)
Econ 201 or 202 Principles of Economics or Econ 272 Foundations of Economic Analysis (3-4 cr)
Engl 317 Technical Writing (3 cr)
Engr 105 Engineering Graphics (2 cr)
Engr 210 Engineering Statics (3 cr)
Engr 240 Introduction to Electrical Circuits (3 cr)
Engr 350 Engineering Mechanics of Materials (3 cr)
Math 170 Analytic Geometry and Calculus I (4 cr)
Math 175 Analytic Geometry and Calculus II (4 cr)
Math 275 Analytic Geometry and Calculus III (3 cr)
Math 310 Ordinary Differential Equations (3 cr)
MSE 101 Intro to Metallurgy and Materials Science (2 cr)
MSE 201 Elements of Materials Science (3 cr)
MSE 308 Thermodynamics of Materials (3 cr)
MSE 309 Transport Phenomena for Design (4 cr)
MSE 313 Physical Metallurgy (4 cr)
MSE 341 Particulate Materials Processing (4 cr)
MSE 412 Mechanical Behavior of Materials (3 cr)
MSE 413 Phase Equilibria in Materials (3 cr)
MSE 414 Process Design (3 cr)
MSE 415 Materials Selection and Design (3 cr)
MSE 417 Instrumental Analysis (3 cr)
MSE 423 Corrosion (3 cr)
MSE 427 Ceramic Materials (3 cr)
MSE 430 Electronic, Optical, and Magnetic Properties of Materials (3 cr)
MSE 432 Fundamentals of Thin Film Fabrication (3 cr)
MSE 434 Fundamentals of Polymeric Materials (3 cr)
Phys 211, 212 Engineering Physics I, II (8 cr)
Stat 301 Probability and Stat or CE 402 Applied Numerical Methods for Engineers (3 cr)
Technical electives (9 cr)

The minimum number of credits for the degree is 131, exclusive of Engl 101 and mathematics courses numbered lower than Math 170.

Academic Minor Requirements

MATERIALS SCIENCE AND ENGINEERING MINOR

MSE 201 Elements of Materials Science (3 cr)
And 15 cr from the following courses (Note: If completing both the Metallurgical Engineering and the Materials Sciences and Engineering minors, must have 12 unique credits towards each minor):

- Met 344 Hydroprocessing of Materials (4 cr)
- MSE 313 Physical Metallurgy I (4 cr)
- MSE 341 Particulate Materials Processing (4 cr)
- MSE 407 Materials Fabrication (3 cr)
- MSE 412 Mechanical Behavior of Materials (3 cr)
- MSE 430 Electrical, Optical, and Magnetic Properties of Materials (3 cr)
- MSE 432 Fundamentals of Thin Film Fabrication (3 cr)
- Phys 212 Engineering Physics II (3 cr)

METALLURGICAL ENGINEERING MINOR

Met 201 Elements of Materials Science (3 cr)
Met 309 Metallurgical Transport Phenomena (4 cr)
And 15 cr from the following courses (Note: If completing both the Metallurgical Engineering and the Materials Sciences and Engineering minors, must have 12 unique credits towards each minor):

- Met 313 Physical Metallurgy I (4 cr)

Met 341 Particulate Materials Processing (4 cr)
Met 344 Hydroprocessing of Materials (4 cr)
Met 407 Materials Fabrication (3 cr)
Phys 212 Engineering Physics II (3 cr)

Graduate Degree Programs

Candidates must fulfill the requirements of the College of Graduate Studies and of the Department of Chemical and Materials Engineering. See the College of Graduate Studies section of Part 4 for the general requirements applicable to each degree.

Master of Science. Majors are available in chemical engineering, materials science and engineering, and metallurgical engineering. General M.S. requirements apply.

Master of Science degrees in metallurgical engineering, and materials science and engineering are offered through the Engineering Outreach program. Degrees through Engineering Outreach have both thesis and non-thesis options, but otherwise have the same requirements (i.e., 30 credits) as degree programs offered on the Moscow campus.

Master of Engineering. General M.Engr. requirements apply.

Doctor of Philosophy. Majors are available in chemical engineering and materials science and engineering While most students entering the graduate program possessing only the bachelor's degree will first earn the M.S., it is possible to bypass the M.S. and work directly toward the Ph.D. Students electing this option will be expected to critically analyze a current research area as part of their degree requirements. This will constitute their Ph.D. qualifying examination. For others, the oral M.S. thesis examination serves as the Ph.D. qualifying examination. A written research proposal modeled after those submitted to such agencies as the National Science Foundation is required as part of the requirements for the Ph.D.