

## 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](mailto:Jon.Kellar@sdsmt.edu)

### Advisory Council

Advisory Council members are from the Departments of Civil and Environmental Engineering, Mechanical Engineering, Materials and Metallurgical Engineering, 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 head 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, Mechanical, Materials and Metallurgical Engineering, and the Departments of Physics, and Chemistry.

The Graduate Record Examination (GRE), three 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: 80 credits)

#### M.S. Degree (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 (3 credits)

ME 673 (3-0) Applied Engineering Analysis I

PHYS 581 (3-0) Mathematical Physics

#### Numerical Mathematics (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 547 (3-0) Design and of Experiments

ME 773 (3-0) Applied Engineering Analysis II

MET 614 (3-0) Advanced Metallurgical Simulation Techniques

MEM 533 (3-1) Computer Applications in Geoscience Modeling

#### Program Emphasis (30 credits)

Two program emphasis areas are available: materials science and materials engineering. See sections below.

#### Research (20 credits)

MES 898 (19) Dissertation

MES 890 (1-0) Seminar

A maximum of 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: 30 credits)

#### Thermodynamics of Solids (3 credits)

MES 712 (3-0) Interfacial Phenomena

PHYS 743 (3-0) Statistical Mechanics

CBE 613 (3-0) Transport Phenomena: Heat

CBE 714 (3-0) Transport Phenomena: Mass

MES 728 (3-0) Heterogeneous Kinetics

#### Crystal Structure/Chemistry of Solids

(3 credits)

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

#### Bulk or Surface Analysis (3 credits)

MES 708/708L(3-1) Advanced Instrumental Analysis

NANO 703/703L(3-1) Instrumentation and Characterization of Nano-Materials

#### Fundamental Engineering Mechanics

(6 credits)

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

ME 425 (3-0) Probabilistic Mechanical Design

MET 450 (3-0) Forensic Engineering

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 (12 credits)

## **Engineering Emphasis Requirements**

(minimum program requirements: 30 credits)

### **Analytical Mechanics**

ME 623	(3-0)	Advanced Mechanical Vibrations
ME 613	(3-0)	Transport Phenomena: Heat
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**

ME 715	(3-0)	Advanced Composite Materials Fundamental Materials Science (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
CBE 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.