

Materials Engineering and Science Ph.D.



Contact Information

Dr. Jon J. Kellar
Department of Materials and Metallurgical
Engineering
Mineral Industries 112
(605) 394-2343
e-mail: jon.kellar@sdsmt.edu

Advisory Council

Program Coordinator and Advisory Council
Chair; Professor Kellar with representatives from
the Departments of Chemical and Biological,
Civil and Environmental, Electrical, Mechanical,
Materials and Metallurgical Engineering, and the
Departments of Physics, and Chemistry.

Materials Engineering and Science

The doctor of philosophy program in materials
engineering and science (MES) offers a student
the opportunity to expand his/her knowledge and
understanding of the science and technology of
materials production, behavior, and applications.
The student will undertake multidisciplinary
approaches, combining the basic elements of both
engineering and science, to the solution of
materials-related problems. Because such
problems are found in every science and
engineering discipline, the degree applicant has
considerable flexibility in the selection of the
department in which to pursue dissertation
research, within the confines of the applicant's
academic preparation and interests. Candidates

will study either a science or engineering
emphasis within the MES Ph.D. program. For
example, research emphasis may be placed on
improving processes for the production of
metallic, polymeric, ceramic, or other structural or
electronic materials. Alternatively, the degree
candidate may investigate mechanisms for
improving material properties, which in turn,
could lead to new or better applications.
Classroom and individualized instruction will
provide the necessary theory to complement such
creative activities.

Example areas of specialization include but
are not limited to:

- Activities of Multicomponent Systems
- Computational Modeling
- Polymer Synthesis
- Concrete Technology
- Corrosion Inhibition
- Development of Multiphase Materials
- Fiber Reinforced Composites
- Geotechnology
- Magnetic Nanocomposites
- Nanoscale Electronic Materials
- Polymer Matrix Composites
- Reaction Kinetics
- Semiconductor Materials and Devices
- Strengthening Mechanisms
- Surface Chemistry of Flotation
- Thermophysical Properties
- Thin Films

The program is administered directly by the
Dean of Graduate Education and sponsored
programs, with the chair of the MES Ph.D.
advisory council serving as program coordinator.
The advisory council currently comprises faculty
members from the Departments of Civil and
Environmental, Electrical, Mechanical, Materials
and Metallurgical Engineering, and the
Departments of Physics, Chemistry, and Chemical
Engineering.

The Graduate Record Examination (GRE),
three (3) letters of recommendation, and a GPA of
3.00 or better are required of all applicants for the
MES Ph.D. program. The TOEFL exam is
required for students whose native language is not
English.

All candidates for the MES Ph.D. program are

required to successfully complete the following minimum credits and earn a grade of “C” or better, except for a final grade of “S” in MES 800:

Category	Credits
Analytical Mathematics	3
Numerical Mathematics	3
Program Major Emphasis (Engineering or Science)	44-54
Dissertation Research	20-30
Total beyond the B.S. degree	80

General Program Requirements

(Minimum program requirements: eighty (80) credits)

M.S. Degree (twenty-four (24) credits)

Programs-major courses may be used to satisfy course work hour requirements for analytical mathematics, numeral mathematics, or fundamental science courses taken in the M.S. program of study (subject to approval).

Analytical Mathematics (three (3) credits)

ME 673	(3-0)	Applied Engineering Analysis I
PHYS 671	(3-0)	Mathematical Physics I
PHYS 673	(3-0)	Mathematical Physics II

Numerical Mathematics (three (3) credits)

CEE 784	(3-0)	Modeling and Computation in Civil Engineering
CEE 785	(3-0)	Applications of Finite Element Methods in Civil Engineering
MATH 687	(3-0)	Statistical Design and Analysis of Experiments
ME 773	(3-0)	Applied Engineering Analysis II
MET 614	(3-0)	Advanced Metallurgical Simulation Techniques
MineE 533	(3-1)	Computer Applications in Geoscience Modeling

Program Emphasis (thirty (30) credits)

Two program emphasis areas are available: Materials Science and Materials Engineering. See sections below.

Research	(twenty (20) credits)
MES 898	(19) Dissertation
MES 890	(1-0) Seminar

A maximum of ten (10) additional research credits may be included within the hours specified for the program major, subject to approval by the student’s advisory committee. The courses listed in Sections II and III below are suggested courses for the science of engineering emphasis, but students are not limited to this selection. Students may take courses out of each emphasis when developing their programs of study.

Science Emphasis Requirements

(Minimum program requirements: thirty (30) credits)

Thermodynamics of Solids (3 credits)

MES 712	(3-0)	Interfacial Phenomena
MET 636	(3-0)	Thermodynamics of Solids
MET 638	(3-0)	Solid State Phase Transformations
PHYS 743	(3-0)	Statistical Mechanics
Transport in Solids (three (3) credits)		
CHE 613	(3-0)	Transport Phenomena: Heat
CHE 614	(3-0)	Transport Phenomena: Mass
MES 728	(3-0)	Heterogeneous Kinetics

Crystal Structure/Chemistry of Solids

(three (3) credits)

CHEM 455/555	(3-0)	Advanced Inorganic Chemistry
MES 603	(4-0)	Condensed Matter Physics
MES 604	(4-0)	Chemistry of Materials
MES 737	(3-0)	Solid State Physics I
PHYS 777	(3-0)	Quantum Mechanics I
PHYS 779	(3-0)	Quantum Mechanics II

Bulk or Surface Analysis (three (3) credits)

GEOL 643	(2-1)	Intro to Microbeam Instruments
MES 708L	(1-2)	Experimental Advanced Instrumental Analysis

Fundamental Engineering Mechanics

(six (6) credits)

Courses from the Engineering emphasis section can also be used to fulfill this requirement.

ME 424	(3-0)	Fatigue Design of Mechanical Components
ME 425	(3-0)	Probabilistic Mechanical Design
ME 442	(3-0)	Failure Modes of Engineering Materials
MET 440/540	(3-0)	Mechanical Metallurgy
ME/MET 443	(3-0)	Composite Materials
MET 625	(3-0)	Strengthening Mechanisms in Materials
Dissertation Related Topics (twelve (12) credits)		

Engineering Emphasis Requirements

(minimum program requirements: thirty (30) credits)

Analytical Mechanics

ME 623	(3-0)	Advanced Mechanical Vibrations
ME 613	(3-0)	Advanced Heat Transfer
MES 713	(3-0)	Adv Solid Mechanics I
MES 770	(3-0)	Continuum Mechanics

Elasticity/Plasticity

CEE 643	(3-0)	Advanced Soil Mechanics I
CEE 644	(3-0)	Advanced Soil Mechanics II
CEE 646	(3-0)	Stability of Soil and Rock Slopes
CEE 749	(1-2)	Experimental Soil Mechanics
MES 713	(3-0)	Advanced Solid Mechanics I
MINE 412/512	(3-0)	Rock Mechanics III
MINE 450/550	(3-0)	Rock Slope Engineering

Failure Analysis Fracture Mechanics

CEE 616	(3-0)	Advanced Engineering Materials Technology
MES 614	(3-0)	Mechanics of Composite Materials
Fundamental Materials Science (six (6) credits)		
Courses from the Science Emphasis section		

can also be used to fulfill this requirement.

CHEM 420	(3-0)	Organic Chemistry III
CHEM 452/552	(3-0)	Inorganic Chemistry
CHEM 426/526	(3-0)	Polymer Chemistry
MES 603	(4-0)	Chemistry of Materials
MES 601	(4-0)	Fundamentals of Materials Engineering
MES 604	(4-0)	Condensed Matter Physics
CHE 474/574	(2 to 3)	Polymer Technology
PHYS 439	(4-0)	Solid State Physics
MET 445/545	(3-0)	Oxidation and Corrosion of Metals
MET 421/521	(3-0)	Refractories and Ceramics

An assessment of the student's qualifications will be undertaken early in their program. The assessment is comprised of performance in pre-determined courses and a dissertation proposal. Further information is available in the School of Mines materials engineering and science Ph.D. Handbook.

Each student is also required to pass a comprehensive examination. There is no language requirement for the MES doctoral program.

For program supervision purposes, the MES Ph.D. program coordinator is the graduate advisor until the major professor is appointed. The major professor is the person responsible for the student's dissertation research. The graduate office representative on the student's dissertation committee must be selected from outside of the department with which the major professor is affiliated, and should also be a member of the MES Ph.D. Advisory Council. The MES Ph.D. Advisory Council must approve all programs of study. It is not necessary that the student be associated with the department of affiliation of his or her major professor. The detailed information on examination policy, admission to candidacy, and defense of dissertation are included in the School of Mines Materials Engineering and Science Ph.D. Handbook.