

# SCHOOL OF MATERIALS SCIENCE AND ENGINEERING (SMSE)

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Find us online at the SMSE website (<https://www.research.colostate.edu/sam/>).

Director: Dr. Travis Bailey  
Associate Director: Dr. Chris Weinberger

The overall objective of the School of Materials Science and Engineering (SMSE) program is to develop students to be science and engineering professionals who use their multidisciplinary problem-solving skills to address global challenges in the field of materials science and engineering (MSE).

The development of advanced materials, including their synthesis, characterization, and application in novel devices, occupies a central role in 21st century science, technology, and business. Materials research is, by its very nature, an extraordinarily inter- and multi-disciplinary endeavor, involving expertise in chemistry, physics, and engineering at the core, but also utilizing concepts from various other scientific disciplines as well as business and sociology, as materials research is often very focused on creating a product for the marketplace more efficiently and effectively. Indeed, work in this area concerns materials structure, property, and function. Thus, we educate future materials scientists and engineers to understand how different combinations of molecules can result in different thermal, mechanical, electrical, optical, and magnetic properties; to measure those properties at the atomic, electronic, surface, and bulk level; and to manufacture usable devices from the resulting materials. It is imperative that the next generation of materials scientists and engineers be explicitly educated in an interdisciplinary manner. The degree program contains elements that address materials technology transfer, materials manufacturing, responsible conduct of research, and other professional development skills necessary for success in the materials community.

## Graduate Master's Programs

- Master of Materials Engineering, Plan C (<https://catalog.colostate.edu/general-catalog/university-wide-programs/interdisciplinary-studies/school-materials-science-engineering/master-materials-engineering-plan-c/>)
- Master of Science in Materials Science and Engineering, Plan A and Plan B (<https://catalog.colostate.edu/general-catalog/university-wide-programs/interdisciplinary-studies/school-materials-science-engineering/materials-science-engineering-ms/>)

## Ph.D.

- Ph.D. in Materials Science and Engineering (<https://catalog.colostate.edu/general-catalog/university-wide-programs/interdisciplinary-studies/school-materials-science-engineering/materials-science-engineering-phd/>)

## Courses

**MSE 436 Green Engineering--Materials and Environment Credits: 3 (3-0-0)**

**Also Offered As:** MECH 436.

**Course Description:** Principles of green engineering in the context of materials, human dependence on materials, and the environmental consequences of materials selection. Perspective, background, methods, and data for evaluating and designing with materials to minimize the environmental impact.

**Prerequisite:** MECH 325 and MECH 331A.

**Registration Information:** Sections may be offered: Online. Credit allowed for only one of the following: MECH 436, MECH 481A4, or MSE 436.

**Term Offered:** Spring (even years).

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**MSE 465 Sustainable Strategies for E-Waste Management Credits: 3 (3-0-0)**

**Also Offered As:** GES 465.

**Course Description:** Trans-disciplinary overview of the electronics industry, with an emphasis on sources and impacts of e-waste on human & natural systems. Systems approaches to mitigating environmental and social impacts of electronics—from product design, materials and manufacture to use, re-use, recycle and disposal. Apply learnings in trans-disciplinary project teams to evaluate opportunities for improving the sustainability of the industry and its products.

**Prerequisite:** None.

**Registration Information:** Junior standing. Sections may be offered: Online. Credit allowed for only one of the following: GES 465, GES 481A1, MSE 465, or MSE 481A1.

**Term Offered:** Fall.

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**MSE 501 Materials Technology Transfer Credit: 1 (1-0-0)**

**Course Description:** The pathways toward commercialization of materials from research. Case studies, technology readiness levels, proposal writing, entrepreneurship, and intellectual property practices.

**Prerequisite:** MECH 331.

**Restriction:** Must be a: Graduate.

**Registration Information:** Senior standing. Sections may be offered: Online.

**Term Offered:** Fall.

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**MSE 502A Materials Science and Engineering Methods: Materials Structure and Scattering Credit: 1 (1-0-0)**

**Course Description:** Introduction to the atomic level arrangements of materials, defects related to these structures, and X-ray Diffraction, X-ray scattering, and electron diffraction methods.

**Prerequisite:** MATH 345 and MECH 331.

**Restriction:** Must not be a: Freshman, Sophomore, Junior.

**Registration Information:** Senior standing. Sections may be offered: Online.

**Term Offered:** Fall.

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**MSE 502B Materials Science and Engineering Methods: Computational Materials Methods Credit: 1 (1-0-0)**

**Course Description:** Introduction to mathematical and computational methods that are used to model materials: Simulation/Modeling, Monte-Carlo, Monte-Carlo Potts, Density Functional Theory, and other approaches.

**Prerequisite:** (MATH 340 or MATH 345) and (MECH 331).

**Restriction:** Must not be a: Freshman, Sophomore, Junior.

**Registration Information:** Senior standing. Sections may be offered: Online.

**Term Offered:** Fall.

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**MSE 502C Materials Science and Engineering Methods: Materials Microscopy Credit: 1 (1-0-0)**

**Course Description:** Introduction to modern microscopy techniques for materials research using optical microscopy. Interferometry and confocal techniques, scanning electron, microscopy transmission electron microscopy, and scanning probe microscopy.

**Prerequisite:** (CHEM 431 or MECH 331) and (MATH 340 or MATH 345).

**Restriction:** Must not be a: Freshman, Sophomore, Junior.

**Registration Information:** Senior standing. Sections may be offered: Online.

**Term Offered:** Fall.

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**MSE 502D Materials Science and Engineering Methods: Materials Spectroscopy Credit: 1 (1-0-0)**

**Course Description:** The investigation and measurement of spectra produced when matter interacts with or emits electromagnetic radiation, including an introduction to X-ray photoelectron spectroscopy, electron energy loss spectroscopy, Raman and infrared, and energy dispersive spectroscopy for materials research.

**Prerequisite:** (MATH 340 or MATH 345) and (MECH 331).

**Restriction:** Must not be a: Freshman, Sophomore, Junior.

**Registration Information:** Senior standing. Sections may be offered: Online.

**Term Offered:** Spring.

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**MSE 502E Materials Science and Engineering Methods: Bulk Properties and Performance Credit: 1 (1-0-0)**

**Course Description:** Physical properties of materials and how they relate to the functionalization of materials, including their use in electronic, magnetic, optical, and other functional devices.

**Prerequisite:** (MATH 340 or MATH 345) and (MECH 331).

**Restriction:** Must not be a: Freshman, Sophomore, Junior.

**Registration Information:** Senior standing. Sections may be offered: Online.

**Term Offered:** Spring.

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**MSE 502F Materials Science and Engineering Methods: Experimental Methods for Materials Research Credit: 1 (1-0-0)**

**Course Description:** Modern experimental design methods and techniques for materials research. Topics include vacuum systems, cryogenic experimentation, temperature characterization, data acquisition and digitization, device and circuitry design in the context of materials research.

**Prerequisite:** (MATH 340 or MATH 345) and (MECH 331).

**Restriction:** Must not be a: Freshman, Sophomore, Junior.

**Registration Information:** Senior standing. Sections may be offered: Online.

**Term Offered:** Spring.

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**MSE 503 Mechanical Behavior of Materials Credits: 3 (3-0-0)**

**Course Description:** The mechanical behavior of metals, polymeric, ceramic, and composite materials in mechanical designs considering multiple factors such as structure, processing, and physical properties. Practical and specific performance analyses of structural materials are examined.

**Prerequisite:** (MSE 501 or MSE 502A or MECH 331) and (MATH 340 or MATH 345).

**Registration Information:** Senior standing. Sections may be offered: Online.

**Term Offered:** Fall.

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**MSE 504 Thermodynamics of Materials Credits: 3 (3-0-0)**

**Course Description:** The determination of whether and the means by which a given reaction can occur. Macroscopic and microscopic solid-state thermodynamics with experimental methodologies for characterizing them, with a focus on thermodynamic and statistical mechanical aspects of material structure-property relationships.

**Prerequisite:** (CBE 210 or CHEM 476 or MECH 331 or PH 361) and (MATH 340 or MATH 345).

**Restriction:** Must not be a: Freshman, Sophomore, Junior.

**Registration Information:** Senior standing. Sections may be offered: Online.

**Term Offered:** Fall.

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**MSE 505 Kinetics of Materials Credits: 3 (3-0-0)**

**Course Description:** The determination of whether and the means by which a given reaction can occur. Macroscopic and microscopic solid-state kinetics with experimental methodologies for characterizing them, with a focus on the kinetic aspects of material structure-property relationships.

**Prerequisite:** MSE 504.

**Restriction:** Must not be a: Freshman, Sophomore, Junior.

**Registration Information:** Senior standing. Sections may be offered: Online.

**Term Offered:** Spring.

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**MSE 523 Electronic Properties of Materials Credits: 3 (3-0-0)**

**Course Description:** Introduction to the electronic properties of materials, including band structures, quantum mechanics and optical characteristics.

**Prerequisite:** MATH 340 or MATH 345.

**Restriction:** Must not be a: Freshman, Sophomore, Junior.

**Registration Information:** Senior standing. Credit allowed for only one of the following: ECE 523, ECE 580B7, ECE 580B8, ECE 580C2, MSE 523, MSE 580B7, MSE 580B8, MSE 580C2.

**Term Offered:** Spring.

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**MSE 631 Defects in Crystals Credits: 3 (3-0-0)**

**Also Offered As:** MECH 631.

**Course Description:** Mechanics, thermodynamics and kinetics of defects in crystalline solids including point defects, dislocations, and grain boundaries.

**Prerequisite:** None.

**Restriction:** Must be a: Graduate, Professional.

**Registration Information:** Sections may be offered: Online. Credit allowed for only one of the following: MECH 631, MSE 631, or MECH 681A2.

**Term Offered:** Spring.

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**MSE 651 Special Topics in Materials Science Credits: 3 (0-0-3)**

**Course Description:** New or emerging topics in materials science and engineering.

**Prerequisite:** MECH 331.

**Restriction:** Must be a: Graduate, Professional.

**Registration Information:** Sections may be offered: Online.

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**MSE 695 Independent Study Credits: Var[1-5] (0-0-0)**

**Course Description:** Independent study of special topics in materials science and engineering.

**Prerequisite:** None.

**Restriction:** Must be a: Graduate, Professional.

**Registration Information:** Written consent of advisor.

**Terms Offered:** Fall, Spring, Summer.

**Grade Mode:** Instructor Option.

**Special Course Fee:** No.

**MSE 699 Thesis Credits: Var[1-6] (0-0-0)**

**Course Description:** Thesis in materials science and engineering.

**Prerequisite:** None.

**Restriction:** Must be a: Graduate, Professional.

**Registration Information:** Written consent of advisor.

**Terms Offered:** Fall, Spring, Summer.

**Grade Mode:** S/U Sat/Unsat Only.

**Special Course Fee:** No.

**MSE 784 Supervised College Teaching Credits: Var[1-5] (0-0-0)**

**Course Description:** Supervised college teaching in materials science and engineering.

**Prerequisite:** None.

**Restriction:** Must be a: Graduate, Professional.

**Registration Information:** Written consent of advisor.

**Terms Offered:** Fall, Spring, Summer.

**Grade Mode:** Instructor Option.

**Special Course Fee:** No.

**MSE 793A Professional Development Seminar: MSE, Diversity, Equity, and Inclusion Credit: 1 (0-0-1)**

**Course Description:** Professional and personal skill development regarding diversity, equity, and inclusion as it pertains to opportunities in materials science and engineering.

**Prerequisite:** None.

**Restriction:** Must be a: Graduate, Professional.

**Registration Information:** Bachelor's degree required. Admission to MSE graduate programs. Sections may be offered: Online.

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**MSE 793B Professional Development Seminar: Materials and Society Credit: 1 (0-0-1)**

**Course Description:** The connections between materials and society, fusing basic concepts in materials science and engineering with perspectives and methods from anthropology, history, and sociology.

**Prerequisite:** None.

**Restriction:** Must be a: Graduate, Professional.

**Registration Information:** Bachelor's degree required. Admission to MSE graduate programs. Sections may be offered: Online.

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**MSE 793C Professional Development Seminar: Materials Science Engineering Careers Credit: 1 (0-0-1)**

**Course Description:** Professional and personal skill development pertaining to careers in materials science and engineering (MSE) and presentations from speakers in various MSE careers roles.

**Prerequisite:** None.

**Restriction:** Must be a: Graduate, Professional.

**Registration Information:** Bachelor's degree required. Admission to MSE graduate programs. Sections may be offered: Online.

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**MSE 795 Independent Study Credits: Var[1-5] (0-0-0)**

**Course Description:** Advanced independent study of special topics in materials science and engineering.

**Prerequisite:** None.

**Restriction:** Must be a: Graduate, Professional.

**Registration Information:** Written consent of advisor.

**Terms Offered:** Fall, Spring, Summer.

**Grade Mode:** Instructor Option.

**Special Course Fee:** No.

**MSE 799 Dissertation Credits: Var[1-12] (0-0-0)**

**Course Description:** Dissertation in materials science and engineering.

**Prerequisite:** None.

**Restriction:** Must be a: Graduate, Professional.

**Registration Information:** Written consent of advisor.

**Terms Offered:** Fall, Spring, Summer.

**Grade Mode:** S/U Sat/Unsat Only.

**Special Course Fee:** No.