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# Intercollegiate Interdisciplinary Graduate Programs

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Many graduate programs have an interdisciplinary dimension. The programs in this section are administered by the Division of Graduate Studies and/or by more than one other college. Refer to the college sections for other interdisciplinary programs. For more information, see “Interdisciplinary Study,” page 82.

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## Arts, Media, and Engineering

[ame.asu.edu](http://ame.asu.edu)  
480/965-9253

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At ASU, engineering, arts, and science disciplines invested in media research and training have come together to create the Arts, Media, and Engineering program (AME). The program’s mission is research and education in the integrated development of media systems. The program’s specialized focus is the study and development of experiential media systems. These are systems that integrate computation and digital media in the physical human experience for the production of enhanced physical-digital experiences. The program’s goals are achieved through a large interdisciplinary network of faculty and students working under a common, use-inspired research and education agenda.

For more information, access the Web site at [ame.asu.edu](http://ame.asu.edu).

### ARTS, MEDIA, AND ENGINEERING (AME)

**M AME 592 Research.** (1–12)  
*selected semesters*

**M AME 593 Applied Project.** (1–12)  
*selected semesters*

**M AME 598 Special Topics.** (1–4)

*selected semesters*

Topics may include the following:

- Active Learning in Mediated Environments. (3)
- Applied Cognition and Perception-Action. (3)
- Computational Models for Media and Arts. (3)
- Computer Music for Multimodal Systems. (3)
- Digital Graphics and Animation for Multimodal Systems. (3)
- Dynamic Multimodal Environments. (3)
- Dynamic User-Centered Modeling and Design. (3)
- History and Analysis of Media Arts/Arts and Technology. (3)
- Image Understanding or Image and Video Analysis for Media. (3)  
Credit is allowed for only AME 598 or EEE 598.
- Kinesiology for Consciousness of Movement. (3)
- Media Performance Ensemble. (1)
- Media Theory. (3)
- Mediated Biosystems. (3)
- Motion Capture and Analysis. (3)
- Multimedia Systems. (3)  
Credit is allowed for only AME 598 or CSE 591.
- Multimodal Context Models. (3)
- Multimodal Interfaces and Interactive Technologies. (3)
- Multimodal Pattern Analysis. (3)
- Multisensor Models or Multimodal Data Fusion. (3)
- Network Consumption and Construction. (3)
- Physical Computing. (3)
- Signal Processing for Media Arts. (3)
- Sound Analysis for Multimodal Environments. (3)

**M AME 599 Thesis.** (1–12)

*selected semesters*

**M AME 790 Reading and Conference.** (1–12)

*selected semesters*

**M AME 792 Research.** (1–15)

*selected semesters*

**M AME 799 Dissertation.** (1–15)

*selected semesters*

**Omnibus Courses.** For an explanation of courses offered but not specifically listed in this catalog, see “Omnibus Courses,” page 63.

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## Business Administration

### Interdisciplinary Doctoral Program

[www.poly.asu.edu/msabr/agn\\_phd.htm](http://www.poly.asu.edu/msabr/agn_phd.htm)

480/727-1585

WANER 240

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The Morrison School of Agribusiness and Resource Management and the W. P. Carey School of Business offer an interdisciplinary program leading to the PhD degree in Business Administration with a concentration in agribusiness.

## INTERCOLLEGIATE INTERDISCIPLINARY GRADUATE PROGRAMS

### DOCTOR OF PHILOSOPHY

As an academic discipline, agribusiness focuses on the application of theory and quantitative methods in economics, finance, marketing, and management to issues involved in the production, distribution, and marketing of food and fiber. Agribusiness PhD students study topics such as consumer behavior in food markets, strategic marketing by food retailers, supply-chain management, derivatives and risk management, and international agricultural trade and policy. The objective of the agribusiness PhD program is to produce scholars who are trained in the latest methods of business and economic analysis. Graduates are prepared to be at the forefront of problem solving in one of the most important sectors of the global economy. With this background, graduates of the concentration are expected to assume teaching and research positions at top-ranked research universities.

**Admission.** Applicants to the PhD in Business Administration with a concentration in agribusiness must submit an application for admission by January 15, and all supporting materials in time to obtain a complete application package by February 1 for fall study. For general admission requirements, access the Web site at [wpcarey.asu.edu/grad/phd/phd\\_ba\\_concentrations.cfm](http://wpcarey.asu.edu/grad/phd/phd_ba_concentrations.cfm). All application packets meeting these minimum requirements will be evaluated by graduate faculty of the Morrison School.

**Program of Study.** See “Doctor of Philosophy,” page 177, for general requirements. Agribusiness PhD students are expected to develop programs of study that consist of three elements: (1) a core of theory and quantitative methods course work in economics and management from the W. P. Carey School, (2) completion of at least one advanced course in economics, finance, and marketing or management from the W. P. Carey School, and (3) completion of a two-course sequence of PhD-level theory and methods as applied to issues and concepts specific to the agribusiness sector from the Morrison School. The agribusiness PhD is designed to allow “flexibility with focus” so each student’s program of study is unique, but is designed to produce the highest level of research competency in the student’s chosen area of interest.

**Comprehensive Examination.** After completion of all course work, each student completes a comprehensive written examination that covers both core and interest-area subject matter. The intent of the exam is to determine whether the student is sufficiently prepared to conduct dissertation research to the standards of the W. P. Carey School and the Morrison School research faculty. Consequently, the exam is set and graded by faculty in both schools. Students must pass the comprehensive exam and have their dissertation prospectus accepted by their committee in order to be admitted to candidacy.

**Dissertation.** PhD students select a dissertation committee consisting of a minimum of three faculty members, with at least one member from the W. P. Carey School and one from the Morrison School. The PhD dissertation represents an original body of research that contributes to existing knowledge in the chosen field in a significant way.

**Final Examination.** Upon completing the dissertation, PhD candidates take an oral examination in defense of their work. The oral examination is administered by the PhD committee and one external member from within the university community. The PhD is granted upon successful completion of the oral defense and any revisions to the dissertation required by committee members.

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## Creative Writing

### Interdisciplinary Master’s Program

[www.asu.edu/clas/english/creativewriting](http://www.asu.edu/clas/english/creativewriting)

480/965-3528

LL 307C

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### Cynthia Hogue, Director, Executive Committee

#### English

Regents’ Professors: Carlson, Dubie, Ríos  
Professors: Boyer, Goldberg, Hogue, Pritchard, Rhodes  
Associate Professors: McNally, Savard  
Senior Lecturer: Cook

#### Theatre and Film

Associate Professor: Reyes

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Faculty of the Creative Writing Committee offer an interdisciplinary Master of Fine Arts degree in Creative Writing. The program is offered jointly by the Department of English in the College of Liberal Arts and Sciences and the School of Theatre and Film in the Katherine K. Herberger College of Fine Arts.

### MASTER OF FINE ARTS

One of the unique features of this interdisciplinary program is that, because it utilizes faculty research, creative activity, and teaching interests of two academic units, a student may tailor a course of study to fit individual needs, talents, and goals. The Department of English administers the program and reviews the applications for admission. In the English Department, the studio/academic program requires poets and prose writers to divide work equally between writing workshops and literature courses. This flexible curriculum allows candidates time to study with several gifted writers and scholars in a stimulating atmosphere, time to get quality advice on writing, and time to explore and develop their talents. In the School of Theatre and Film, the studio/academic program emphasizes the collaborative process of playwrighting. Working with actors and directors, playwrights’ workshops include informal readings, staged readings, and workshop production of students’ plays.

**Admission.** In addition to meeting the general requirements of the Division of Graduate Studies, applicants should have an undergraduate major in English or Theatre, with a GPA of 3.00 or above. Applicants who do not have an

undergraduate major in English or Theatre may be admitted on the basis of excellent creative and academic work. Deficiencies in undergraduate preparation may be removed while pursuing the MFA degree. Applicants must also submit the following:

1. three letters of recommendation;
2. a professional résumé; and
3. a statement of career goals, including the designation of an area of specialization (options include creative nonfiction, fiction, playwriting, and poetry) and a manuscript sample of one of the following: 30 pages of drama; 20 pages of poetry; 30 pages of prose fiction or creative nonfiction; or 40 total pages of work in two of these literary forms.

**Selection Procedures.** Application should be made to the Division of Graduate Studies at [www.asu.edu/graduate](http://www.asu.edu/graduate), and transcripts should also be mailed directly to the graduate division. All other materials and manuscripts, including the teaching assistant application form, should be submitted to the Department of English by February 1. The Creative Writing Committee reviews the materials and manuscripts and makes recommendations for admission by March 15. Guidelines for admission recommendations used by the committee include the following: applicant's academic record and capabilities for successful graduate study; talent and promise demonstrated in the manuscript sample; strength of letters of recommendation; quality of applicant's undergraduate background; and compatibility of the applicant's career goals with the purpose of the degree program.

**Program of Study.** In poetry and fiction, the program of study requires a minimum of 48 semester hours of graduate credit approved by the student's supervisory committee, the director of the Creative Writing Committee, and the dean of graduate studies. Of these, 24 semester hours must be creative writing courses and must include nine semester hours of ENG 580, and nine semester hours of any combination of ENG 562, 563, 594, 598, 662, 663, and 664. The course 594 Conference and Workshop may be taken twice to varied offerings. The literature component of 24 semester hours must include ENG 591, 665, and two ENG courses in literature selected by the student's supervisory committee or the director of the creative writing committee such as ENG 667. In playwriting, the program of study requires a minimum of 48 semester hours of graduate credit approved by the student's supervisory committee, the director of the Creative Writing Committee, and the dean of graduate studies. The program of study must include the following: THP 519 (six semester hours), 560 (15 semester hours), 561 (three semester hours), 598 (three semester hours), and 693 (nine semester hours). The literature component must include THE 500, 504, 505, and 520.

**Credit Before Admission.** Subject to the recommendation of the supervisory committee, students with a completed MA or PhD degree in English or Theatre may have up to 15 semester hours of literature credit applied to the MFA program of study. A maximum of nine semester hours taken before admission and not as part of a completed degree at ASU and/or another institution may be used to fulfill degree requirements.

**Comprehensive Examinations.** A final written comprehensive examination is required and is scheduled once each semester and once during the summer. Upon completion of course work, the student is required to take the written examination. The student is also required to notify the Creative Writing Committee of intent to take the examination at least 30 days in advance. A student is not eligible to apply for the written examination until a program of study has been filed. If the candidate fails the examination, a reexamination may be administered no sooner than three months and no later than one year from the date of the original examination. Permission for reexamination must be obtained from the student's supervisory committee, the director of the Creative Writing Committee, and the dean of graduate studies. Only one reexamination is permitted. Students are examined in the following areas:

1. 20th-century American writers: modern period;
2. 20th-century writers: contemporary period; and
3. 20th-century critical theory.

Playwrights are examined in the following areas: (1) European and American drama and (2) dramatic theory and criticism. The examination is constructed and graded by members of the Creative Writing Examination Committee.

**Practicum and Performance Requirements.** ENG 580 Practicum is required of all students in the program. For nine semester hours of credit, the student creates a book-length volume of poetry, short stories, novel, drama, translation, or creative nonfiction (except literary criticism). This project must be approved in advance by the student's supervisory committee on the basis of sample pages and a summary of the proposal. The supervisory committee must evaluate and approve the final project. As the last requirement for the degree, the candidate must read or perform from the practicum or applied project before students and members of the faculty.

## RESEARCH AND SCHOLARLY ACTIVITY

Research and scholarly endeavors inform the creative work of the faculty, which includes publication of poetry, fiction, and drama; collaborative production with musicians, fine printers, and visual artists. Special research courses are offered on contemporary perspectives emphasizing such topics as "Magical Realism," "The Long Poem," "Pedagogy Forum for Creative Writers," "The Literature of Obsession," "Internship for Community Outreach," "Death and Transfiguration," "Poetry as Witness," and "Latino and Latina Theatre."

Research and creative activity is enhanced by vigorous faculty and student involvement in producing a national literary magazine, *Hayden's Ferry Review*, an ASU student publication. Creative writing faculty and graduate students participate in public outreach programs, including workshops at ASU for adults and high school students in rural and metropolitan areas of the region. Public lectures and readings by faculty members, original play productions and reader's theatre, and a regular series of public readings, lectures and conferences featuring writers of national renown provide a forum for exchange among artist, audience, scholar, and student. Recent conferences, with support from

## INTERCOLLEGIATE INTERDISCIPLINARY GRADUATE PROGRAMS

the Virginia G. Piper Center for Creative Writing and other agencies, have brought together writers, editors, and publishers, focusing attention on issues in publishing creative work.

### COURSES

For courses, see "English (ENG)," page 339, "Theatre (THE)," page 300, and "Theatre Performance and Production (THP)," page 301.

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## Geographic Information Science

### Interdisciplinary Certificate Program

[www.asu.edu/giscert](http://www.asu.edu/giscert)

480/727-7360

LSE 218

480/727-1288

QUAD 2 114

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**John M. Briggs, Director, Executive Committee**  
**William H. Miller, Director, Executive Committee**

#### Geography

Associate Professor: Wentz

#### Life Sciences

Professors: Briggs, Klopatek

#### Planning

Associate Professor: Guhathakurta

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Under the auspices of the Division of Graduate Studies, the interdisciplinary certificate program in Geographic Information Science (GIS) is administered by an executive committee. The objective of this program is to enable existing ASU graduate students and GIS professionals with advanced degrees to learn how to apply GIS concepts and technology for the purposes of spatial analysis.

A minimum of 16 semester hours consisting of three required and two elective courses (three semester hours each) plus a capstone seminar (one semester hour) is required to complete the GIS Certificate. For a full description of the program course work, access the GIS Web site at [www.asu.edu/giscert](http://www.asu.edu/giscert).

Current graduate students receive priority admission to the certificate program. Students qualify for admission to the certificate program by maintaining good standing in a cooperating department and completing an application specific to the GIS Certificate. Practicing professionals who already hold a graduate degree furnish proof of an advanced degree by a formal transcript and enroll as nondegree graduate students through the Division of Graduate Studies. Prospective students must complete prerequisites listed for the level one required course, or pass a proficiency test.

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## Materials Science

### Interdisciplinary Master's Program

[www.asu.edu/graduate/SEM](http://www.asu.edu/graduate/SEM)

480/965-2460

PS A323

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**James B. Adams, Codirector**  
**William T. Petuskey, Codirector**

#### Chemical and Materials Engineering

Professors: Adams, Alford, Dey, Krause, Mahajan, Newman  
Research Professor: Picraux

#### Chemistry and Biochemistry

Regents' Professor: Buseck  
Professors: Kouvetakis, Petuskey  
Assistant Professor: Matyushov

#### Electrical Engineering

Regents' Professor: Ferry  
Professors: Goodnick, Kozicki, Schroder, Thornton, Zhang

#### Mechanical and Aerospace Engineering

Professor: Sieradzki

#### Physics and Astronomy

Regents' Professor: Smith  
Professors: Bennett, Ponce, Rez, Sankey, Tsong, Venables  
Associate Professors: Culbertson, Drucker, Herbots, Marzke

#### Solid State Science

Regents' Professor: Smith  
Professor: Carpenter  
Senior Research Scientists: Crozier, McCartney, McKelvy  
Associate Research Scientist: Sharma

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The Science and Engineering of Materials Program offers an interdisciplinary master's degree in Materials Science. The members of the faculty are from several academic and research units in the College of Liberal Arts and Sciences and the Ira A. Fulton School of Engineering: the Departments of Chemical and Materials Engineering, Chemistry and Biochemistry, Electrical Engineering, Mechanical and Aerospace Engineering, and Physics and Astronomy, and the Center for Solid State Science.

### MATERIALS SCIENCE—MS

The MS degree in Materials Science is an interdisciplinary program of study that integrates courses offered by several academic departments and faculty representing various disciplines to provide a sound foundation for research leading to a thesis. Emphasis is placed on application of the core fundamentals for investigation of the relationships between syntheses, microstructure, physical and chemical properties, and the performance of solids in current technological applications.



**Admission.** All applications for graduate study are processed by the ASU Division of Graduate Studies. An online application is on the Web at [www.asu.edu/graduate](http://www.asu.edu/graduate). Applicants must satisfy Division of Graduate Studies requirements, which include

1. application;
2. application fee of \$45;
3. official transcripts;
4. official TOEFL for international students (minimum of 600 for admission to the SEM Program); and
5. TSE for students who wish to be considered for a teaching assistantship.

Students must also satisfy the requirements of the program:

1. GRE (verbal, quantitative, and analytical);
2. résumé;
3. statement of purpose; and
4. three letters of recommendation.

All application materials must be received by the program (postmarked) by February 15 for the fall semester and October 15 for the spring semester.

**Program of Study.** The master's degree is structured around a comprehensive set of courses contained in the participating disciplines. Because of the multidisciplinary

emphasis of the program, a balance is sought of courses that are taught with engineering and science objectives. The program consists of 33 semester hours beyond the bachelor's degree. A minimum of 24 semester hours are split evenly between four core courses (12 semester hours) and four elective courses (12 semester hours). The remaining semester hours are devoted to seminar, research, and thesis (three semester hours each).

**Interdisciplinary Course Hours**

CHM 471 Solid-State Chemistry .....	3
CHM 541 Advanced Thermodynamics .....	3
or MSE 530 Materials Thermodynamics and Kinetics (3)	
PHY 481 Materials Physics I.....	3
SEM 500 Research Methods.....	3
SEM 591 Seminar .....	3
Total .....	15

**Foreign Language Requirements.** None.

**Thesis Requirements.** The thesis, which is the final and most important product of the student's effort in this program, must report original research in the field and demonstrate the student's ability to conduct creative, independent research. Each candidate must register for three semester hours of research and three semester hours of thesis.



Associate Dean for Graduate Academic Programs Filiz Ozel represented the ASU Division of Graduate Studies at the International Graduate Scholarship Conference held in Beijing, China, as part of a recruitment effort by the Woodrow Wilson National Responsive PhD program.

Aykut Ozel photo

**Final Examination.** The final examination in defense of the thesis is conducted by the student's thesis committee and other faculty members appointed by the dean of graduate studies.

### COURSES

For courses, see "Science and Engineering of Materials (SEM)," page 93.

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## Physical Activity, Nutrition, and Wellness

### Interdisciplinary Doctoral Program

[www.poly.asu.edu/ecollege/wellness](http://www.poly.asu.edu/ecollege/wellness)

480/727-1945

EAW 109

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**Pamela Swan, Executive Committee Chair**

#### Exercise and Wellness

Professor: Stone

Associate Professors: Swan, Tudor-Locke

Assistant Professor: Adams

#### Nursing

Professor: Fleury

#### Nutrition

Professors: Johnston, Vaughan

Associate Professor: Hampl

Assistant Professor: Winham

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The Executive Committee of the Physical Activity, Nutrition, and Wellness program offers an interdisciplinary graduate program leading to the PhD degree in Physical Activity, Nutrition, and Wellness (PANW). One of the unique features of this interdisciplinary program is that a student may tailor a course of study to fit individual needs and goals within two main concentration areas: (1) exercise and wellness and (2) nutrition. The program focuses on issues that contribute to health through the reduction of disease risk, quality of life promotion, and enhancement of well being. While many healthy lifestyles are studied, the emphasis is on physically active living and sound nutrition.

### DOCTOR OF PHILOSOPHY

The PhD degree in PANW is an individualized interdisciplinary program that integrates graduate courses from several academic units to provide a sound foundation for research leading to a dissertation. The PANW doctoral program prepares research scholars, teachers, and professionals who study physical activity, nutrition, healthy lifestyles, and wellness. The program prepares graduates for careers in higher education, government agencies, and health-related positions in private industry. The interdisciplinary PhD pro-

gram requires residency and three years of full-time study after the master's degree. Students are actively involved in research at all stages of their doctoral study through their participation in formal research internships, independent research experiences, seminars and colloquia, and dissertation research.

### Admission

In addition to meeting Division of Graduate Studies requirements, students must submit a letter designating potential concentration area, area of research interest, the name of a potential mentor (from the list of approved faculty mentors), and a statement of career goals to the chair of the PANW Executive Committee. Graduate Record Examination (GRE) scores (verbal, quantitative, and writing), a writing sample, a professional résumé, and three letters of recommendation must also be submitted. Additionally, all students must submit an application for a teaching or research assistantship. Applicants whose native language is not English must submit a Test of English as a Foreign Language score. Applicants must have successfully received a master's degree before admission to the PhD program, and it is preferable that they have completed a data-based research thesis. Admission decisions are based on the compatibility of the applicant's research interests and career goals with the purpose of the degree program, previous academic training and GPA, GRE scores, recommendations, and match of research interests with those of available mentors. First priority for fall admission is given to completed applications received by January 15.

### Program of Study

The program of study (POS) consists of a minimum of 90 semester hours past the MS degree distributed across five areas of study: core (12), internships (four research and two teaching), inquiry/analysis (21), concentration (27) and dissertation (24). It is expected that 12 of the 27 semester hours in the concentration are in a focused content area within the concentration. In addition, at least one course in the concentration should be taken from a program/department outside the student's home program. A maximum of 12 graduate semester hours may be counted toward the 90-semester-hour requirement at the discretion of the student's program committee. An individual POS is selected in consultation with the student's supervisory committee. It is expected that students admitted to the PhD program have a strong foundation in either exercise and wellness or nutrition. Those lacking background in these areas are required to make up deficiencies. Minimal undergraduate course requirements are human anatomy/physiology; BIO 201 and 202 Human Anatomy and Physiology I and II; NTR 241 Human Nutrition; and EXW 315 Physiological Foundations of Movement. It is also expected that all students enter the program with at least basic statistics and basic research methods courses. Other requirements may be necessary depending on the area of study and are determined by the mentor and program committee.

**Residence.** It is expected that students spend three years in full-time residence. The intent is to involve and embed the student in ongoing research as well as class study. Thus, all PhD students are to be full-time students and hold part-time

appointments (50 percent time, 20 hours a week) as a teaching assistant or research assistant. As such, to be accepted into the program one must have the expertise, experience, and willingness to teach courses in the physical activity program or in the EXW or nutrition undergraduate curriculum or be a research assistant and conduct research with a mentor as funding allows.

**Foreign Language Requirements.** None.

**Comprehensive Examinations.** Upon completion of course work and before commencing dissertation research, the student is given written and oral examinations. After the student has passed the comprehensive examinations, a dissertation committee is approved by the PANW Executive Committee and the dean of graduate studies. After the dissertation committee has approved the dissertation prospectus, the student is eligible to apply for admission to candidacy.

**Dissertation Requirements.** The dissertation must consist of a fully documented written analysis of a problem that extends the knowledge and/or theoretical framework of the field. The research should demonstrate the student's creativity and competence for independent research

**Final Examination.** A final oral examination in defense of the dissertation is required. The candidate must take the final oral examination within five years after passing the comprehensive examinations. Any exception must be approved by the supervisory committee, the chair of the PANW Executive Committee, and the dean of graduate studies and ordinarily involves repetition of the comprehensive examinations.

## COURSES

For courses, refer to the course listings under the Department of Exercise and Wellness and the Department of Nutrition. Applicable courses are also available through other departments with approval of the student's supervisory committee.

## Science and Engineering of Materials

### Interdisciplinary Doctoral Program

[www.asu.edu/graduate/SEM](http://www.asu.edu/graduate/SEM)

480/965-2460

PS A323

**James B. Adams, Codirector**  
**William T. Petuskey, Codirector**

### Chemical and Materials Engineering

Professors: Adams, Alford, Dey, Krause, Mahajan, Newman  
Research Professor: Picraux

### Chemistry and Biochemistry

Regents' Professor: Buseck  
Professors: Kouvetakis, Petuskey  
Assistant Professor: Matyushov

### Electrical Engineering

Regents' Professor: Ferry  
Professors: Goodnick, Kozicki, Schroder, Thornton, Zhang

### Mechanical and Aerospace Engineering

Professor: Sieradzki

### Physics and Astronomy

Regents' Professor: Smith  
Professors: Bennett, Ponce, Rez, Sankey, Tsong, Venables  
Associate Professors: Culbertson, Drucker, Herbots, Marzke

### Solid State Science

Regents' Professor: Smith  
Professor: Carpenter  
Senior Research Scientists: Crozier, McCartney, McKelvy  
Associate Research Scientist: Sharma

The Committee on the Science and Engineering of Materials offers an interdisciplinary graduate program leading to the PhD degree in Science and Engineering of Materials, with concentrations in high-resolution nanostructure analysis and solid-state device materials design. The members of the faculty composing the program are from several academic research units in the College of Liberal Arts and Sciences and the Ira A. Fulton School of Engineering: the Center for Solid State Science, the Departments of Chemical and Materials Engineering, Chemistry and Biochemistry, Electrical Engineering, Mechanical and Aerospace Engineering, and Physics and Astronomy.

## DOCTOR OF PHILOSOPHY

The PhD degree in the Science and Engineering of Materials is an interdisciplinary program of study that integrates courses offered by faculty representing various disciplines, along with courses in mathematics, to provide a sound foundation for research leading to a dissertation. Emphasis is placed upon applications of the core fundamentals for investigation of the relationships between microstructure and properties and performance of solids, and the dependence of microstructure on processing.

**Admission.** Admission to the SEM Program is a two-step process. First, all prospective students must satisfy the general admission requirements of the Division of Graduate Studies. International students must submit a Test of English as a Foreign Language (TOEFL) score. The minimum TOEFL score required by the SEM Program is 600. Second, students must satisfy the requirements of the SEM Program. These requirements are a GRE passing score (verbal, quantitative, analytical), a professional résumé, a statement of purpose, and three letters of recommendation. International students who wish to be considered for teaching assistantships must provide the program with a Test of Spoken English (TSE) score. Application materials must be received by the SEM Program Office by the following

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established deadlines: for fall, documents must be received (postmarked) by February 1; for spring, by October 1.

**Program of Study.** The program consists of a minimum 84 semester hours beyond the bachelor's degree, at least 24 of which are research and dissertation credit. Programs of study for individual students are defined during discussions between the student and the faculty supervisory committee. At least 30 semester hours of the approved program of study, including the core, exclusive of research and dissertation, must be completed after admission to the PhD program at ASU.

A minimum of 10 graduate-level courses beyond the bachelor's degree is required.

The curriculum includes core courses that define the essential course work for all students, involving 21 semester hours of selected courses in materials, chemistry, and physics. Students who previously have taken courses fulfilling some of the core requirements may select electives.

### Interdisciplinary Core Courses

CHM 471 Solid-State Chemistry .....	3
or CHM 453 Inorganic Chemistry (3)	
CHM 541 Advanced Thermodynamics .....	3
CHM 545 Quantum Chemistry .....	3
or EEE 434 Quantum Mechanics for Engineers (3)	
or PHY 571 Quantum Physics (3)	
PHY 511 Materials Physics I.....	3
or PHY 512 Materials Physics II (3)	
SEM 500 RM: Introduction to Physical Materials.....	3
SEM 591 Seminar .....	3

Students may choose one of the following concentrations in their program of study: (1) high-resolution nanostructure analysis or (2) solid-state device materials design. Or students may tailor a program of study in the science and engineering of materials to meet their professional and academic needs. Students achieve the desired concentration by completing three or more of the courses in the appropriate concentration group of courses. The courses in these concentrations are a part of the elective portion of the degree course requirements.

**High-Resolution Nanostructure Analysis.** The courses composing the high-resolution nanostructure analysis concentration provide the most comprehensive education in the theory and application of transmission electron microscopy in the U.S. This group of courses is highly interdisciplinary. Because of the strict and important correspondence between the properties of materials and their nanostructure, transmission electron microscopy plays a central role in modern materials science, far beyond its role in other fields of natural science and engineering. Nanostructure analysis comprises one-third of the field of materials research and is often the critical knowledge necessary to understand the behavior of materials. The development and applications of high-resolution nanostructure analysis methods is one of the university's strongest materials research and education specialties and is an important part of the SEM program. Required courses are as follows:

SEM 552 Electron Microscopy I.....	3
SEM 553 Electron Microscopy Laboratory I.....	3

SEM 554 Electron Microscopy II .....	3
SEM 555 Electron Microscopy Laboratory II .....	3
Total .....	12

**Solid-State Device Materials Design.** The courses specified for the solid-state device materials design concentration are materials applications and characterization courses that introduce SEM students to the culture of device engineering. Students apply their knowledge of basic materials science to contemporary problems of the solid-state electronics industry. Required courses are as follows:

EEE 435 Microelectronics .....	3
EEE 436 Fundamentals of Solid-State Devices .....	3
EEE 536 Semiconductor Characterization.....	3
IEE 572 Design of Engineering Experiments .....	3
MSE 598 ST: Growth and Processing of Semiconductors.....	3
Total .....	15

**Foreign Language Requirements.** None.

**Comprehensive Examination.** Near completion of course work and no later than three years after admission to the program, the student is given a comprehensive examination with oral and written components. The written component is a test that examines the student's knowledge in the core course subjects. The examination is administered by the Curriculum and Examination Committee. The oral component requires the presentation of a research proposition to the student's faculty supervisory committee. The student must define a research problem of current relevance to the materials science field. The problem may be experimental, theoretical, or a combination of both. The presentation should be based on the study of literature and discussions with members of the supervisory committee and materials researchers. The student defines the problem, describes its significance in the field, proposes a method of investigation leading to a solution of the problem, and defends the problem and proposed solution before the faculty supervisory committee. The proposed problem may be from any area of materials research but it may not be part of the student's dissertation topic. The student must prepare and deliver to the members of the supervisory committee the written proposal describing the research proposition not less than seven business days before the scheduled examination date. The comprehensive exams may be taken no more than twice upon formal application to, and under conditions specified by, the student's faculty committee, the director of the supervisory program, and the dean of graduate studies. Upon successful completion of this examination, the student is advanced to candidacy for the degree by the Division of Graduate Studies.

**Dissertation Requirements.** The dissertation, which is the final and most important product of the student's effort in this program, must report original research in the field and demonstrate the student's ability to conduct creative, independent research. Each candidate must register for 24 semester hours of research and dissertation as part of the degree requirements; specifically, 12 semester hours of SEM 792 Research and 12 semester hours of SEM 799 Dissertation. Dissertation credits should be taken in the semester(s) following the student's advancement to candidacy.



After the student passes the comprehensive examinations, and every semester up to the time the student defends the dissertation, the student must submit a one-page report on the dissertation proposal to his or her dissertation committee at the end of the semester.

**Final Examination.** The final oral examination in defense of the dissertation is conducted by the dissertation committee and others appointed by the dean of graduate studies.

### SCIENCE AND ENGINEERING OF MATERIALS (SEM)

#### **M SEM 500 Research Methods. (1–12)**

*selected semesters*

Topics may include the following:

- Introduction to Physical Materials. (3)

#### **M SEM 552 Electron Microscopy I. (3)**

*fall*

Kinematical and dynamical electron diffraction and microscopy. Defect structure and composition using STEM imaging, x-ray and electron-energy-loss spectroscopy. Cross-listed as MSE 552/PHY 552. Credit is allowed for only MSE 552 or PHY 552 or SEM 552. Prerequisite: instructor approval.

#### **M SEM 553 Electron Microscopy Laboratory I. (3)**

*fall*

Lab support for SEM 552. Cross-listed as MSE 553/PHY 553. Credit is allowed for only MSE 553 or PHY 553 or SEM 553. Pre- or corequisite: MSE 552 or PHY 552 or SEM 552.

#### **M SEM 554 Electron Microscopy II. (3)**

*spring*

Determination of structure and composition of materials using high-resolution imaging, convergent-beam diffraction, and electron holography. Novel developments and applications. Cross-listed as MSE 554/PHY 554. Credit is allowed for only MSE 554 or PHY 554 or SEM 554. Prerequisite: instructor approval.

#### **M SEM 555 Electron Microscopy Laboratory II. (3)**

*spring*

Lab support for SEM 554. Cross-listed as MSE 555/PHY 555. Credit is allowed for only MSE 555 or PHY 555 or SEM 555. Pre- or corequisite: MSE 554 or PHY 554 or SEM 554.

#### **M SEM 591 Seminar. (1–12)**

*fall and spring*

Emphasizes discussion, student presentations, and written research papers.

#### **M SEM 592 Research. (1–12)**

*fall, spring, summer*

#### **M SEM 594 Conference and Workshop. (1–12)**

*spring*

Topics may include the following:

- Vacuum System Science and Engineering. (3)  
Vacuum concepts, equipment, and systems are studied to give an operational knowledge of modern vacuum technology. Equal emphasis is placed on theoretical and practical instruction. Class time is equally distributed between lecture and laboratory sessions. Lab sessions consist of exercises and tours to provide hands-on experience with and a working perspective of the vacuum techniques and systems principally used in industry, academia, and government laboratories. Undergraduates take two written exams; graduate students take two written exams and complete a vacuum system design project. Prerequisite: college algebra.

#### **M SEM 598 Special Topics. (1–4)**

*selected semesters*

Topics may include the following:

- Phase Transformations in Solids. (3)

#### **M SEM 599 Thesis. (1–12)**

*fall, spring, summer*

#### **M SEM 700 Research Methods. (1–12)**

*selected semesters*

#### **M SEM 790 Reading and Conference. (1–12)**

*selected semesters*

Independent study in which a student meets regularly with a faculty member to discuss assignments (such as intensive reading in a spe-

cialized area, writing synthesis of literature on a specified topic, writing literature review of a topic).

#### **M SEM 791 Seminar. (1–12)**

*selected semesters*

#### **M SEM 792 Research. (1–15)**

*fall, spring, summer*

#### **M SEM 799 Dissertation. (1–15)**

*fall, spring, summer*

**Omnibus Courses.** For an explanation of courses offered but not specifically listed in this catalog, see "Omnibus Courses," page 63.

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## Statistics

### Interdisciplinary Master's and Certificate Programs

[www.asu.edu/graduate/statistics](http://www.asu.edu/graduate/statistics)

480/965-5003

PS A744

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**Dennis L. Young, Codirector, Executive Committee**

**Douglas C. Montgomery, Codirector, Executive Committee**

#### **Economics**

Professor: Mayer

#### **Health Management and Policy**

Associate Professors: Reiser, Wilson

#### **Industrial Engineering**

Professors: Hubele, Montgomery, Runger

Assistant Professor: Kulahci

#### **Information Systems**

Professor: St. Louis

#### **Mathematical Sciences and Applied Computing**

Professor: Berger

Associate Professor: Borrer

#### **Mathematics and Statistics**

Professors: Eubank, Lohr, Young

Associate Professor: Prewitt

Assistant Professors: Chen, Majumdar

#### **Supply Chain Management**

Associate Professor: Brooks

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The Committee on Statistics offers a program leading to a graduate Certificate in Statistics and the MS degree in Statistics. The program is interdisciplinary in that it draws upon faculty research and teaching interests from various academic units so that programs of study can be tailored to reflect individual needs and goals. The committee, which sets program requirements and supervises programs of study, is composed of faculty from departments in the Ira A. Fulton School of Engineering, the College of Liberal Arts and Sciences, the W. P. Carey School of Business, and the New College of Interdisciplinary Arts and Sciences.

## INTERCOLLEGIATE INTERDISCIPLINARY GRADUATE PROGRAMS

### MASTER OF SCIENCE

The program for the MS degree in Statistics provides preparation for either a research-oriented or a practice-oriented career. Requirements specific to this program ensure balanced attention to the theoretical and applied aspects of the discipline of statistics. (See “Master’s Degrees,” page 75, for general requirements.) Flexibility in the program reflects the fact that statistical analysis is one of the most widely used tools of modern scientific reasoning.

**Admission.** Applicants must satisfy the general requirements for admission to the Division of Graduate Studies (see “Admission to the Division of Graduate Studies,” page 65) and must, in addition, have three letters of academic recommendation submitted to the admissions subcommittee of the Committee on Statistics. Although most applicants earn the bachelor’s degree in a quantitative area (such as statistics, quantitative business analysis, mathematics, engineering, or computer science), this is not required for admission to the program.

Applicants should have completed the following courses (equivalents at ASU are given in parentheses): calculus (MAT 270, 271, and 272), advanced calculus (MAT 371), linear algebra (MAT 342), computer programming (CSE 100), and introductory applied statistics (QBA 221 or STP 420). The submission of Graduate Record Examination test scores is strongly recommended, but not necessary.

**Supervisory Committee.** Upon entering the program, the student should contact the program director for assistance in selecting a three-member supervisory committee. (Typically, the student progress subcommittee of the Committee on Statistics serves as the student’s initial supervisory committee.) The faculty member who directs the student’s work on the thesis or applied project must be a member of the Committee on Statistics and serves as the chair of the student’s final supervisory committee.

**Program of Study.** The student’s program of study must contain at least 30 semester hours of credit, none of which may be from the prerequisites and at least 18 of which must be at or above the 500 level. The program must include the nine semester hours from three required theory courses: probability (STP 421), mathematical statistics (STP 427), and theory of statistical linear models (STP 526). The program must also include either three semester hours of applied project (IEE 593, QBA 593, or STP 593) or six semester hours of thesis (IEE 599, QBA 599, or STP 599).

The remaining 15 or 18 semester hours may come from elective courses chosen by the student with the approval of supervising faculty. A maximum of six semester hours may be chosen from a related field on which statistics relies (such as computer science) or in which statistics is an essential tool (e.g., biostatistics, quality control).

The required theory courses are fundamental to the education of statisticians and are necessary for more advanced graduate study. The elective courses allow the student to emphasize a particular area of statistical inference, culminating in an applied project report or a thesis on a topic in that area. The student has considerable flexibility in selecting an area of specialty. Possible areas of specialty include, among others, mathematical statistics, biostatistics, applied

data analysis, design of experiments, statistical modeling, time series analysis, statistical process control, variance components analysis, statistical computing, and survey research. Sample programs of study for such areas of specialty may be obtained from the director of the program.

**Foreign Language Requirements.** None.

**Comprehensive Examination.** None.

**Thesis Requirements.** Either an applied project or a thesis is required. The content of the applied project report or thesis must, in its final form, be suitable for submission to an academic journal or conference proceedings. The thesis must conform to Division of Graduate Studies format requirements.

**Final Examination.** An oral examination in defense of the applied project or thesis is required.

**Certificate in Statistics.** This certificate provides statistical training to graduate students and professionals. The certificate requires 15 semester hours of course work selected from approved ASU graduate-level courses. To enroll, the



The College of Design offers five graduate degree programs.

John Buchholz photo

applicant must have a bachelor’s degree, an introductory applied statistics course, and one semester of calculus and is also required to have some computer literacy with knowledge of a programming language, a spreadsheet program, or a statistical software program. For more information, access the Web site at [www.asu.edu/graduate/statistics](http://www.asu.edu/graduate/statistics).

**RESEARCH ACTIVITY**

Research interests of committee members include non-parametric regression, variance components, generalized linear models; multivariate analysis, latent structure models, categorical data analysis; biostatistics, biomedical research; time series analysis and forecasting, econometrics, statistical process control, statistical decision support systems; statistical computing, statistical graphics; panel data analysis, complex sampling designs; decision-theoretic methods, risk assessment, robust statistical methods; design of experiments; process optimization; and response surface methodology.

**COURSES**

For courses, see “Industrial Engineering (IEE),” page 269, “Quantitative Business Analysis (QBA),” page 182, and “Statistics and Probability (STP),” page 384.

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**Transportation Systems**  
**Interdisciplinary Certificate Program**  
[www.asu.edu/caed/transportation](http://www.asu.edu/caed/transportation)  
**480/965-6395**  
**AED 358**

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**Mary Kihl, Director**

**Aeronautical Management Technology**

Professor: Gesell  
 Associate Professor of Practice: Karp

**Civil and Environmental Engineering**

Professors: Mamlouk, Washington

**Geography**

Associate Professor: Kuby

**Planning**

Professors: Kihl, Pijawka  
 Associate Professor: Guhathakurta  
 Assistant Professor: Balsas

Under the auspices of the Division of Graduate Studies, an advisory committee administers the Graduate Interdisciplinary Certificate in Transportation Systems program. The objective of this program is to enable existing graduate students and transportation professionals to examine transpor-

tation-related issues from a variety of perspectives and in the context of different travel modes.

The certificate program requires a minimum of 15 semester hours of course work. To qualify, the student must complete an interdisciplinary issues pro-seminar class (three semester hours) and a capstone research paper that explores a transportation problem from a multidisciplinary perspective (three semester hours). A thesis in the area of transportation may substitute for the capstone paper. Students selecting the thesis option must take an additional elective course.

**Core Courses**

TRC 591 Seminar .....	3
TRC 593 Applied Project .....	3

**Elective Courses.** Nine semester hours of elective course work is also required. Students should choose three classes from the following approved transportation-related courses.

AMT 521 Air Transportation Regulation .....	3
AMT 525 Airport Planning and Design .....	3
AMT 527 Airline Management Strategies.....	3
AMT 598 Special Topics .....	3
CEE 475 Highway Geometric Design.....	3
CEE 512 Pavement Performance and Management.....	3
CEE 515 Properties of Concrete.....	3
CEE 573 Traffic Engineering .....	3
CEE 598 Special Topics .....	3
GCU 442 Geographical Analysis of Transportation.....	3
GCU 444 Geographic Studies in Urban Transportation.....	3
GCU 591 Seminar .....	3
GPH 471 Geographics: Interactive and Animated Cartography and Geovisualization.....	3
GPH 494 Special Topics .....	3
GPH 598 Special Topics .....	3
PAF 505 Public Policy Analysis .....	3
PAF 591 Seminar .....	3
PUP 510 Citizen Participation.....	3
PUP 544 Urban Land Use Planning.....	3
PUP 598 Special Topics .....	3
PUP 642 Land Economics.....	3

Master’s degree candidates in good standing in participating departments may apply. Current practicing professionals who already hold a graduate degree or who have at least three years of postbaccalaureate professional transportation experience may also apply. Applications are reviewed by the advisory committee, made up of representatives of participating departments. Enrollment in all classes outside the major requires permission of the instructor. For more information, contact the program director at 480/965-6395.

**TRANSPORTATION SYSTEMS CERTIFICATE (TRC)**

**M TRC 591 Seminar. (1–12)**

*fall and spring*  
 Topics may include the following:  
 • Transportation Systems Pro-Seminar. (3)

**M TRC 593 Applied Project. (1–12)**

*fall and spring*  
 Topics may include the following:  
 • Transportation, Advanced Research. (3)

**Omnibus Courses.** For an explanation of courses offered but not specifically listed in this catalog, see “Omnibus Courses,” page 63.