

Degree Requirements

Master of Arts or Master of Science Interdisciplinary Studies
<p>Each program is developed individually according to the student's interests and background but must be intellectually defensible and clearly interdisciplinary in nature. In addition to any Graduate College requirements not mentioned here, the requirements of the IDS Program are as follows:</p>
<ol style="list-style-type: none"> 1. Course work must be selected from a minimum of two academic areas. 2. No more than 6 credits of work completed prior to approval of the degree plan by the IDS Committee may be included in the program. 3. No more than 11 credits of 300G or 400G courses may be applied toward the program. 4. No more than 9 transfer credits may be included in the program. 5. No more than 9 credits of independent study (596) may be included in the program. 6. Courses may not be challenged for credit. 7. The degree will consist of a total of no less than 33 credits, of which no more than 16 credits may be earned in the College of Business. Students may select (with IDS Committee approval) from a thesis/project option or a written examination option. The thesis/project will carry 6 credits. Under either option, the student will be required to draw critically upon the two or more disciplines studied and to integrate disciplinary insights. 8. Students completing the thesis/project option will, upon completion of that option, meet with their 3-person graduate committee for a final review of the thesis or project. 9. Students completing the examination option will take a written examination prepared by their 3-person graduate committee, with whom they will subsequently meet for a review of results. 10. Minor revisions to the plan of study may be approved by the Director of Interdisciplinary Studies upon the recommendation of the student's graduate advisor; major changes must be approved by the university-wide IDS Committee. 11. All work toward the MA/MS degree in Interdisciplinary Studies must be completed within a period of seven years.

Course Offerings

INTDIS—INTERDISCIPLINARY STUDIES

INTDIS 591 PROJECT (0-V-6). Students are expected to draw critically upon the two or more disciplines studied and to integrate disciplinary insights. Before beginning the Project, a prospectus must be approved by the student's graduate committee. After its completion, the Project must be defended at an oral examination scheduled by the graduate advisor. PREREQ: Admission to candidacy.

INTDIS 593 THESIS (0-V-6). A Thesis must reflect scholarly integration of the two or more disciplines studied and demonstrate original research or new and logical interpretation of existing data. Before beginning the Thesis, a prospectus must be approved by the student's graduate committee. After its completion, the Thesis must be defended at an oral examination scheduled by the graduate advisor. PREREQ: Admission to candidacy.

Master of Science in Materials Science and Engineering

College of Engineering

Department of Materials Science and Engineering

Graduate Program Coordinator: Peter Müllner

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Engineering Graduate Faculty: Darryl Butt, Janet Callahan, Kris Campbell, Sean M. Donovan, Megan Frary, Will Hughes, William Knowlton, Amy Moll, Peter Müllner, Rick Ubic, Bernard Yurke

Physics Graduate Faculty: Charles Hanna, Byung-Il Kim, Alex Punnoose, Dmitri Tenne

Chemistry and Biochemistry Graduate Faculty: Eric Brown, Henry Charlier, Jeunghoon Lee, Owen, McDougal, Jeff Peloquin, Dale Russell, Martin Schimpf, Don Warner

Biological Sciences Graduate Faculty: Julia Thom Oxford

General Information

The Department of Materials Science and Engineering offers two distinct graduate degree programs. The program leading to the Master of Science in Materials Science and Engineering (M.S. MSE) is a thesis-based program designed to prepare students for research and development and further study at the doctoral level. The program leading to the Master of Engineering in Materials Science and Engineering (M.Engr. MSE) is a non-thesis program with a focus on professional development. Both programs are interdisciplinary and involve faculty members from the College of Engineering and the College of Arts and Sciences with expertise in electrical engineering, mechanical engineering, physics, chemistry, and biology.

Admission and Application Requirements

Admission Requirements An applicant must satisfy the minimum admission requirements of the Graduate College. In addition, the applicant must hold a baccalaureate degree in engineering from an ABET-accredited program or a baccalaureate degree in physics or chemistry, and must follow the application procedures specified below. Admission is competitive and the achievement of minimum requirements does not guarantee admission.

Application Procedures A prospective student may apply at any time and should follow the general graduate application procedure for degree-seeking students (see Applying as a Degree-Seeking Student in this catalog). The applicant must also 1) submit a statement of purpose to the graduate program coordinator, 2) have three letters of recommendation submitted directly by the references to the graduate program coordinator, and 3) arrange to have GRE

Interdisciplinary Programs

Master of Science in Materials Science and Engineering

General Test scores submitted by the Educational Testing Service (www.ets.org) directly to Boise State University (code R4018). The statement of purpose should give the educational and professional background of the student and his or her motivation for graduate study including career goals. Once the applicant's file is complete, it will be evaluated by the Materials Science and Engineering Graduate Studies Committee and an admission recommendation (regular, provisional, or denial) will be forwarded to the Dean of the Graduate College. In order to ensure proper mentoring of all graduate students, a recommendation for regular or provisional admission will not be forwarded unless a faculty member of the Department of Materials Science and Engineering is available to serve as the major advisor. The graduate dean will make the final admission decision and notify the applicant and the Materials Science and Engineering Graduate Studies Committee.

Advisor and Supervisory Committee

The Materials Science and Engineering Graduate Studies Committee will initiate the assignment of a supervisory committee for each admitted student. The supervisory committee will include a major advisor who serves as chair and at least two additional members appointed such that the committee contains a representative from the College of Engineering and from the College of Arts and Sciences. The role of the supervisory committee is to guide the student in all aspects of his or her graduate study.

Degree Requirements

Students must complete at least 30 graduate credits distributed as shown in the degree requirements table. A written thesis proposal and oral presentation to the supervisory committee is required prior to the completion of 15 credits applicable to the degree requirements. Work on the thesis can only be undertaken after approval of the thesis proposal by the supervisory committee. The thesis must constitute an original contribution to knowledge in materials science and engineering and must be successfully defended at a final oral examination. All work directly related to the thesis must be represented by at least 6 credits of MSE 593, PHYS 593, or CHEM 593.

Master of Science in Materials Science and Engineering	
Course Number and Title	Credits
Required Courses	13
MSE 505 Bonding and Structure of Materials.....	3
MSE 508 Solid State Thermodynamics	4
PHYS 515 Solid State Physics	3
PHYS 523 Physical Methods of Materials Characterization.....	3
Other Graduate Courses	11
Graduate courses in materials science and engineering or related field; all courses to be selected with student input and approved by the supervisory committee.	
Thesis	6
MSE 593 Thesis OR PHYS 593 Thesis OR CHEM 593 Thesis (P/F)	
TOTAL	30

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College of Engineering

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Degree Requirements

Students must complete at least 31 graduate credits distributed as shown in the degree requirements table. A maximum of 3 credits of MSE 696 Directed Research may be applied to meet the degree requirements. The comprehensive examination cannot be attempted prior to the last semester of the program. If the comprehensive examination is failed on the first attempt, then the student will be permitted a second attempt. Failure on the second attempt will result in dismissal from the program.

Master of Engineering in Materials Science and Engineering	
Course Number and Title	Credits
Required Courses	13
MSE 505 Bonding and Structure of Materials.....	3
MSE 508 Solid State Thermodynamics	4
PHYS 515 Solid State Physics	3
PHYS 523 Physical Methods of Materials Characterization.....	3
Other Graduate Courses	17
Graduate courses in materials science and engineering or related field; all courses to be selected with student input and approved by the supervisory committee.	
Comprehensive Examination	1
MSE 600 Assessment (P/F)	
TOTAL	31

Special Rule on Transfer Credit. The normal transfer credit policies of the Graduate College hold except that up to 15 transfer credits earned in combination at the University of Idaho and Idaho State University may be applied to either degree program (M.S. MSE or M. Engr. MSE) with the approval of the supervisory committee.

Course Offerings

CHEM—CHEMISTRY

CHEM 501 ADVANCED INORGANIC CHEMISTRY (3-0-3) (F). Atomic structure, molecular structure using valence bond and molecular orbital theories, elementary group theory, transition metal coordination chemistry, acids and bases, descriptive transition and nontransition metal chemistry. PREREQ: CHEM 322 or PERM/INST.

ECE—ELECTRICAL AND COMPUTER ENGINEERING

ECE 540 INTRO TO INTEGRATED CIRCUIT AND MEMS PROCESSING (3-0-3) (F). Fundamentals of integrated circuit and micro electromechanical systems (MEMS) fabrication technology; semiconductor substrates; theory of unit processes such as diffusion, oxidation, ion implantation, rapid thermal processing, photolithography, wet etching and cleaning, dry etching, thin-film deposition; chemical mechanical polishing; process integration; metrology;

statistical process control; TCAD. COREQ: ECE 540L. PREREQ: ECE 323 or PERM/INST.

ECE 540L INTRO TO INTEGRATED CIRCUIT AND MEMS PROCESSING LAB (0-3-1) (F). Semiconductor cleanroom practices; heavy lab safety; students will fabricate and test simple structures in lab; application of TCAD to practical problems. COREQ: ECE 540.

ECE 542 PHOTOLITHOGRAPHY (3-0-3) (F/S). Principles of optics, diffraction, interference, superposition of waves, imaging systems, fundamentals of microlithography, resolution, contact and projection lithography, photoresist processing, metrology. Phase shift masks, anti-reflective coatings, deep-ultraviolet lithography, off-axis annular illumination. Use of TCAD lithography simulation software. COREQ: ECE 442.

ECE 542L PHOTOLITHOGRAPHY LAB (0-3-1) (F/S). Cleanroom lab experience accompany ECE 542, utilizing a projection-printing wafer stepper, photoresist wafer track, SEM, and optical metrology equipment. Use of TCAD lithography simulation software. PREREQ: ECE 342. COREQ: ECE 542.

MSE—MATERIALS SCIENCE AND ENGINEERING

MSE 501 SURVEY OF MATERIALS SCIENCE (3-0-3) (F/S) (On demand). Application of the principles of chemistry and physics to the engineering properties of materials. Development of an in-depth understanding of the relationship between structure, properties, processing and performance for all classes of materials. PREREQ: PERM/INST.

MSE 505 BONDING AND STRUCTURE OF MATERIALS (3-0-3) (F/S). Bonding, atomic arrangements and crystal structures of metals, ceramics, electronic materials and polymers; electronic structure of solids; physical properties of solids; defects in solids; relationship between processing, microstructure and properties of materials. PREREQ: ENGR 245.

MSE 508 SOLID STATE THERMODYNAMICS (4-0-4) (S). The laws of thermodynamics are applied to multicomponent, multiphase reacting systems, and other thermodynamic systems. These concepts are used to discuss and mathematically compute equilibrium phase diagrams. The energy effects due to the geometry of solid surfaces are discussed in regards to capillarity effects. Classical thermodynamics is related to atom-level distributions using statistical thermodynamics and the partition function. Electrochemical thermodynamics is discussed in the context of two phase interfacial reactions. PREREQ: MATH 333, CHEM 322 or ENGR 320 or MSE 308 or PHYS 432.

MSE 510 ELECTRICAL, OPTICAL, AND MAGNETIC PROPERTIES OF MATERIALS (3-0-3) (F/S). Introduction to the physical principles underlying the electric, optical and magnetic properties of modern solids. Crystalline and energy band structure of materials, thermal properties and electrical conduction in semiconductors and metals, optical and magnetic properties of solids are covered. PREREQ: ENGR 245.

MSE 511 SEMICONDUCTOR MATERIALS (3-0-3) (F/S). Examination of the physical properties of semiconductors including electronic structure, free carrier statistics, optical properties, crystallography, and defects. Study of thermodynamic properties as related to lattice vibrations and diffusion. PREREQ: ENGR 245.

MSE 512 MECHANICAL PROPERTIES OF MATERIALS (3-0-3) (F/S). Study of deformation and fracture in engineering materials, including elastic and plastic deformations; dislocation theory; alloy hardening and creep deformation; fracture mechanisms; linear elastic and nonlinear elastic fracture mechanics; toughening of metals, ceramics, and composites; environmentally assisted failure. PREREQ: ENGR 245.

MSE 518 PHASE TRANSFORMATIONS AND KINETICS (3-0-3) (F). Kinetics of phase transformations, nucleation, crystallization, decomposition, chemical reactions, and atomic and molecular diffusion. Surface and interface phenomenon, nanoparticle-matrix interactions, sintering, grain growth, recovery and recrystallization. PREREQ: MSE 308 or MSE 508.

MSE 521 INTRODUCTION TO ELECTRON MICROSCOPY (2-2-3) (S). Theory and practice of scanning electron microscopy (SEM) and transmission electron microscopy (TEM), including electron optics, contrast mechanisms, diffraction theory, chemical analysis techniques, and sample preparation. Some understanding of crystallography is recommended. Applications of SEM and TEM in materials science and engineering will be covered. PREREQ: MSE 305 or MSE 505.

MSE 522 ADVANCED TRANSMISSION ELECTRON MICROSCOPY (1-3-2) (F). In-depth understanding of the transmission electron microscope (TEM), electron diffraction, imaging techniques, analytical techniques, and high-resolution electron microscopy (HREM). Students are required to have an approved project that utilizes the TEM. PREREQ: MSE 421 or MSE 521.

MSE 528 INTERFACES AND DISLOCATION BEHAVIOR (3-0-3) (S) (Even years). Structure of interfaces as groups of line defects including dislocations, disconnections, and disclinations; application of general concepts to special situations including epitaxial interfaces, twin boundaries and phase transformations. PREREQ: MSE 305 or MSE 505.

MSE 549 ADVANCED TOPICS IN MATERIALS SCIENCE AND ENGINEERING (3-0-3) (F/S) (On demand). Selected advanced topics from current research in Materials Science and Engineering such as defects in solids, physics of thin films, nanomaterials, optoelectronics, computational materials science, corrosion, reliability physics. PREREQ: ENGR 245.

MSE 561 MICROELECTRONIC PACKAGING MATERIALS (3-0-3) (F/S). Engineering analysis of electronic packaging materials and their affect on electrical design, assembly, reliability, and thermal management. Selection process for packaging materials, manufacturing and assembly, single and multi-chip packaging. PREREQ: ENGR 245.

MSE 565 APPLICATIONS OF MATHEMATICA FOR MATERIALS SCIENCE AND ENGINEERING (1-0-1) (F/S). The basics of using Mathematica software to solve problems in Materials Science and Engineering. PREREQ: ENGR 245 and MATH 175.

MSE 577 (BIOL 577) (ME 577) BIOMATERIALS (3-0-3) (F/S). Theory of biomaterials science. Medical and biological materials and their applications. Selection, properties, characterization, design and testing of materials used by or in living systems. May be taken for BIOL, ME or MSE credit, but only from one department. PREREQ: ENGR 245 or CHEM 112.

MSE 588 BIOCOMPATIBILITY AND ENVIRONMENTAL DEGRADATION (3-0-3) (F/S). Theory of environmental degradation of metals, ceramics, polymers and biomaterials. The scientific principles of materials degradation with emphasis on material interactions within a living organism (in vivo). PREREQ: CHEM 112 or ENGR 245.

PHYS—PHYSICS

PHYS 512 INTRODUCTORY QUANTUM MECHANICS (3-0-3) (F/S). Introduction to fundamentals of quantum mechanics, including Schrodinger equation, energy levels, angular momentum, electron spin, perturbations, and scattering. Applications, such as tunneling, orbitals, magnetic resonance, and nanoscale effects. PREREQ: PHYS 309.

PHYS 515 SOLID STATE PHYSICS (3-0-3) (F/S). Quantum physics applied to understanding the properties of materials, including semiconductors, metals, superconductors, and magnetic systems. PREREQ: PHYS 309.

PHYS 523 PHYSICAL METHODS OF MATERIALS CHARACTERIZATION (3-0-3) (S). Physical principles and practical methods used in determining the structural, electronic optical, and magnetic properties of materials. Course topics will include optical, electron, and scanning microscopies, diffraction, surface analysis, optical spectroscopy, electrical transport, and magnetometry. Individual projects will focus on the application of an analytical technique to solve a specific problem. PREREQ: PHYS 309 or PERM/INST.

PHYS 530 OPTICS (3-0-3). Geometrical and physical optics, including lenses, fiber optics, Fourier optics, polarization, interference, diffraction, lasers, and holography. PREREQ: PHYS 212, MATH 333. COREQ: PHYS 534.

PHYS 532 THERMAL PHYSICS (3-0-3) (S). Discussion of temperature, work, specific heat, and entropy. The laws of thermodynamics are discussed and applied to physical problems. Ideal gases, statistics, Gibbs free energy, and cryogenics. Work on heat transfer of lattice vibrations and phonons will be required. PREREQ: Graduate standing or PERM/INST.

PHYS 534 OPTICS LABORATORY (0-3-1). Laboratory to be taken concurrently with PHYS 530. Experiments in optics, including optical systems, thick lenses, interference, diffraction, Fourier optics, image processing, and holography. COREQ: PHYS 530.