DEPARTMENT OF CHEMICAL AND MATERIALS ENGINEERING

Chemical Engineering Program

The Chemical Engineering Program is an ABET accredited program that 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. The Chemical Engineering Program 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 energy systems, 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: research and development, design and construction, operations, management, teaching, or technical sales.

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 analyze, understand, 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, performance at international design competitions, exit interviews with graduating students, and surveys of graduated students and their employers.

The faculty of the Chemical Engineering Program 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, much of the equipment that is installed in Chemical Engineering laboratories 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-stage evaporator, two types of chemical reactors, a catalytic reactor, liquid extraction equipment, membrane-based gas separation, three scanning probe microscopes, three vibrational spectroscopy instruments, multiple gas chromatographs, process control labs, and supporting analytical equipment all used by undergraduate students. Proof that the program's 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.

Students entering the graduate program in Chemical Engineering can work towards an M.S., M. Engr., or Ph.D. degree. The department has available a number of fellowships and assistantships for students, from industry and alumni, UI graduate assistantships, and externally-funded research assistantships. Entering graduate students must normally hold a B.S. in Chemical Engineering. 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 needed to meet prerequisites to courses required for the M.S. (Ch.E.) degree.

Graduate studies in this program 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 energy systems, pulp and paper, food applications, hazardous waste characterization and bioremediation, membranes, nanoscience, fluid mechanics, biochemical engineering, and mass transfer. The graduate program in chemical engineering requires the GRE with scores of: Analytical >4.5, Quantitative >157 and Verbal >153, as well as a TOEFL score of at least 550 (paper based) or 79 (computer based).

Materials Science and Engineering Program

The educational objectives of the Materials Science and Engineering Program 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 is an ABET accredited program with an educational mission to produce graduates equipped to begin competitive and productive careers in their engineering
professions; they define and solve materials science and engineering problems to meet desired needs and produce societal benefits; while understanding the importance of working responsibly, acting ethically and pursuing professional growth.

Although the program emphasizes economics and technology, engineering training also includes environmental, ethical, 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 materials science and engineering, often in sophisticated designs, to the preservation and enhancement of our society. The program provides technical training to prepare our graduates for productive and rewarding engineering careers.

Laboratory facilities for Materials Science and Engineering include: state-of-the-art magnetic, thin-film, electrical and optical materials characterization, semiconductor processes including thin-film sputtering and deposition, inductively-coupled plasma processing, electron cyclotron resonance plasma dry etching, mechanical alloying, vacuum arc furnaces, combustion synthesis, clean room, electron beam lithography, ion beam technology, electro-chemistry, computer chip and bio-chip design, micro-electromechanical systems (MEMS), nanomaterials, nano-devices and other modern technologies including optical, electron and atomic force microscopies, x-ray diffraction, differential scanning calorimetry and thermogravimetric analysis, etc. These laboratories provide an understanding of nanoscale technology, magnetic, electronic, bio-active, 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 regional industries and research groups through field trips, guest speakers, study problems, and work time during the summer.

A minor in Materials Science and Engineering is offered that integrates with majors in chemical or mechanical engineering along with other engineering and science disciplines. This minor allows the graduate to combine expertise in materials with another technical discipline.

A minor in Metallurgical Engineering is offered that integrates with majors in either chemical or materials engineering, and allows the graduate to specialize in the minerals processing area of metal materials, fabrication, and research.

The program offers the Master of Science (M.S.) and the Doctor of Philosophy (Ph.D.) degrees in Materials Science and Engineering. These programs include a mix of theoretical and practical study most appropriate to each student. Studies include topics on nanotechnology, electronic materials, alternative energy materials (nuclear, solar, etc.), and advanced materials processing techniques, as well as traditional areas, such as corrosion, welding, powder metallurgy, etc. Some students prefer to work on applied problems presented by regional industry or research establishments, generally with funding from outside sources. Studies can be tailored to individual interests. The graduate program in MSE requires a TOEFL score of at least 550 (paper based) or 79 (computer based).

These advanced studies are financed by research grants, industry sponsors, or 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 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 24 months beyond the B.S. degree and the doctoral program entails at least three years beyond the B.S. 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. Materials and metallurgical engineers have a wide variety of career options. They range 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 transformed into the products we use in our daily lives, such as our cars, home appliances, farm equipment, and electrical and electronic equipment. Everything we touch, with the exception of agricultural or forestry products, has had its origin as a mineral in the earth. Materials engineers and scientists develop new products to fit specific demands, such as materials to withstand high stress, high temperature environments, or the extremecold, radiation and vacuum of outer space. Some of our graduates are also employed as engineering consultants or by government agencies.


*ADMASSU, Wudneh; 1992; Professor of Chemical Engineering; Ph.D.; 1984; University Of Idaho.

*ASTON, D. Eric; 2001; Professor of Chemical Engineering; Affiliate Professor of Materials Science and Engineering and Metallurgical Engineering; Department Chair, Department of Chemical and Materials Engineering. Ph.D.; 2001; University of Washington.

BALDUS, Ronald J; 1981; Adjunct Assistant Professor of Chemical Engineering; Ph.D.; 1979.

*BATDORF, James A; 1989; Adjunct Assistant Professor of Chemical Engineering; Ph.D.; 1988; University of Idaho.

*BERNARDS, Matthew; 2016; Assistant Professor in Chemical Engineering; Ph.D.; 2008; University of Washington.

BRUCK, Hugh A; 1995; Adjunct Assistant Professor of Materials Science and Engineering and Metallurgical Engineering; Ph.D.; 1994; California Institute of Technology.

BRYANT, Patrick S; 1991; Adjunct Assistant Professor of Chemical Engineering; Ph.D.; 1993; University of Idaho.
BUTT, Darryl P.; 2011; Adjunct Professor of Chemical and Materials Engineering; Ph.D.; 1991; Penn State University.

*CHARIT, Indrajit; 2007; Associate Professor of Materials Science and Engineering; Ph.D.; 2004; University of Missouri.

*CHOUDHURY, Samrat; 2015; Assistant Professor of Chemical and Materials Engineering; Ph.D.; 2008; Pennsylvania State University.

CRAWFORD, Douglas C; 1999; Adjunct Assistant Professor of Materials Science and Engineering and Metallurgical Engineering; Ph.D.; 1991; University of Michigan.

*DROWN, David C; 1980; Associate Professor of Chemical Engineering; Ph.D.; 1975; University of Idaho.

FILLER, Jeff R; 2000; Adjunct Assistant Professor of Materials Science and Engineering and Metallurgical Engineering; Ph.D.; 1989; Washington State University.

GAN, Jian; 2005; Adjunct Assistant Professor of Materials Science and Engineering; Ph.D.; 1999; University of Michigan.

GOFF, Kenneth M; 2006; Adjunct Associate Professor of Materials Science and Engineering; Ph.D.; 1991; Georgia Institute of Technology.

GOMBERT, Dirk; 2000; Adjunct Assistant Professor of Chemical Engineering; Ph.D.; 1994; University of Idaho.

GOODWIN, Anthony R.H.; 1993; Adjunct Assistant Professor of Chemical Engineering and Mechanical Engineering; Ph.D.; 1987; University College.

HENAGER, Charles H. Jr.; 1995; Adjunct Professor of Materials Science and Engineering and Metallurgical Engineering; Ph.D.; 1983; University of Washington.

HOLMES, Robert G; 1996; Adjunct Faculty in Materials Science and Engineering; Adjunct Faculty in Metallurgical Engineering; Ph.D.; 1975; University of Idaho.

HONG, Yang-Ki; 2006; Adjunct Professor of Materials Science and Engineering; Adjunct Faculty in Metallurgical Engineering; Ph.D.; 1981; University of Utah.

HOOVER, Robert; 2016; Adjunct Faculty in Chemical and Materials Engineering; Ph.D.; 2014; University of Idaho.

KNOWLTON, William B; 2004; Adjunct Assistant Professor of Materials Science and Engineering and Metallurgical Engineering; Ph.D.; 1988; University of California Berkeley.

*KUMAR, Gautam; 2016; Assistant Professor in Chemical and Materials Science Engineering; Ph.D.; 2013; Lehigh University.

LINAREZ-ROYCE, Nancy J; 2000; Adjunct Assistant Professor of Materials Science and Engineering and Metallurgical Engineering; Ph.D.; 2000; University of Idaho.

LU, Li; 2001; Adjunct Professor of Materials Science and Engineering and Metallurgical Engineering; Ph.D.; 1989; Katholieke Universiteit Te Leu.

*MOBERLY, James G; 2013; Assistant Professor of Chemical and Materials Engineering; Ph.D.; 2010; Montana State University.

MOLL, Amy J; 2004; Adjunct Assistant Professor of Materials Science and Engineering and Metallurgical Engineering; Ph.D.; 1994; University of California Berkeley.

MOXSON, Vladimir S; 1999; Adjunct Associate Professor of Materials Science and Engineering and Metallurgical Engineering; Ph.D.; 1979; Moscow Institute of Steel and Alloys.

NEILSON, Robert M. Jr.; 1994; Adjunct Professor of Materials Science and Engineering and Metallurgy; M.S.; 1979; SUNY at Stony Brook.

O’BRIEN, Michael H; 1993; Adjunct Professor of Materials Science and Engineering and Metallurgical Engineering; Ph.D.; 1987; Iowa State University.

*PESIC, Batric; 1983; Professor of Materials Science and Engineering and Metallurgical Engineering; Affiliate Professor of Environmental Science; Ph.D.; 1981; University of Utah.

*PHONGIKAROON, Supathorn; 2013; Adjunct Faculty of Chemical and Materials Engineering; Ph.D.; 2001; University of Maryland.

*RAJA, Krishnan; 2011; Associate Professor of Chemical and Materials Engineering; Ph.D.; 1993; Indian Institute of Technology.

ROBERTSON, Eric P; 2008; Adjunct Assistant Professor of Chemical Engineering; Ph.D.; 2005; Colorado School of Mines.

ROGERS, J.W.; 2011; Adjunct Faculty of Chemical and Materials Engineering; Ph.D.; 1979; University of Texas.

*ROLL, Mark; 2011; Associate Professor in Chemical and Materials Engineering; Ph.D.; 2010; University of Michigan.

SCHELDORF, Jay J. Jr; 1992; Adjunct Assistant Professor of Chemical Engineering; Ph.D.; 1992; University of Idaho.

SIMPSON, Michael F; 2004; Adjunct Assistant Professor of Chemical Engineering; Ph.D.; 1996; Princeton University.

SMARTT, Herschel B; 1986; Adjunct Associate Professor of Materials Science and Engineering and Metallurgical and Mining Engineering; Ph.D.; 1974; University of Texas.

SMITH, Daniel B; 1996; Adjunct Assistant Professor of Chemical Engineering; Ph.D.; 1991; University of Idaho.

*SRAVASTAVA, Soumya K; 2013; Assistant Professor of Chemical and Materials Engineering; Ph.D.; 2010; Mississippi State University.

STRAND, William; 1989; Adjunct Assistant Professor of Chemical Engineering; Ph.D.; 1989; University of Idaho.

SWITZER, William R; 1993; Adjunct Assistant Professor of Chemical Engineering, M.S.Ch.E.; 1972; University of Southern California.

TOTEMEIER, Terry C; 1999; Adjunct Assistant Professor of Materials Science and Engineering and Metallurgical Engineering; Ph.D.; 1994; University of Cambridge.

TYSON, David R; 2006; Adjunct Assistant Professor of Chemical Engineering; Ph.D.; 1990; Iowa State University.

*UGTIKAR, Vivek; 2001; Professor of Chemical and Materials Engineering; Affiliate Professor of Environmental Science; Associate Dean for Research, College of Engineering; Ph.D.; 1993; University of Cincinnati.

VON LINDERN, Ian H; 1981; Adjunct Professor of Chemical Engineering; Ph.D.; 1980; Yale University.
WAGSTAFF, Robert B.; 1998; Adjunct Assistant Professor of Materials Science and Engineering and Metallurgical Engineering; B.S.; 1987; University of Idaho.

WARD-CLOSE, Malcolm; 1992; Adjunct Professor of Materials Science and Engineering and Metallurgy; Ph.D.; 1977; University of Birmingham.

WELLS, Richard B.; 1981; Adjunct Professor in Chemical and Materials Engineering and in Neuroscience; Ph.D.; 1985; University of Idaho.

WHEELEER, Lee; 1983; Adjunct Professor of Chemical Engineering; B.S.; 1970; University of Idaho.

WIENCEK, John M; 2015; Professor of Chemical and Materials Engineering; Provost and Executive Vice President, University of Idaho; Ph.D.; 1989; Case Western Reserve University.

WINDES, William E; 2008; Adjunct Assistant Professor of Material Science and Engineering; Ph.D.; 2003; University of Idaho.

WRIGHT, Richard N; 1993; Adjunct Professor of Metallurgy; Ph.D.; 1982; Michigan Technology University.

*ZHAO, Haiyan; 2014; Assistant Professor of Chemical and Materials Engineering; Ph.D.; 2009; Virginia Polytechnic Institute.

*ZHAO, Haiyan; 2014; Assistant Professor of Chemical and Materials Engineering; Ph.D.; 2009; Virginia Polytechnic Institute.

Majors

- Chemical Engineering (B.S.Ch.E.) (https://catalog.uidaho.edu/colleges-related-units/engineering/chemical-materials-engineering/chemical-engineering-bsche)

Minors


Chemical and Materials Engineering Graduate Program

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 (https://catalog.uidaho.edu/colleges-related-units/graduate-studies) section for the general requirements applicable to each degree.

- Chemical Engineering (M.S.) (https://catalog.uidaho.edu/colleges-related-units/engineering/chemical-materials-engineering/chemical-engineering-ms)
- Chemical Engineering (M.Engr.) (https://catalog.uidaho.edu/colleges-related-units/engineering/chemical-materials-engineering/chemical-engineering-mengr)
- Chemical Engineering (Ph.D.) (https://catalog.uidaho.edu/colleges-related-units/engineering/chemical-materials-engineering/chemical-engineering-phd)
- Materials Science and Engineering (M.S.) (https://catalog.uidaho.edu/colleges-related-units/engineering/chemical-materials-engineering/materials-science-engineering-ms)
- Metallurgical Engineering (M.S.) (https://catalog.uidaho.edu/colleges-related-units/engineering/chemical-materials-engineering/metallurgical-engineering-ms)
- Metallurgy (M.S.) (https://catalog.uidaho.edu/colleges-related-units/engineering/chemical-materials-engineering/metallurgy-ms)

Chemical Engineering

CHE 110 Introduction to Chemical Engineering

Che 110 Introduction to Chemical Engineering (1 cr)
Introduction to chemical engineering career opportunities and process principles including problem solving and documentaion skills. Graded P/F.

CHE 123 Computations in Chemical Engineering

Che 123 Computations in Chemical Engineering (2 cr)
Methods of analyzing and solving problems in chemical engineering using personal computers; spreadsheet applications, data handling, data fitting, material balances, experimental measurements, separations, and equation solving. Coordinated lec-lab periods.

Prereq: Min 520 SAT math or min 22 ACT math or 49 COMPASS Algebra or Math 143 or Math 170, or Permission
Coreq: Math 143, Math 170, or higher.

CHE 204 (s) Special Topics

Che 204 (s) Special Topics (cr arr).

CHE 210 Integrated Chemical Engineering Fundamentals

Che 210 Integrated Chemical Engineering Fundamentals (1 cr)
Recitation support for fundamental STEM courses and process principles including problem solving and documentation skills. Twice a week, 2 hour recitation sessions. Graded P/F.

Prereq: Che 110 and Che 123.

CHE 223 Material and Energy Balances

Che 223 Material and Energy Balances (3 cr)
Conservation of mass and energy calculations in chemical process systems.

Prereq: Chem 112, Math 175.

CHE 299 (s) Directed Study

Che 299 (s) Directed Study (cr arr).

CHE 307 Group Mentoring

Che 307 Group Mentoring (1 cr, max 3)
Mentoring of student groups in engineering classes where a process education environment is used; students taking this course will improve their engineering skill in the area they are mentoring as well as improving their team, communication, and leadership skills. Students must attend all classes or labs where group activities in the process education environment are done (a minimum of 2 mentoring sessions per week).

Prereq: Permission.
CHE 326 Chemical Engineering Thermodynamics
ChE 326 Chemical Engineering Thermodynamics (3 cr)
Behavior and property estimation for nonideal fluids; phase and reaction equilibria; applications to industrial chemical processes.
Prereq: ChE 223, Engr 320 and 335, Math 310
Coreq: Chem 305.
CHE 330 Separation Processes I
ChE 330 Separation Processes I (3 cr)
Equilibrium stagewise operations, including distillation, extraction, absorption.
Prereq: ChE 326, Chem 305.
CHE 340 Transport and Rate Processes I
ChE 340 Transport and Rate Processes I (4 cr)
Same as MSE 340. Transport phenomena involving momentum, energy, and mass with applications to process equipment design. Coordinated lec-lab periods.
Prereq: Engr 335, Math 310, and ChE 223 or MSE 201.
CHE 341 Transport and Rate Processes II
ChE 341 Transport and Rate Processes II (4 cr)
Transport phenomena involving momentum, energy, and mass with applications to process equipment design. Coordinated lec-lab periods.
Prereq: ChE 340.
CHE 393 Chemical Engineering Projects
ChE 393 Chemical Engineering Projects (1-3 cr, max 9)
Problems of a research or exploratory nature.
Prereq: Permission of department.
CHE 398 (s) Engineering Cooperative Internship
ChE 398 (s) Engineering Cooperative Internship (3 cr)
Supervised internship in professional engineering settings, integrating academic study with work experience; requires written report; positions are assigned according to student’s ability and interest. Graded P/F.
Prereq: Permission.
CHE 400 (s) Seminar
ChE 404 (s) Special Topics
ChE 404 (s) Special Topics (cr arr)
Prereq: Permission.
CHE 423 Reactor Kinetics and Design
ChE 423 Reactor Kinetics and Design (3 cr)
Chemical reaction equilibria, rates, and kinetics; design of chemical and catalytic reactors.
Prereq: ChE 223, Math 310, Chem 305.
CHE 433 Chemical Engineering Lab I
ChE 433 Chemical Engineering Lab I (1 cr)
Senior lab experiments in chemical engineering.
Prereq: ChE 330, 341, 423.
CHE 434 Chemical Engineering Lab II
ChE 434 Chemical Engineering Lab II (1 cr)
Senior lab experiments in chemical engineering.
Prereq: ChE 330, 341, 423.
CHE 440 Applied Mathematics in Chemical Engineering
ChE 440 Applied Mathematics in Chemical Engineering (3 cr)
Mathematical approaches to modeling chemical behavior in transport, separation, reactor, and process systems.
Prereq: CHE 341 or permission.
CHE 444 Process Analysis and Control
ChE 444 Process Analysis and Control (3 cr)
CHE 445 Digital Process Control
ChE 445 Digital Process Control (3 cr)
Same as ECE 477. Dynamic simulation of industrial processes and design of digital control systems. Coordinated lecture-lab periods. Recommended Preparation: ChE 444 (Recommended Preparation for EE majors: ECE 350).
CHE 451 Environmental Management and Design
ChE 451 Environmental Management and Design (cr arr)
Waste management application projects; projects require original design, working model, and report. May involve week-long trip to national competition. One lec and 3 hrs of lab a wk; weekly team status report meetings plus weekly task reviews with advisor.
Prereq: Permission (by invitation only).
CHE 452 Environmental Management and Design
ChE 452 Environmental Management and Design (cr arr)
Gen Ed: Senior Experience
Waste management application projects; projects require original design, working model, and report. May involve week-long trip to national competition. One lec and 3 hrs of lab a wk; weekly team status report meetings plus weekly task reviews with advisor.
Prereq: Permission (by invitation only).
CHE 453 Process Analysis & Design I
ChE 453 Process Analysis and Design I (3 cr)
Same as MSE 453. Estimation of equipment and total plant costs, annual costs, profitability decisions, optimization; design of equipment, alternate process systems and economics, case studies of selected processes. ChE 453 and ChE 454/MSE 453 and MSE 454 are to be taken in sequence. (Fall only)
Prereq: ChE 330, ChE 341, and ChE 423; or MSE 201, MSE 308, MSE 313, MSE 340, and MSE 412.
CHE 454 Process Analysis and Design II
ChE 454 Process Analysis and Design II (3 cr)
Gen Ed: Senior Experience
Same as MSE 454. Estimation of equipment and total plant costs, annual costs, profitability decisions, optimization; design of equipment, alternate process systems and economics, case studies of selected processes. ChE 453 and 454 are to be taken in sequence. (Spring only)
Prereq: ChE 453 or MSE 453.
CHE 455 Surface and Colloids
ChE 455 Surfaces and Colloids (3 cr)
Chemical and physical phenomena near material interfaces and behaviors of colloidal particles in dispersing media.
Prereq: CHE 326 or CHEM 305 or permission.
CHE 491 (s) Seminar
ChE 491 (s) Seminar (1 cr)
Recent developments and topics. Graded P/F
Prereq: Senior standing.
CHE 498 (s) Internship
ChE 499 (s) Directed Study
ChE 499 (s) Directed Study (cr arr).
CHE 500 Master's Research and Thesis
ChE 500 Master's Research and Thesis (cr arr).
MSE 101 Introduction to Metallurgy and Materials Science
Principles relating properties of metals, ceramics, polymers, and composites to their structures.

Prereq: Chem 111.

MSE 201 Elements of Materials Science (3 cr)
MSE 201 Elements of Materials Science (3 cr)
Principles relating properties of metals, ceramics, polymers, and composites to their structures.

Prereq: Chem 111.

MSE 204 (s) Special Topics

MSE 299 (s) Directed Study

MSE 308 Thermodynamics of Materials

MSE 308 Thermodynamics of Materials (3 cr)

Prereq: MSE 201 and Chem 112
Coreq: Math 310.

MSE 313 Physical Metallurgy

MSE 313 Physical Metallurgy (3 cr)
Theory, structure, and properties of materials. (Fall only)

Prereq: MSE 201.

MSE 313L Physical Metallurgy Laboratory

1 credit
Metallurgical principles and practices, hardness testing, structure-property correlations. One 2-hr lab per week.

Prereq or Coreq: MSE 313.

MSE 340 Transport and Rate Processes I

MSE 340 Transport and Rate Processes I (4 cr)
See ChE 340.

MSE 341 Particulate Materials Processing

MSE 341 Particulate Materials Processing (4 cr)
Engineering science of particulates; powder production, powder properties, separation; design of systems applied to metals, ores, and concentrates.
Three lec and one hr of lab a wk; two 1-day field trips. Recommended Preparation: CS 211, Phys 212, and Engr 240.

Prereq: Chem 112
Coreq: Math 310.

MSE 393 Materials Engineering Projects

MSE 393 Materials Engineering Projects (1-3 cr, max 9)
Problems of a research exploratory nature.

Prereq: Permission.

MSE 400 (s) Seminar

MSE 400 (s) Seminar (cr arr).

MSE 404 (s) Special Topics

MSE 404 (s) Special Topics (cr arr).

MSE 412 Mechanical Behavior of Materials

MSE 412 Mechanical Behavior of Materials (3 cr)
Theories of elasticity and plasticity, dislocation based plastic deformation, strengthening mechanisms, mechanical properties of solids and relevant testing methods, failure processes and theories, fracture mechanics. Coordinated lecture-lab periods.

Prereq: MSE 201 and Junior Standing; or Permission.

MSE 413 Phase Transformation and Kinetics

MSE 413 Phase Transformation and Kinetics (3 cr)
Free energy minimization algorithms. Construction of phase diagrams for liquid and solid systems. Reaction kinetics in liquid and solid systems. Determination of reaction kinetics parameters (reaction order, activation energy, reaction rate constants, etc.). Coordinated lec-lab periods. Additional projects/assignments reqd for grad cr.

Prereq: Chem 112.
### MSE 415 Materials Selection and Design

**MSE 415 Materials Selection and Design (3 cr)**

Selection of materials for use in structural applications; consideration of environment, stress conditions, cost, and performance as guide to properties; optimization of choice of materials and fabrication methods; open-ended problems of real applications in various industries. Recommended Preparation: MSE 313 and MSE 465. (Spring only)

**Prereq:** MSE 201 and Engr 350.

### MSE 417 Instrumental Analysis

**MSE 417 Instrumental Analysis (3 cr)**

Principles and laboratory experiments in x-ray diffraction, scanning electron microscopy, transmission electron microscopy, thermal analysis, etc. (Fall only)

**Prereq:** Junior/Senior standing in an engineering discipline.

### MSE 421 Light Metals

**MSE J421/J521 Light Metals (3 cr)**

Principles behind the physical and extractive metallurgy of the light metals Al, Mg, Ti, Be; discussion of characteristics and applications of alloys based on these metals. Additional projects/assignments reqd for grad cr. Recommended Preparation: MSE 313.

### MSE 423 Corrosion

**MSE J423/J523 Environmental Degradation of Materials (3 cr)**

Engineering aspects of corrosion and its control presented in ways of importance to a practicing engineer. Topics include corrosion economics, detecting and monitoring corrosion, regulations, specifications, safety. Emphasis on corrosion monitoring and corrosion fundamentals: chemical and electrochemical reactions; chemical and electrochemical equilibria—including Pourbaix diagrams; electrochemical kinetics. Selection and use of materials, from stainless steels to plastics. Failure analysis. Additional projects/assignments reqd for graduate credit. (Fall only)

**Prereq:** Chem 112 and MSE 201 or ChE 223; or Permission.

### MSE 427 Ceramics Materials

**MSE J427/J527 Ceramics Materials (3 cr)**

Crystallography, ceramic crystal structures, phase diagrams, phase transformation; mechanical properties, thermal properties, electrical and magnetic properties. Additional projects/assignments reqd for graduate credit. Recommended Preparation: MSE 313.

### MSE 432 Fundamentals of Thin Film Fabrication

**MSE J432 Fundamentals of Thin Film Fabrication (3 cr)**

Physical deposition, chemical deposition, post deposition process, film characterization, and film properties. (Spring only)

**Prereq:** Senior standing or Permission.

### MSE 434 Fundamentals of Polymeric Materials

**MSE J434 Fundamentals of Polymeric Materials (3 cr)**

Polymer structure/property relationships and engineering applications. Topics include: overview of polymer chemistry and physics as they inform structure and properties for real-world applications, including sustainability considerations. Coordinated lecture-lab periods.

**Prereq:** Chem 111 and Chem 112.

### MSE 437 Radiation Effects on Materials

**MSE J437/J537 Radiation Effects on Materials (3 cr)**

Same as NE J437/J537. Interactions between radiation and solids.

**Prereq:** MSE 201 or Permission.

### MSE 438 Fundamentals of Nuclear Materials

**MSE J438/J538 Fundamentals of Nuclear Materials (3 cr)**

Same as NE J438/J538. This course is designed for students who wish to learn about nuclear materials and fuels from a materials science viewpoint. Topics to be covered include crystal structure, diffusion, radiation damage processes etc. Students who wish to receive credit for the 500 level course are required to do term-projects and advanced problems. (Spring only)

**Prereq:** MSE 201 or NE 450; or Permission.

### MSE 453 Process Analysis & Design I

**MSE 453 Process Analysis and Design I (3 cr)**

See ChE 453.

### MSE 454 Process Analysis & Design II

**MSE 454 Process Analysis and Design II (3 cr)**

**Gen Ed:** Senior Experience

See ChE 454.

### MSE 456 Metallic Materials

**MSE 456 Metallic Materials (3 cr)**

Processes for extracting metals; various classes of metallic alloys; casting, powder metallurgy, mechanical working, and joining of metals. Emphasis on understanding relationship of processing, structure and properties. Some lab demonstration of metal fabrication processes included.

**Prereq:** MSE 313 or Permission.

### MSE 464 Materials Physics and Engineering

**MSE 464 Materials Physics and Engineering (3 credits)**

Joint-listed with MSE 564. Cross-listed with PHYS 464. Materials for circuits, Magnetism and magnetic materials, Ferroelectric and piezoelectric materials, Semiconductors, Optical properties of semiconductor for optoelectronics, thermal properties, electron band theory, superconductivity. Additional projects/assignments required for graduate credit. (Spring only)

**Prereq:** Senior standing in an Engineering or Physics major, or PHYS 305 and PHYS 321; or Permission.

### MSE 498 (s) Internship

**MSE 498 (s) Internship (cr arr).**

### MSE 499 (s) Directed Study

**MSE 499 (s) Directed Study (cr arr).**

### MSE 500 Master’s Research and Thesis

**MSE 500 Master’s Research and Thesis (cr arr).**

### MSE 504 (s) Special Topics

**MSE 504 (s) Special Topics (cr arr).**

### MSE 507 Microstructures and Defects

**MSE 507 Microstructures and Defects (3 cr)**

This course correlates microstructure and defects with mechanical, physical and chemical properties of engineering materials. The fundamental characteristics of point, line, surface and volume defects in crystals will be elucidated on an advanced level. The essential elements of microstructure and their role in engineering materials will be discussed.

**Prereq:** Graduate standing or Permission.
MSE 511 Nuclear Degradation Mechanisms
MSE 511 Nuclear Degradation Mechanisms (3 cr)
Same as NE 511. Topics include various degradation mechanisms as applicable to nuclear structural components, including corrosion, creep, radiation damage etc.
Prereq: Graduate standing or Permission.

MSE 512 Nuclear Components Inspection
MSE 512 Nuclear Components Inspection (3 cr)
Same as NE 512. This course will cover various non-destructive testing techniques to evaluate the environmental degradation of the nuclear structural components. Remnant life estimation of structural components exposed to fatigue, creep and stress corrosion cracking service conditions will be discussed.
Prereq: Graduate standing or Permission.

MSE 513 Phase Transformation and Kinetics
MSE 513 Phase Transformation and Kinetics (3 cr)
See MSE J413/J513.

MSE 517 Reaction Kinetics
MSE 517 Reaction Kinetics (3 cr)
Application of absolute reaction rate theory; time and temperature dependence; kinetics of gas-solid reactions; kinetics of solid-solid reactions; corrosion, diffusion, and recrystallization. (Alt/yr)
Prereq: Materials Science Engineering graduate student or Permission.

MSE 521 Light Metals
MSE 521 Light Metals (3 cr)
See MSE J421/J521.

MSE 523 Corrosion
MSE 523 Corrosion (3 cr)
See MSE J423/J523.

MSE 525 Electronic Materials
MSE 525 Electronic Materials (3 cr)
Study of major chemical and physical principles affecting properties of solid state engineering materials. Topics include bonding, carrier statistics, band-gap engineering, optical and transport properties, novel materials systems, characterization, magnetism, and comprehensive introduction to physics of solid state devices.
Prereq: Materials Science Engineering graduate student or Permission.

MSE 527 Ceramic Materials
MSE 527 Ceramics Materials (3 cr)
See MSE J427/J527.

MSE 537 Radiation Effects on Materials
MSE 537 Radiation Effects on Materials (3 cr)
See MSE J437/J537.

MSE 538 Fundamentals of Nuclear Materials
MSE 538 Fundamentals of Nuclear Materials (3 cr)
See MSE J438/J538.

MSE 564 Materials Physics and Engineering
3 credits
Joint-listed with MSE 464, Cross-listed with PHYS 564
Materials for circuits, Magnetism and magnetic materials, Ferroelectric and piezoelectric materials, Semiconductors, Optical properties of semiconductor for optoelectronics, thermal properties, electron band theory, superconductivity. Additional projects/assignments required for graduate credit. (Spring only)
Prereq: Senior standing in an Engineering or Physics major, or PHYS 305 and PHYS 321; or Permission.

MSE 585 Nuclear Fuel Cycles
MSE 585 Nuclear Fuel Cycles (3 cr)
Same as NE 585. Processes to support the existing LWR fuel cycle. Alternative fuel cycles including U-233, Pu239 and mixed oxide fuels, and advanced reactor concepts. Recycling and recovery of nuclear materials, with emphasis on traditional fast reactor recycle.
Prereq: Permission.

MSE 598 (s) Internship
MSE 598 (s) Internship (cr arr).

MSE 599 (s) Research
MSE 599 (s) Non-thesis Master's Research (cr arr).

MSE 600 Doctoral Research & Dissertation
MSE 600 Doctoral Research and Dissertation (cr arr).