
Mass Communication

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PROFESSORS

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ASSOCIATE PROFESSORS

ALLEN, BRAMLETT-SOLOMON, GALICIAN, HOY, LENTZ,
 MATERA, RUSSELL

ASSISTANT PROFESSORS

BARRETT, GORMLY, RUSSOMANNO

CLINICAL ASSOCIATE PROFESSORS

ITULE, LEIGH

LECTURERS

CASAVANTES, NICHOLS

MASTER OF MASS COMMUNICATION

The faculty in the Walter Cronkite School of Journalism and Telecommunication offer a graduate program leading to the professional degree Master of Mass Communication (M.M.C.). The program is designed to help students achieve academic and professional growth, to prepare students for positions in the mass media, and to provide a background to enable persons currently in the media to advance their careers.

Admission. In addition to the general requirements for admission to the Graduate College, the M.M.C. program requires applicants to provide three letters of recommendation (including two from professors in the last unit of study from degree-granting institutions), scores on either the GRE (verbal and quantitative) or the MAT, a biographical sketch that includes all professional media experience, and a 250–500 word statement outlining career aspirations that could be enhanced by admission to the program (the statement is also used as a writing sample). The applicant's undergraduate GPA, letters of recommendation, test scores, and professional media experience are all considered in the admission process. A TOEFL score of 600 or higher is required of all applicants whose native language is not English. Applicants wishing to enroll for fall semester must have all their application materials submitted by March 1.

Admission Classification. Applicants who have an undergraduate degree in an area of mass communication, who meet all other requirements, and who receive regular admission may begin in the program in either the fall or spring semester. A two-year program is designed for applicants who have an undergraduate degree in a discipline other than mass communication. The program consists of 45 semester hours. The first-year courses are designed to provide a foundation in journalism knowledge and skills and must be taken

in prescribed sequence. Some first-semester courses are prerequisites for courses to be taken in subsequent semesters.

Registration. Registration in courses numbered 500 is limited to students who have been admitted to the M.M.C. program or have approval from the instructor of the class. Non-degree graduate students may not register for 500-level courses in the School of Journalism and Telecommunication during early registration. Undergraduate students wishing to reserve graduate course credit must follow Graduate College guidelines and obtain approval from the director of graduate studies.

Program of Study. The program consists of 36 semester hours of graduate credit for students with undergraduate degrees in the areas of mass communication. Requirements are as follows:

1. 12 hours of core course work,
2. six to 12 hours of specialization courses,
3. nine to 15 hours of a related area outside the school, and
4. three hours of supervised applied project (MCO 593).

The program consists of 45 semester hours of credit for students with undergraduate degrees in areas other than mass communication. Requirements are as follows:

1. 15 hours of core course work,
2. 12 hours of specialization courses,
3. six hours of mass communication writing skills courses,
4. nine hours of a related area outside the school, and
5. three hours of supervised applied project (MCO 593).

Foreign Language Requirements. None.

Thesis Requirements. None.

Final Examinations. An oral examination in defense of the supervised research or creative project is required.

RESEARCH AND CREATIVE ACTIVITY

Research activities in the School of Journalism and Telecommunication complement its teaching and service missions. Research interests of faculty are varied. The school encourages inquiry into mass communication problems and issues by drawing upon diverse approaches, including legal, historical, and quantitative methods. Faculty are involved in creative activity and research for both academic and professional publication. Recent and current projects include technological effects on the mass media, effects of U.S. Supreme Court decisions on the mass media, media portrayal of the elderly, perceptions of good news and bad news on television, and media and minorities.

In addition to publications in journals on varied research projects, the following titles of faculty-written books represent a diversity of interest areas: *Business Management of Consumer Magazines*; *Contemporary Sports Reporting*; *Photojournalism: The Visual Approach*; *Target: Cancer*; *The Practice of Newspaper Management*; *Electronic Age News Editing*; *The Gene Age*; *A "Washington Merry-Go-Round" of Libel Actions*; *News Writing and Reporting for Today's Media*; *Contemporary News Reporting*; *Visual Editing: A Graphic Guide for Journalists*; *Symbols, the*

News Magazines, and Martin Luther King; Eisenhower and the Mass Media; Reruns on File: A Guide to Electronic Media Archives; Press Law in South Korea; and The Healing Blade: A Tale of Neurosurgery.

JOURNALISM (JRN)

JRN 401 Public Relations Techniques. (3) F, S

Theory and practice of publicity, public relations, and related techniques and procedures. Prerequisites: JRN 301 (or TCM 315); major.

JRN 412 Editorial Interpretation. (3) N

The press as an influence on public opinion. The role of the editorial in analyzing and interpreting current events. Prerequisite: JRN 301.

JRN 413 Advanced Editing. (3) F, S

Theory and practice of newspaper editing, layout and design, picture, and story selection. Prerequisite: JRN 313.

JRN 414 Electronic Publication Design. (3) F, S

Theory, organization, and practice of layout, typography, and design in traditional and multimedia publishing. Prerequisite: JRN 401.

JRN 415 Writing for Public Relations. (3) F, S

Development of specific writing techniques for the practitioner in public relations agencies and divisions of major organizations. Prerequisite: JRN 401.

JRN 417 Public Relations Campaigns. (3) F

Theory, principles, and literature of public relations and how they relate to audiences, campaigns, and ethics. Prerequisites: JRN 401, 415; instructor approval.

JRN 420 Reporting Public Affairs. (3) F, S

Instruction and assignments in reporting the courts, schools, government, city hall, social problems, and other areas involving public issues. Prerequisite: JRN 301.

JRN 440 Magazine Writing. (3) F, S

Writing and marketing magazine articles for publication. Prerequisite: JRN 301 or instructor approval.

JRN 451 Photojournalism II. (3) F, S

Theory and practice of photojournalism with emphasis on shooting, lighting, and layout for the media. Prerequisite: JRN 351.

JRN 452 Photojournalism III. (3) F, S

Advanced theory and practice of photojournalism with emphasis on the photo essay and illustrations in black and white and color. 2 hours lecture, 2 hours lab. Prerequisite: JRN 451.

JRN 465 Precision Journalism. (3) S

An advanced writing course with focus on reporting polls and surveys and other numerically-based stories as well as on understanding the concepts that underlie polls and surveys. Lecture, lab. Prerequisite: JRN 301 or instructor approval.

Omnibus Graduate Courses: See page 51 for omnibus graduate courses that may be offered.

MASS COMMUNICATION (MCO)

MCO 402 Mass Communication Law. (3) F, S, SS

Legal aspects of the rights, privileges, and obligations of the press, radio, and television. Prerequisite: 70 earned semester hours. *General Studies: L2.*

MCO 418 History of Mass Communication. (3) F, S

American journalism from its English and colonial origins to the present day. Development and influence of newspapers, magazines, radio, television, and news gathering agencies. *General Studies: SB, H.*

MCO 421 News Problems. (3) S

Trends and problems of the news media, emphasizing editorial decisions in the processing of news. Prerequisite: 9 hours of mass communication/journalism/telecommunication courses or instructor approval.

MCO 430 International Mass Communication. (3) F, S

Comparative study of communication and media systems. Information gathering and dissemination under different political and cultural systems. *General Studies: G.*

MCO 450 Visual Communication. (3) F, S, SS

Theory and tradition of communication through the visual media with emphasis on the continuity of traditions common to modern visual media. *General Studies: HU.*

MCO 456 Political Communication. (3) F, S

Theory and research related to political campaign communication. The persuasive process of political campaigning, the role of the media, the candidate, and image creation. *General Studies: SB.*

MCO 460 Race, Gender, and Media. (3) S

Readings seminar designed to give students a probing examination of the interface between AHANA Americans and the mass media in the United States. *General Studies: C.*

MCO 463 Introduction to Media Statistics. (3) F, S

An introduction to statistical analysis as applied to the mass media. Prerequisite: professional status in Broadcasting or Journalism.

MCO 501 Newswriting and Reporting. (3) F

Designed for graduate students in the MMC program who have undergraduate degrees in nonjournalism areas. Objective is to teach fundamentals of writing and reporting. Lecture, lab. Prerequisite: acceptance into M.M.C. graduate program.

MCO 503 Press Freedom Theory. (3) S

Examination of philosophical and legal aspects of press freedom. Emphasis on First Amendment theory evolution from 1791 to present.

MCO 510 Research Methodology in Mass Communication. (3) F, S

Identification of research problems in mass communication. Overview of questionnaire construction. Attention to survey, historical, content analysis, experimental, and legal research methods.

MCO 520 Mass Communication Theories and Process. (3) F

Analysis of various theoretic models of mass communication with emphasis on the applications of these theories to various professional communication needs.

MCO 522 Mass Media and Society. (3) S

Mass media as social institutions, particularly interaction with government and public. Emphasis on criticism and normative statements.

MCO 530 Media Ethics. (3) F

Ethical conventions and practices of print and electronic media as they relate to the government and private sectors of the society.

MCO 531 Broadcast Journalism. (3) S

News and information practices of networks, stations, and industry. Practice in writing, reporting, and editing with emphasis on video. Lecture, lab. Prerequisite: MCO 501.

MCO 540 Historical/Legal Methods. (3) S

Introduction to legal and historical methods necessary to conduct qualitative mass communication research. Prerequisite: MMC graduate student.

MCO 560 Arizona Media Law. (3) F 2000

Case study approach of first amendment issues, media access, libel, confidentiality, and invasion of privacy as applied to media organizations in Arizona. Lecture, seminar.

Omnibus Graduate Courses: See page 51 for omnibus graduate courses that may be offered.

TELECOMMUNICATION (TCM)

TCM 433 Broadcast Sales and Promotion. (3) F, S

Basics of electronic media marketing practices, including commercial time sales techniques and radio/TV promotion fundamentals. Prerequisite: TCM 200.

TCM 435 Cable TV and Emerging Telecommunication Systems. (3) F, S

Structures and utilization of cable, industrial, and instructional television, satellite, and videocassettes. Prerequisite: TCM 200.

TCM 437 Advanced TV Production. (3) F, S

Emphasis on individual production projects of the student's own conception and design utilizing studio, field, and postproduction techniques. Prerequisite: TCM 235.

TCM 472 Broadcast Station Management. (3) F, S, SS

Management principles and practices, including organization, procedures, policies, personnel problems, and financial aspects of station management. Prerequisite: TCM 332.

TCM 475 Television Newscast Production. (3) F, S

Writing, reporting, and production of the television newscast. The course serves as the capstone of the broadcast journalism emphasis. Prerequisite: instructor approval.

Omnibus Graduate Courses: See page 51 for omnibus graduate courses that may be offered.

Mathematics

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REGENTS' PROFESSOR TROTTER

PROFESSORS

ARMBRUSTER, BREMNER, BUSTOZ, FELDSTEIN,
 GARDNER, HELTON, HOPPENSTEADT, IHRIG,
 JACKIEWICZ, JACOBOWITZ, KADELL, KAWSKI,
 KIERSTEAD, KOSTELICH, KUANG, KUIPER, LEONARD,
 McDONALD, MITTELMANN, NICOLAENKO, QUIGG,
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 SPIELBERG, SWIMMER, TAYLOR, TURNER, WELFERT

ASSISTANT PROFESSORS

CARLSON, GELB, D. JONES, KALISZEWSKI, NIKITIN,
 PREWITT, ZANDIEH, ZUO

The faculty in the Department of Mathematics offer graduate programs leading to the M.A. and Ph.D. degrees in Mathematics.

The faculty also participate in the program leading to the Master of Natural Science degree when one of the concentrations is mathematics.

In addition, the faculty participate in the interdisciplinary program leading to the M.S. degree in Statistics (see "Statistics," page 294).

It is recommended but not required that students applying to one of these programs submit scores on the Graduate Record Examination.

Students in the College of Education admitted to the Master of Education (see "Master of Education," page 174) or Doctor of Education (see "Doctor of Education," page 175) degree program in Secondary Education may elect mathematics as the subject matter field. These programs are offered and administered through the College of Education.

MASTER OF ARTS

This degree is designed for students who wish to extend their knowledge of mathematics or prepare for certain careers related to mathematics. In order to be admitted without deficiencies, the student's background should include an undergraduate mathematics major or an equivalent preparation such as may be obtained in certain undergraduate programs in engineering or the sciences. In particular, it is required that the student's preparation include courses in linear algebra and foundations of analysis. A certain degree

of familiarity with computer languages may also be required for some areas of study.

Students pursuing the M.A. degree in Mathematics may choose one of the following areas: general mathematics, applied mathematics, statistics and probability, and computational mathematics. Information concerning the requirements for each area may be obtained from the Department of Mathematics.

See "Master's Degrees," page 98, for general requirements.

Program of Study. The program of study, including courses in mathematics and related subjects, is selected with the recommendation of the student's supervisory committee. Ordinarily, a program of study consists of a minimum of 30 semester hours.

Foreign Language Requirements. None.

Comprehensive Examinations. A written comprehensive examination is required. For details inquire in the Department of Mathematics.

Thesis Requirements. A thesis is required.

Final Examinations. A final oral examination in defense of the thesis is required.

MASTER OF NATURAL SCIENCE

The faculty of the Department of Mathematics participate in programs leading to the Master of Natural Science degree (see "Master of Natural Science," page 257). This degree is intended for the student who is interested in an interdisciplinary program with a major emphasis in mathematics and a minor emphasis in a related subject outside mathematics. The student's supervisory committee consists of two faculty members of the Department of Mathematics and one faculty member of the department in the related area. The supervisory committee designs a program of study of at least 36 semester hours that is appropriate for the type of interdisciplinary work the student wishes to pursue. For more information contact the Department of Mathematics.

DOCTOR OF PHILOSOPHY

This degree is intended for the student with superior mathematical ability, emphasizing the development of creative scholarship and breadth and depth in background knowledge. Admission to the Ph.D. degree program is normally granted after completion of the master's degree.

See "Doctoral Degrees," page 100, for general requirements.

Program of Study. The program of study is selected with the recommendation of the student's supervisory committee.

Qualifying Examinations. Qualifying examinations are required. They test a student's mastery of basic material in two of the following five areas: algebra, differential equations, mathematical statistics, numerical methods, and real analysis. Normally, students entering the graduate program with a bachelor's degree take these qualifying examinations at the beginning of the third semester, and those entering with a master's degree at the beginning of the second semester. These examinations are given once each semester.

Foreign Language Requirements. A student is required to have a reading knowledge of a language other than English in which mathematics research is published.

Comprehensive Examinations. Written and oral comprehensive examinations are required.

Dissertation Requirements. A dissertation reporting significant, original research suitable for publication in a professional research journal is required. (See "Doctoral Dissertations," page 100.)

Final Examinations. A final oral examination in defense of the dissertation is required.

RESEARCH ACTIVITY

Department members are actively engaged in research in the following areas: applied mathematics; mathematical physics; mathematical modeling; mathematical biology; mathematical neurobiology; bifurcation analysis; dynamical systems; control theory; nonlinear analysis; ordinary and partial differential equations; integral equations; computational mathematics; real, complex, and functional analysis; operator algebras; operator theory; algebra; number theory; topology; discrete mathematics; probability; theoretical and applied statistics; and mathematical education.

The department has several clusters of high-end UNIX workstations both for number-crunching and for graphics. Most students will do both class projects and their research computing on these computers. A number of PC and Macintosh computers are also available to students. In addition, all students have access to central computing facilities, which include IBM mainframes, UNIX clusters, and multiprocessor computers.

MATHEMATICS (MAT)

MAT 410 Introduction to General Topology. (3) A

Topological spaces, metric spaces, compactness, connectedness, and product spaces. Prerequisite: MAT 300 or 371 or instructor approval.

MAT 415 Introduction to Combinatorics. (3) S

Topics include proof techniques, permutations, combinations; counting techniques including recurrence relations, generating functions, inclusion-exclusion; Ramsey theory and combinatorial designs. Prerequisites: MAT 300 (or 243) and 342 (or 242) or instructor approval.

MAT 416 Introduction to Graph Theory. (3) S

Topics include trees, cycles, matchings, planarity, connectivity, hamiltonicity, colorings, graph algorithms, and other advanced topics. Prerequisites: MAT 300 (or 243) and 342 (or 242) or instructor approval.

MAT 419 Introduction to Linear Programming. (3) S

Simplex method, duality, and network flows. Applications to game theory, geometry, combinatorics, graph theory, and posets. Prerequisites: CSE 100 (or 200 or 210); MAT 300 (or 243), 342 (or 242) or instructor approval. *General Studies: N2.*

MAT 420 Scientific Computing. (3) F

Survey and application of programming languages, libraries, and scientific visualization tools. Programming assignments emphasize software development skills. Lecture, lab. Prerequisites: CSE 200 and MAT 274 and 342 or equivalents or instructor approval.

MAT 421 Applied Computational Methods. (3) F, S

Numerical methods for quadrature, differential equations, roots of nonlinear equations, interpolation, approximation, linear equations, floating-point arithmetic, and roundoff error. Prerequisites: MAT 271 (or equivalent) and fluency in computer programming (preferably FORTRAN) or instructor approval. *General Studies: N3.*

MAT 423 Numerical Analysis I. (3) F, S

Analysis and algorithms for numerical solutions linear/nonlinear equations, direct solvers, iterative procedures, optimization. Determination of eigenvalues. Elementary computer arithmetic. Prerequisites: MAT 342 and 371 and fluency in computer programming or instructor approval. *General Studies: N3.*

MAT 425 Numerical Analysis II. (3) F, S

Analysis of and algorithms for numerical interpolation, integration, and differentiation. Numerical solution of ordinary differential equations, and method of lines. Those seeking a methods survey course should take MAT 421. Prerequisites: MAT 342 and 371 and fluency in computer programming or instructor approval. *General Studies: N3.*

MAT 427 Computer Arithmetic. (3) S

Number systems, hardware/software arithmetic, overflow, significance, rounding, multiple precision, and automatic error control; impact on languages, architectures, robust programming, and software development. Prerequisite: CSE 100 (or 200) or MAT 421 and 423 (or MAT 425) or instructor approval. *General Studies: N3.*

MAT 442 Advanced Linear Algebra. (3) F

Fundamentals of linear algebra, dual spaces, invariant subspaces, canonical forms, bilinear and quadratic forms, and multilinear algebra. Prerequisites: MAT 300 and 342 or instructor approval.

MAT 443 Introduction to Abstract Algebra. (3) F

Introduction to concepts of abstract algebra. Not open to students with credit in MAT 444. Prerequisites: MAT 300 and 342 or instructor approval.

MAT 444 Intermediate Abstract Algebra. (3) S

Basic theory of groups, rings, and fields, including an introduction to Galois theory. Appropriate as preparation for MAT 543. Prerequisites: MAT 300, 342.

MAT 445 Theory of Numbers. (3) S

Prime numbers, unique factorization theorem, congruences, Diophantine equations, primitive roots, and quadratic reciprocity theorem. Prerequisites: MAT 300 and 342 or instructor approval.

MAT 451 Mathematical Modeling. (3) S

A detailed study of 1 or more mathematical models that occur in the physical or biological sciences. May be repeated for credit with instructor approval. Prerequisites: MAT 242 (or 342) and 274 or instructor approval. *General Studies: N2.*

MAT 452 Introduction to Chaos and Nonlinear Dynamics. (3) F

Properties of nonlinear dynamical systems; dependence on initial conditions; strange attractors; period doubling; bifurcations; symbolic dynamics; Smale-Birkhoff theorem; and applications. MAT 371 is recommended. Prerequisites: MAT 274, 342 (or 242).

MAT 455 Introduction to Fractals and Applications. (3) S

Fractals; self-similar structures, fractals with iterated function systems of maps, computing fractals, fractal dimensions, chaotic dynamics on fractals, applications. MAT 371 is recommended. Prerequisites: MAT 274, 342 (or 242).

MAT 460 Applied Real Analysis. (3) S

Vectors, curvilinear coordinates, Jacobians, implicit function theorem, line and surface integrals, Green's, Stokes', and divergence theorems. Not open to students with credit in MAT 372. Prerequisites: MAT 242 (or 342), 272, 274.

MAT 461 Applied Complex Analysis. (3) F, SS

Analytic functions, complex integration, Taylor and Laurent series, residue theorem, conformal mapping, and harmonic functions. Prerequisite: MAT 272 or equivalent.

MAT 462 Applied Partial Differential Equations. (3) S

Second order partial differential equations, emphasizing Laplace, wave, and diffusion equations. Solutions by the methods of characteristics, separation of variables, and integral transforms. Prerequisites: MAT 242 (or 342), 274.

MAT 472 Intermediate Real Analysis. (3) F

Introduction to analysis in metric spaces with emphasis on the real line. Appropriate as preparation for MAT 570. Prerequisites: MAT 300, 342.

MAT 475 Differential Equations. (3) F

Asymptotic behavior of solutions of linear and nonlinear ordinary differential equations, stability, Sturm-Liouville problems, boundary value problems, and singular point behavior of autonomous systems. Prerequisites: MAT 242 (or 342), 274.

MAT 476 Partial Differential Equations. (3) S

First order quasilinear, second order linear (wave, Laplace, heat). Characteristics, harmonic functions, maximum principles, Fourier series, separation of variables. Prerequisites: MAT 274 (or 475), 372 (or 472).

MAT 485 History of Mathematics. (3) N

Topics from the history of the origin and development of mathematical ideas. Prerequisite: MAT 272 or equivalent.

MAT 505 Perturbation Methods. (3) N

Nonlinear oscillations, strained coordinates, renormalization, multiple scales, boundary layers, matched asymptotic expansions, turning point problems, and WKBJ method. Cross-listed as MAE 505. Credit is allowed only for MAE 505 or MAT 505.

MAT 510 Point Set Topology. (3) F

Topological spaces, metric spaces, compactness, connectedness, local properties, product and decomposition spaces, mappings, covering properties, and separation properties. Prerequisite: MAT 371 or 410 or instructor approval.

MAT 511 Point Set Topology. (3) S

Continuation of MAT 510. Prerequisite: MAT 510 or instructor approval.

MAT 514 Enumerative Combinatorics I. (3) F

First semester of a systematic development of enumerative combinatorics including: elementary counting techniques, sieve methods, and partially ordered sets. Prerequisite: graduate standing or instructor approval.

MAT 515 Enumerative Combinatorics II. (3) S

Second semester of a systematic development of enumerative combinatorics including: lattices, exponential structures, symmetric functions, and selected special topics. Prerequisite: MAT 514 or instructor approval.

MAT 516 Graph Theory I. (3) F

First semester of a systematic development of graph theory including: matchings, connectivity, arboricity, planarity, coloring, network flows. Prerequisite: graduate standing or instructor approval.

MAT 517 Graph Theory II. (3) S

Second semester of a systematic development of graph theory including: dense and sparse graphs, Ramsey theory, hamiltonicity, random graphs, minors. Prerequisite: MAT 516 or instructor approval.

MAT 518 Combinatorial Optimization I. (3) F

First semester of a systematic development of combinatorial optimization including: linear programming, duality, primal-dual algorithms, network flow algorithms, weighted matchings. Prerequisite: graduate standing or instructor approval.

MAT 519 Combinatorial Optimization II. (3) S

Second semester of a systematic development of combinatorial optimization including: matroid algorithms, theory of NP-completeness, polynomial time approximation, dynamic programming. Prerequisite: MAT 518 or instructor approval.

MAT 520 Numerical Linear Algebra. (3) F

Direct solution of linear systems, iterative methods, eigenvalues and eigenvectors, singular value decomposition, the QR algorithm, error propagation, arithmetic, and stability. Prerequisites: MAT 342 and 423 (or 421) or instructor approval.

MAT 521 Iterative Methods. (3) S

Numerical methods for solving linear/nonlinear systems of equations (symmetric, nonsymmetric). Iterative methods for linear systems, conjugate gradients, multigrid methods, preconditioning, Krylov methods. Prerequisites: MAT 371 and 423 (or 421) or instructor approval.

MAT 523 Numerical Optimization. (3) N

Linear programming, unconstrained nonlinear minimization, line search algorithms, conjugate gradients, quasi-Newton methods, constrained nonlinear optimization, gradient projection, and penalty methods. Prerequisite: MAT 342 or 371 or 460 or 520 (or equivalent) or instructor approval.

MAT 524 Parallel Numerical Algorithms. (3) N

Algorithms for massively parallel, hypercube architectures; "parallel" FORTRAN; solution of linear, nonlinear systems; partial differential equations; iterative methods; multigrid; domain decomposition. Prerequisites: MAT 371 and 423 (or 421) or instructor approval.

MAT 526 Numerical Solution of Bifurcation Problems. (3) N

Nonlinear parameter-dependent differential, algebraic equations, numerical solutions; bifurcation, turning points; continuation methods, branch switching; steady-state, time-dependent cases; Hopf Bifurcation. Prerequisites: MAT 371 and 423 (or 421) or instructor approval.

MAT 530 Numerical Solution of Ordinary Differential Equations. (3) F

One step, linear multistep methods; consistency, order, stability, convergence; discretization, roundoff errors, error estimation, adaptive strategy; implementation, software for nonstiff equations. Prerequisites: MAT 371 and 423 (or 421) or instructor approval.

MAT 531 Numerical Solution of Stiff Differential Systems. (3) S

Runge-Kutta methods, order conditions, construction of highly stable methods, order stars, error estimation, stepsize selection, contractivity properties, linear multistep methods. Prerequisites: MAT 371 and 423 (or 421) or instructor approval.

MAT 533 Computational Elliptic and Parabolic Partial Differential Equations. (3) F

Parabolic and elliptic equations, finite difference, finite element methods, stability, consistency, convergence, practical aspects, applications, software. Prerequisites: MAT 371 and 423 (or 421) or instructor approval.

MAT 534 Computational Hyperbolic Partial Differential Equations. (3) S

Numerical solutions of hyperbolic PDEs, finite difference methods, well-posedness, stability, consistency, convergence, adaptive grids; Maxwell's equations, elastic wave propagation; Navier-Stokes. Prerequisites: MAT 371 and 423 (or 421) or instructor approval.

MAT 535 Spectral Methods for Partial Differential Equations. (3) N

Spectral, pseudo-spectral theory; Galerkin, collocation methods; Tau-methods, global approximation properties, stability; convergence; solutions for linear, nonlinear systems. Prerequisites: MAT 371 and 423 (or 421) or instructor approval.

MAT 543 Abstract Algebra. (3) F

Groups, modules, rings and fields, Galois theory, homological algebra, and the representation theory. Prerequisite: MAT 444 or instructor approval.

MAT 544 Abstract Algebra. (3) S

Continuation of MAT 543. Prerequisite: MAT 543 or instructor approval.

MAT 550 Variational Methods. (3) F

Calculus of variations and its applications to extremal problems, classical mechanics, and partial differential equations. Prerequisites: MAT 274 and 462 or equivalents.

MAT 551 Linear Operators and Integral Equations. (3) S

Bounded linear and compact operators on Hilbert spaces. Linear integral equations, Fredholm and Hilbert-Schmidt theory, and approximate methods. Distributions. Prerequisites: MAT 242 and 462 or equivalents.

MAT 555 Fractal Geometry. (3) N

Geometry and analysis of fractal sets; definitions of dimensions; calculating dimensions; projections, products of fractals; random fractals; multifractal measures; and applications. Prerequisites: MAT 371, 455. MAT 472 is recommended.

MAT 570 Real Analysis. (3) S

Lebesgue integration, selected function spaces, differentiation, abstract measure theory, and elements of functional analysis. Prerequisite: MAT 372 or instructor approval.

MAT 571 Real Analysis. (3) F

Continuation of MAT 570. Prerequisite: MAT 570 or instructor approval.

MAT 572 Complex Analysis. (3) F

Analytic functions, series and product representations, entire and meromorphic functions, normal families, Riemann mapping theorem, harmonic functions, and Riemann surfaces. Prerequisite: MAT 371 or instructor approval.

MAT 573 Complex Analysis. (3) S

Continuation of MAT 572. Prerequisite: MAT 572 or instructor approval.

MAT 574 Theory of Ordinary Differential Equations. (3) N

Systems, existence proofs, singularities, asymptotic behavior of solutions, boundedness of solutions, eigenvalues and eigenfunctions, and perturbation theory. Prerequisite: MAT 372 or instructor approval.

MAT 575 Theory of Ordinary Differential Equations and Dynamical Systems. (3) N

Geometric approach to ODEs and dynamical systems; (un)stable, center manifolds; structural stability; normal forms; averaging; chaos; persistence. May be repeated for credit with instructor approval. Prerequisites: MAT 452 and 475 or MAT 574 or instructor approval.

MAT 576 Theory of Partial Differential Equations. (3) N

Existence and uniqueness theorems, boundary value and initial value problems, characteristics, Green's functions, maximum principle, distributions, and weak solutions. Prerequisite: knowledge of Lebesgue integration or instructor approval.

MAT 577 Theory of Partial Differential Equations. (3) N

Continuation of MAT 576. Prerequisite: MAT 576 or instructor approval.

MAT 578 Functional Analysis. (3) N

Locally convex, normed, and Hilbert spaces. Linear operators, spectral theory, and application to classical analysis. Prerequisite: MAT 472 or 571 or instructor approval.

MAT 579 Functional Analysis. (3) N

Continuation of MAT 578. Prerequisite: MAT 578 or instructor approval.

MAT 591 Seminar. (1–3) N

Topics may be selected from the following:

- (a) Algebra
- (b) Analysis
- (c) Applied Mathematics
- (d) Combinatorial Mathematics
- (e) Mathematical Logic
- (f) Numerical Analysis
- (g) Topology

Omnibus Graduate Courses: See page 51 for omnibus graduate courses that may be offered.

MATHEMATICS EDUCATION (MTE)**MTE 480 Mathematics in the Upper-Elementary Grades I.** (3) N

An introduction to probability and statistics, including open-ended data gathering and processing, counting techniques, sampling strategies, estimation, and decision making. Prerequisite: MTE 381 or instructor approval.

MTE 481 Mathematics in the Upper-Elementary Grades II. (3) N

Elementary functions and their applications. A thorough investigation of some of the algorithms of basic arithmetic. Prerequisite: MTE 480 or instructor approval.

MTE 482 Methods of Teaching Mathematics in Secondary School. (3) F, SS

Examination of secondary school curricular material and analysis of instructional devices. Teaching strategies, evaluative techniques, diagnosis, and remediation and problem solving. Prerequisite: instructor approval.

MTE 483 Mathematics in the Secondary School. (3) S, SS

Topics in geometry, number theory, algebra, and analysis. Emphasis on unifying principles. Prerequisite: MAT 310 or instructor approval.

MTE 582 Modern Mathematics for Teachers. (3) N

Theory of sets, real number system, transfinite numbers, and other selected topics. Prerequisite: instructor approval.

MTE 583 Abstract Algebra for Teachers. (3) N

Postulational approach to algebra and elementary mathematical systems, including groups and fields. Prerequisite: instructor approval.

MTE 585 Modern Geometry for Teachers. (3) A

Euclidean, projective, and non-Euclidean geometries. Prerequisite: instructor approval.

MTE 587 Analysis for Teachers. (3) N

Subject matter in mathematics appropriate for accelerated programs in secondary schools, including analytic geometry and calculus. Prerequisite: instructor approval.

MTE 588 Analysis for Teachers. (3) N

Continuation of MTE 587. Prerequisite: MTE 587 or instructor approval.

Omnibus Graduate Courses: See page 51 for omnibus graduate courses that may be offered.

STATISTICS AND PROBABILITY (STP)**STP 420 Introductory Applied Statistics.** (3) F, S, SS

Introductory probability, descriptive statistics, sampling distributions, parameter estimation, tests of hypotheses, chi-square tests, regression analysis, analysis of variance, and nonparametric tests. Prerequisite: MAT 117 or equivalent. *General Studies: N2.*

STP 421 Probability. (3) F

Laws of probability, combinatorial analysis, random variables, probability distributions, expectations, moment generating functions, transformations of random variables, and central limit theorem. Prerequisites: MAT 300 and STP 420 or equivalents.

STP 425 Stochastic Processes. (3) S

Markov chains, stationary distributions, pure jump processes, 2D order processes, and other topics in stochastic processes. Prerequisites: MAT 342; STP 421.

STP 427 Mathematical Statistics. (3) S

Limiting distributions, interval estimation, point estimation, sufficient statistics, and tests of hypotheses. Prerequisite: STP 421.

STP 429 Experimental Statistics. (3) S

Statistical inference for controlled experimentation. Multiple regression, correlation, analysis of variance, multiple comparisons, and nonparametric procedures. Prerequisite: STP 420 or equivalent. *General Studies: N3.*

STP 525 Advanced Probability. (3) N

Measure-theoretic foundations of probability, distribution functions and characteristic functions, laws of large numbers and central limit theorems, conditional probabilities, martingales, and topics in stochastic processes. Prerequisites: MAT 571 and STP 421 or instructor approval.

STP 526 Theory of Statistical Linear Models. (3) F

Multinomial distribution, distribution of quadratic forms, full and nonfull rank models, generalized inverses, unbalanced data, variance components, and the large sample theory. Prerequisites: STP 427; knowledge of matrix algebra.

STP 530 Applied Regression Analysis. (3) F

Method of least squares, simple and multiple linear regression, polynomial regression, analysis of residuals, dummy variables, and model building. Prerequisite: STP 420 or equivalent.

STP 531 Applied Analysis of Variance. (3) S

Factorial designs, balanced and unbalanced data, fixed and random effects, randomized blocks, Latin squares, analysis of covariance, and multiple comparisons. Prerequisite: STP 420 or equivalent.

STP 532 Applied Nonparametric Statistics. (3) F

One sample test, tests of 2 or more related or independent samples, measures of correlation, and tests of trend and dependence. Prerequisite: STP 420 or equivalent.

STP 533 Applied Multivariate Analysis. (3) S

Discriminant analysis, principal components, factor analysis, cluster analysis, and canonical correlation. Prerequisite: STP 420 or equivalent.

STP 534 Applied Discrete Data Analysis. (3) N

Models for discrete and count data, measures of association, and log-linear and regression models for contingency tables. Prerequisite: STP 420 or equivalent.

STP 535 Applied Sampling Methodology. (3) S

Simple random, stratified, cluster sampling; variance estimation in complex surveys; nonparametric superpopulation approaches; nonresponse models; computational methods. Prerequisite: STP 420 or equivalent.

STP 591 Seminar. (1–3) N

Topics may be selected from the following:

- (a) Probability
- (b) Statistics

Omnibus Graduate Courses: See page 51 for omnibus graduate courses that may be offered.

Mechanical Engineering

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PROFESSORS

BOYER, DAVIDSON, EVANS, FERNANDO, JANKOWSKI,
 KRAJCINOVIC, PECK, ROY, SHAH, SIERADZKI,
 TSENG, YAO

ASSOCIATE PROFESSORS

CHEN, KUO, SQUIRES

ASSISTANT PROFESSORS

CHAPSKY, McNEILL, PERALTA, PHELAN

The faculty in the Department of Mechanical and Aerospace Engineering offer graduate programs leading to the degrees of M.S., Master of Science in Engineering, and Ph.D. in Mechanical Engineering. A number of areas of study may be pursued, including design and manufacturing, dynamics and control, energy systems, engineering mechanics, and thermosciences.

The faculty also offer graduate degree programs in Aerospace Engineering.

All of the department's graduate programs stress a sound foundation in fundamentals leading to a specialized area of study.

Graduate Record Examination. All applicants are required to take the Graduate Record Examination; the subject test in engineering is highly recommended but not required.

MASTER OF SCIENCE

See "Master's Degrees," page 98, for general requirements.

MASTER OF SCIENCE IN ENGINEERING

See "Master of Science in Engineering," page 182, for information on the Master of Science in Engineering degree.

DOCTOR OF PHILOSOPHY

The Ph.D. degree is conferred upon evidence of excellence in research leading to a scholarly dissertation that is an original contribution to knowledge in the field of mechanical engineering.

See "Doctoral Dissertations," page 100, for general requirements.

Program of Study. The program of study must be established no later than the first semester after successfully completing the qualifying examination.

Qualifying Examinations. The purposes of the qualifying criteria are to assess if the student is qualified to continue in the doctoral program and to detect deficiencies in the stu-

dent's background that can be corrected by appropriate course work and individual study. Within the first year of graduate studies at ASU, a graduate student pursuing a Ph.D. program of study in Mechanical Engineering must complete three 500-level core courses, preferably in the major area of interest, and one 500-level mathematics course, both with an average GPA of 3.25 or higher. Specific qualifying course requirements for each major area are available from the department.

Foreign Language Requirements. None.

Comprehensive Examinations. Written and oral comprehensive examinations are required. The examinations are administered by the program committee.

Dissertation Requirements. A dissertation based on original work demonstrating creativity in research and scholarly proficiency in the subject area is required.

Final Examinations. A final oral examination in defense of the dissertation is required.

RESEARCH ACTIVITY

The department has established a wide variety of theoretical and experimental research programs in mechanical engineering to prepare graduate students for careers with industry, universities, and government agencies. The faculty are informally organized into groups pursuing research topics directly related to the general improvement of knowledge in engineering fields or to the application of engineering principles to problems with high national priorities.

Some recent and current examples of faculty and student research projects include studies in aerospace vehicle dynamics, guidance, and control; laser diagnostics in combustion; solar energy systems; modeling and optimal design of rotor-bearing systems; feature-based modeling; design automation; expert systems for manufacturing; concurrent engineering; kinematic geometry of mechanisms and robots; modeling and control of robots for manufacturing; infrared detection of surface defects; development of finite element models; acoustic fatigue; noise control; failure analysis and life predictions; crystal growth; fluid mechanics; metal cutting; transonic airfoil design; hydrodynamic stability; turbulence modeling; numerical modeling of reacting flows; robotics; magnetic bearing development; thermionics; experimental and analytical studies in two-phase flow; convective heat transfer in complex flows and turbine cooling; unsteady aerodynamics; nonlinear waves; perturbation methods; turbulent mixing in stratified flows; double diffusive instabilities; internal waves and internal gravity currents; topography effects in rotating and stratified flows; experimental and analytical studies on pulverized-coal combustion; pollutant formation and spray burning; combustion diagnostics and modeling of continuous flow combustion.

Experimental investigations are carried out in a number of specialized facilities: computer-aided engineering and expert systems laboratory, computer-aided design/computer-aided manufacturing laboratory, combustion laboratory, composite materials laboratory, direct energy conversion laboratory, dynamics and controls laboratory, heat transfer laboratory, laser diagnostics laboratory, hydrodynamic stability laboratory, robotics laboratory, solar energy laboratory, stratified flow laboratory, rotating flow laboratory, supersonic wind tunnel laboratory, thermoscience

laboratory, unsteady wind tunnel facility, fatigue crack growth at metal/metal and metal/ceramic interfaces, fatigue damage of thin films and nanolayered composites, texture effects on cyclic behavior of polycrystalline metals, mechanical properties of structural silicides, and vibrations laboratory. Equipment fabrication is supported by the college's well-equipped Development Shop, which has a staff of machinists and electronic technicians.

Computer Resources and Facilities

Mechanical Engineering graduate education and research is supported by an extensive array of college- and university-supported computer hardware and software, in addition to laboratory minicomputers and microcomputers. ASU operates an IBM ES9000-732, an IBM 3090-300E, a VAX 6000-634, a MASPAR-MP-2, and a cluster of four IBM RISC-6000 substations, which are available to support graduate research. The College of Engineering and Applied Sciences supports a Convex C220, one Motorola 8640, one DEC VAX, a SPARC 2000, and many minicomputers and microcomputers. All of these machines are available for use by the engineering faculty and students for classroom and research work. The ASU Computing Commons is equipped with three IBM RS/6000-590, one MASPAR, several DEC VAX 5000, numerous Sun Sparc servers, and many other platforms. Access to these computers is via the ASU Advanced Communications Support System (ACSS) broadband network as well as dial-in lines. The university also operates microcomputer sites with more than 400 IBM and Apple Macintosh systems.



Students bask on the steps of the light well, above Hayden Library's entrance.

Tim Trumble photo

MECHANICAL AND AEROSPACE ENGINEERING (MAE)

MAE 402 Introduction to Continuum Mechanics. (3) A

Application of the principles of continuum mechanics to such fields as flow-in porous media, biomechanics, electromagnetic continua, and magneto-fluid mechanics. Prerequisites: ECE 313; MAE 361 (or 371); MAT 242 (or 342).

MAE 404 Finite Elements in Engineering. (3) A

Introduction to ideas and methodology of finite element analysis. Applications to solid mechanics, heat transfer, fluid mechanics, and vibrations. Prerequisites: ECE 313; MAT 242 (or 342).

MAE 406 CAD/CAM Applications in MAE. (4) A

Solution of engineering problems with the aid of state-of-the-art software tools in solid modeling, engineering analysis, and manufacturing; selection of modeling parameters; reliability tests on software. 3 hours lecture, 3 hours lab. Prerequisites: MAE 441; instructor approval.

MAE 417 Control System Design. (3) A

Tools and methods of control system design and compensation, including simulation, response optimization, frequency domain techniques, state variable feedback, and sensitivity analysis. Introduction to nonlinear and discrete time systems. Prerequisite: MAE 317.

MAE 433 Air Conditioning and Refrigeration. (3) A

Air conditioning processes; environmental control; heating and cooling loads; psychrometry; refrigeration cycles. Prerequisite: MAE 388 or MET 432 or instructor approval.

MAE 434 Internal Combustion Engines. (3) A

Performance characteristics, combustion, carburetion and fuel-injection, and the cooling and control of internal combustion engines. Computer modeling. Lab. Prerequisite: MAE 388.

MAE 435 Turbomachinery. (3) A

Design and performance of turbomachines, including steam, gas and hydraulic turbines, centrifugal pumps, compressors, fans, and blowers. Pre- or corequisite: MAE 361 or 371.

MAE 436 Combustion. (3) A

Thermochemical and reaction rate processes; combustion of gaseous and condensed-phase fuels. Applications to propulsion and heating systems. Pollutant formation. Prerequisite: MAE 388.

MAE 447 Robotics and Its Influence on Design. (3) A

Robot applications, configurations, singular positions, and work space; modes of control; vision; programming exercises; design of parts for assembly. Prerequisite: MAE 317.

MAE 455 Polymers and Composites. (3) F

Relationship between chemistry, structure, and properties of engineering polymers. Design, properties, and behavior of fiber composite systems. Cross-listed as MSE 470. Credit is allowed for only MAE 455 or MSE 470. Prerequisite: ECE 350.

MAE 462 Space Vehicle Dynamics and Control. (3) F

Attitude dynamics and control, launch vehicles, orbital mechanics, orbital transfer/rendezvous, space mission design, space structures, spacecraft control systems design. Prerequisite: MAE 317.

MAE 463 Propulsion. (3) A

Fundamentals of gas-turbine engines and design of components. Principles and design of rocket propulsion and alternative devices. Lecture, design projects. Prerequisite: ECE 386. Pre- or corequisite: MAE 361 (or 371).

MAE 465 Rocket Propulsion. (3) A

Rocket flight performance; nozzle design; combustion of liquid and solid propellants; component design; advanced propulsion systems; interplanetary missions; testing. Prerequisite: MAE 361 or 371.

MAE 466 Rotary Wing Aerodynamics and Performance. (3) A

Introduction to helicopter and propeller analysis techniques. Momentum, blade-element, and vortex methods. Hover and forward flight. Ground effect, autorotation, and compressibility effects. Prerequisites: ECE 386 and MAE 361 or instructor approval.

MAE 467 Aircraft Performance. (3) A

Integration of aerodynamic and propulsive forces into aircraft performance design. Estimation of drag parameters for design. Engine, airfoil selection. Conceptual design methodology. Lecture, design projects. Prerequisite: MAE 361 or 371. Pre- or corequisite: MAE 441.

MAE 469 Projects in Astronautics or Aeronautics. (3) F, S

Various multidisciplinary team projects available each semester. Projects include design of high-speed rotocraft autonomous vehicles, liquid-fueled rockets, micro-aerial vehicles, satellites. Prerequisite: instructor approval.

MAE 471 Computational Fluid Dynamics. (3) A

Numerical solutions for selected problems in fluid mechanics. Prerequisites: ECE 384; MAE 361 (or 371).

MAE 504 Laser Diagnostics. (3) S

Fundamentals of optics and the interaction of light with matter. Laser sources, laser spectroscopy, velocimetry, particle sizing, and surface characterization.

MAE 505 Perturbation Methods. (3) N

Nonlinear oscillations, strained coordinates, renormalization, multiple scales, boundary layers, matched asymptotic expansions, turning point problems, and WKBJ method. Cross-listed as MAT 505. Credit is allowed for only MAE 505 or MAT 505.

MAE 506 Advanced System Modeling, Dynamics, and Control. (3) S

Lumped-parameter modeling of physical systems with examples. State variable representations and dynamic response. Introduction to modern control. Prerequisite: ASE 582 or MAT 442.

MAE 507 Optimal Control. (3) F

Optimal control of systems. Calculus of variations, dynamic programming, linear quadratic regulator, numerical methods, and Pontryagin's principle. Cross-listed as EEE 587. Credit is allowed for only EEE 587 or MAE 507. Prerequisite: EEE 482 or MAE 506.

MAE 509 Robust Multivariable Control. (3) S

Characterization of uncertainty in feedback systems, robustness analysis, synthesis techniques, multivariable Nyquist criteria, computer-aided analysis and design. Prerequisites: MAE 417, 506.

MAE 510 Dynamics and Vibrations. (3) F

Lagrange's and Hamilton's equations, rigid body dynamics, gyroscopic motion, and small oscillation theory.

MAE 511 Acoustics. (3) F

Principles underlying the generation, transmission, and reception of acoustic waves. Applications to noise control, architectural acoustics, random vibrations, and acoustic fatigue.

MAE 512 Random Vibrations. (3) S

Review of probability theory, random processes, stationarity, power spectrum, white noise process, random response of single and multiple DOF systems, and Markov processes simulation. Prerequisite: MAE 510 or instructor approval.

MAE 515 Structural Dynamics. (3) S

Free vibration and forced response of discrete and continuous systems, exact and approximate methods of solution, finite element modeling, and computational techniques. Prerequisite: MAE 510 or instructor approval.

MAE 517 Nonlinear Oscillations. (3) F

Existence, stability, and bifurcation of solutions of nonlinear dynamical systems. Methods of analysis of regular and chaotic responses. Prerequisite: MAE 510 or instructor approval.

MAE 518 Dynamics of Rotor-Bearing Systems. (3) S

Natural whirl frequency, critical speed, and response analysis of rigid and flexible rotor systems. Bearing influence and representation. Stability analysis. Methods of balancing.

MAE 520 Solid Mechanics. (3) F

Introduction to tensors: kinematics, kinetics, and constitutive assumptions leading to elastic, plastic, and viscoelastic behavior. Applications.

MAE 521 Structural Optimization. (3) N

Linear and nonlinear programming. Problem formulation. Constrained and unconstrained optimization. Sensitivity analysis. Approximate techniques. FEM-based optimal design of mechanical and aerospace structures. Cross-listed as CEE 533. Credit is allowed for only CEE 533 or MAE 521. Prerequisite: instructor approval.

MAE 522 Variational Principles of Mechanics. (3) S

Virtual work, stationary, and complementary potential energies. Hamilton's principle. Application of these and direct methods to vibrations, elasticity, and stability. Prerequisite: MAE 520 or equivalent.

MAE 523 Theory of Plates and Shells. (3) F

Linear and nonlinear theories of plates. Membrane and bending theories of shells. Shells of revolution. Prerequisite: MAE 520.

MAE 524 Theory of Elasticity. (3) S

Formulation and solution of 2- and 3-dimensional boundary value problems. Prerequisite: MAE 520.

MAE 527 Finite Element Methods in Engineering Science. (3) F

Discretization, interpolation, elemental matrices, assembly, and computer implementation. Application to solid and fluid mechanics, heat transfer, and time dependent problems. Prerequisite: ASE 582.

MAE 536 Combustion. (3) N

Thermodynamics; chemical kinetics of combustion. Explosion and ignition theories. Reactive gas dynamics. Structure, propagation, and stability of flames. Experimental methods. Prerequisite: MAE 436 or instructor approval.

MAE 540 Advances in Engineering Design Theory. (3) F

Survey of research in engineering design process, artifact and design, knowledge, formal and informal logic, heuristic and numerical searches, theory of structure and complexity. Prerequisite: graduate standing.

MAE 541 CAD Tools for Engineers. (3) F

Elements of computer techniques required to develop CAD software. Data structures, including lists, trees, and graphs. Computer graphics, including 2- and 3-dimensional algorithms and user interface techniques.

MAE 542 Geometric Modeling in CAD/CAM. (3) S

Geometric and solid modeling, curve and surface design, CAD database architectures, and integration of solid modeling into engineering processes. Prerequisite: MAE 541 or instructor approval.

MAE 544 Mechanical Design and Failure Prevention. (3) F

Modes of mechanical failure; application of principles of elasticity and plasticity in multiaxial state of stress to design synthesis; failure theories; fatigue; creep; impact. Prerequisite: MAE 443.

MAE 546 CAD/CAM Applications in MAE. (4) F

Solution of engineering problems with the aid of state-of-the-art software tools in solid modeling, engineering analysis; and manufacturing; selection of modeling parameters; reliability tests on software. Open only to students without previous credit for MAE 406. 3 hours lecture, 3 hours lab. Prerequisite: instructor approval.

MAE 547 Mechanical Design and Control of Robots. (3) N

Homogeneous transformations, 3-dimensional kinematics, geometry of motion, forward and inverse kinematics, workspace and motion trajectories, dynamics, control, and static forces.

MAE 548 Mechanism Synthesis and Analysis. (3) S

Algebraic and graphical methods for exact and approximate synthesis of cam, gear, and linkage mechanisms; design optimization; methods of planar motion analysis; characteristics of plane motion; spatial kinematics.

MAE 557 Mechanics of Composite Materials. (3) S

Analysis of composite materials and applications. Micromechanical and macromechanical behavior. Classical lamination theory developed with investigation of bending-extension coupling.

MAE 560 Propulsion Systems. (3) N

Design of air-breathing gas turbine engines for aircraft propulsion; mission analysis; cycle analysis; engine sizing; component design.

MAE 561 Computational Fluid Dynamics. (3) S

Finite-difference and finite-volume techniques for solving the subsonic, transonic, and supersonic flow equations. The method of characteristics. Numerical grid-generation techniques. Prerequisite: MAE 571 or instructor approval.

MAE 563 Unsteady Aerodynamics. (3) S

Unsteady incompressible and compressible flow. Wings and bodies in oscillatory and transient motions. Kernel function approach and panel methods. Aeroelastic applications. Prerequisite: MAE 460 or 461.

MAE 564 Advanced Aerodynamics. (3) F

Perturbation method. Linearized subsonic and supersonic flows. Thin wing/slender body theories. Lifting surface theory. Panel method computation. Prerequisite: MAE 460 or 461.

MAE 566 Rotary-Wing Aerodynamics. (3) F

Introduction to helicopter and propeller analysis techniques. Momentum, blade-element, and vortex methods. Hover and forward flight. Ground effect, autorotation, and compressibility effects. Prerequisite: MAE 361.

MAE 571 Fluid Mechanics. (3) F

Basic kinematic, dynamic, and thermodynamic equations of the fluid continuum and their application to basic fluid models.

MAE 572 Inviscid Fluid Flow. (3) S

Mechanics of fluids for flows in which the effects of viscosity may be ignored. Potential flow theory, waves, and inviscid compressible flows. Prerequisite: MAE 571.

MAE 573 Viscous Fluid Flow. (3) F

Mechanics of fluids for flows in which the effects of viscosity are significant. Exact and approximate solutions of the Navier-Stokes system, laminar flow at low and high Reynolds number. Prerequisite: MAE 571.

MAE 575 Turbulent Shear Flows. (3) F

Homogeneous, isotropic, and wall turbulence. Experimental results. Introduction to turbulent-flow calculations. Prerequisite: MAE 571.

MAE 577 Turbulent Flow Modeling. (3) S

Reynolds equations and their closure. Modeling of simple and complex turbulent flows, calculations of internal and external flows, and application to engineering problems. Prerequisite: MAE 571.

MAE 581 Thermodynamics. (3) F

Basic concepts and laws of classical equilibrium thermodynamics; applications to engineering systems. Introduction to statistical thermodynamics.

MAE 582 Statistical Thermodynamics. (3) A

Kinetic and quantum theory. Statistical mechanics; ensemble theory. Structure and thermodynamics of noninteracting and interacting particles. Boltzmann integro-differential equation. Prerequisite: graduate standing.

MAE 585 Conduction Heat Transfer. (3) F

Basic equations and concepts of conduction heat transfer. Mathematical formulation and solution (analytical and numerical) of steady and unsteady, one- and multidimensional heat conduction and phase change problems. Prerequisites: ECE 386; MAE 388.

MAE 586 Convection Heat Transfer. (3) S

Basic concepts and governing equations. Analysis of laminar and turbulent heat transfer for internal and external flows. Natural and mixed convection. Prerequisite: MAE 388.

MAE 587 Radiation Heat Transfer. (3) F

Advanced concepts and solution methodologies for radiation heat transfer, including exchange of thermal radiation between surfaces, radiation in absorbing, emitting, and scattering media and radiation combined with conduction and convection. Prerequisite: MAE 388.

MAE 588 Two-Phase Flows and Boiling Heat Transfer. (3) S

Pool and flow boiling heat transfer, condensation heat transfer, various models of vapor-liquid mixture flows, gas-solid mixture flows, and experimental measurement techniques.

MAE 589 Heat Transfer. (3) F

Basic concepts; physical and mathematical models for heat transfer. Applications to conductive, convective, radiative, and combined mode heat transfer. Prerequisite: MAE 388.

MAE 594 Graduate Research Conference. (1) F, S

Topics in contemporary research. Required every semester of all departmental graduate students registered for 9 or more semester hours. Not for degree credit.

MAE 598 ST: Special Topics. (1–3) F, S

Special topics courses, including the following, which are regularly offered, are open to qualified students:

- (a) Advanced Spacecraft Control
- (b) Aeroelasticity
- (c) Aerospace Vehicle Guidance and Control
- (d) Boundary Layer Stability
- (e) Hydrodynamic Stability
- (f) Plasticity
- (g) Polymers and Composites

Omnibus Graduate Courses: See page 51 for omnibus graduate courses that may be offered.

Medieval and Renaissance Studies

Interdisciplinary Certificate Programs

Robert E. Bjork

Director

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American Studies

(ASU West)

Assistant Professor: Moulton

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Assistant Professor: Wolfthal

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Professors: Bjork, Brink;

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Assistant Professors: Perry, Stevens, Vaden;

Lecturer: Obermeier

History

Professors: Batalden, Burg, Tillman, Warnicke;

Associate Professors: Barnes, Soergel;

Assistant Professors: McKee, Thornton

Languages and Literatures

Professors: Alexander, Losse, Wixted;

Associate Professors: Hendrickson, Sanchez, Senner;

Assistant Professors: Candela, Vitullo

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Professor: Rose;

Associate Professor: Brennan

Music

Professor: Metz;

Associate Professors: Haefer, Rave

Philosophy

Professor: White

Religious Studies

Professor: Samuelson;

Associate Professor: Coudert;

Assistant Professor: Clay

Theatre

Professor: Knapp

University Honors College

Lecturers: Facinelli, Ramseyer

Graduate students admitted to a degree program in any field may earn one of two M.A.- or Ph.D.-level certificates: the Certificate in Medieval Studies or the Certificate in Renaissance Studies. Since medieval and Renaissance studies are by nature interdisciplinary, students in the certificate program receive interdisciplinary training. Besides the course work and examinations required in their major field, students take six to nine semester hours outside their discipline and receive training in a medieval vernacular language or a modern European language.

The core of the program has two components: (1) Latin, the international language for both the Middle Ages and Renaissance, and (2) paleography, the study of the physical medium through which Latin and other languages were transmitted.

The certificate program prepares students for advanced study or for academic positions by augmenting their skills and knowledge, thereby making them more equipped to handle the demands of their fields. For more information, contact the Arizona Center for Medieval and Renaissance Studies.

Microbiology

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PROFESSORS

BURKE, JACOBS, MOSSMAN, SCHMIDT

ASSOCIATE PROFESSORS

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BLOOM, CHANG

The faculty in the Department of Microbiology offer programs leading to the M.S. and the Ph.D. degrees in Microbiology.

The faculty also participate in the program leading to the Master of Natural Science degree when one of the concentrations is microbiology (see "Master of Natural Science," page 257).

The Graduate Record Examination (GRE) is required for all applicants. Three letters of recommendation and a statement of personal goals must be submitted for admission to the graduate programs. Applicants are expected to have completed the requirements for an undergraduate major in biology, chemistry, microbiology, or have an adequate background in related courses in biology, chemistry, mathematics, physics, and plant biology. Applicants without this background may be asked to take the GRE subject test. Applications are accepted throughout the year. To be considered for assistantships and fellowships, completed applications must be received by February 15 for the fall semester and by October 15 for the spring semester.

The graduate programs are designed to prepare students for careers in teaching and in research on various aspects of microbiology in educational institutions, industry, or government agencies. To ensure proper course selection, new students must have the department's approval for all course registrations.

MASTER OF SCIENCE

See "Master's Degrees," page 98, for general requirements.

Program of Study. A minimum of 30 semester hours of graduate credit are required, of which at least six hours must be thesis and research credit. The program is planned by the student in consultation with the supervisory committee.

Foreign Language Requirements. None.

Comprehensive Examinations. Students are expected to achieve, through course work, a fundamental understanding of the following subdisciplines: bacterial genetics, immunology, molecular biology, physiology and metabolism, and virology. Alternatively, the student may demonstrate this fundamental understanding by a comprehensive examination prepared by the student's supervisory committee.

Thesis Requirements. A thesis is required.

Final Examinations. A final oral examination covering the thesis and related subject matter is required.

DOCTOR OF PHILOSOPHY

See "Doctor of Philosophy," page 101, for general requirements.

Program of Study. At least 60 semester hours of graduate credit, in addition to 24 hours of dissertation and research, are required; a minimum of 24 hours of this total is in formal course work. The program is planned in consultation with the supervisory committee.

Foreign Language Requirements. None.

Comprehensive Examinations. Written and oral comprehensive examinations are required.

Dissertation Requirements. A dissertation based on original work of high quality, demonstrating proficiency in the student's area of interest, is required. (See "Doctoral Dissertations," page 100.)

Final Examinations. A final oral examination in defense of the dissertation is required.

RESEARCH ACTIVITY

The following represent major areas of research emphasis by faculty and graduate students in microbiology: bacterial enzymology, bacterial genetics, immunology, host-parasite relationships, medical molecular biology, neuroimmunology, physiology, systematics, and virology.

Recent studies include the following: structure and function of the outer membrane of *Escherichia coli*; genetics of outer membrane proteins; control and regulation of metabolic pathways; regulation of environmentally responsive genes in bacteria; genetics of *E. coli* isocitrate dehydrogenase; site-specific conjugal recombination in *E. coli*; development of *Bacillus* cloning systems; genetic studies of entomocidal Bacilli; biology of budding and appendaged bacteria; biology of the genus *Seliberia*; molecular mechanism of interferon action; translational control of gene expression in reovirus; immune system-nervous system interactions; CNS involvement in autoimmune disease; mechanisms of stress effects on chronic immunologic diseases; molecular pathogenesis of herpes virus; regulation of VDJ recombination in B lymphocyte development.

MICROBIOLOGY (MIC)

MIC 420 Immunology: Molecular and Cellular Foundations. (3) F
Molecular and cellular foundations of immunology. Antibody/antigen interactions, cellular response, cytokines, immunogenetics, immunoregulation, autoimmunity, psychoneuroimmunology research/medical perspectives. Prerequisites: CHM 231 (or 331) and MIC 205 (or 220) or instructor approval.

MIC 421 Experimental Immunology. (2) F, S

An introduction to the basic techniques, methods, and assays used in immunology. 6 hours lab. Prerequisites: CHM 231 and 331 and MIC 302 or instructor approval.

MIC 425 Advanced Immunology. (3) S 2001

A survey of recent advances in immunology, including lymphocyte membranes, lymphokines/biochemistry, molecular genetics, theoretical immunology, immunoregulation, neuroimmunology, and immunologic diseases. Prerequisite: MIC 420 or instructor approval.

MIC 441 Bacterial Genetics. (3) S

Survey of genetic exchange and regulatory processes in bacteria and their viruses. Bacteria and viruses as tools in genetic engineering. Prerequisites: BIO 340 and MIC 205 (or 220) or instructor approval.

MIC 442 Bacterial Genetics Laboratory. (1) N

Techniques of mutagenesis, mapping, and strain construction. 4 hours lab. Prerequisites: MIC 206, 302. Pre- or corequisite: MIC 441.

MIC 445 Techniques in Molecular Biology/Genetics. (2) F, S

Molecular genetic principles plasmid construction, purification and characterization; PCR; mutagenesis; hybridization and sequence analysis; protein quantitation; immunologic detection and electrophoresis. Prerequisites: BIO 340 and MIC 302 or instructor approval.

MIC 446 Techniques in Molecular Biology/Genetics Lab. (2) F, S

Molecular genetic techniques; plasmid construction, purification and characterization; PCR; mutagenesis; hybridization and sequence analysis; protein quantitation; immunologic detection and electrophoresis. Pre- or corequisite: MIC 445.

MIC 470 Bacterial Diversity and Systematics. (4) F

Biology, classification, and enrichment culture of the nonpathogenic bacteria. 2 hours lecture, 6 hours lab. Prerequisite: MIC 302.

MIC 485 General Virology. (3) F

Fundamental nature of viruses, their replication, pathogenesis, and ecology. Prerequisites: BIO 340 and CHM 331 or instructor approval.

MIC 486 General Virology Laboratory. (2) S

Fundamentals of virus detection, isolation and assay; propagation of virus in mammalian cell culture; recombinant virus and vector construction. 6 hours lab. Prerequisite: MIC 302. Pre- or corequisite: MIC 485.

MIC 527 Neuroimmunology. (3) S

Studying mind's influence on immunity and the immune system's influence on the mind, neuroimmunologic diseases, and the neuroimmunological circuitry involved. Seminar. Prerequisite: MIC 420 or instructor approval.

MIC 581 Molecular Mechanism of Pathogenesis. (3) S

Pathogenic mechanisms and host responses in viral and/or bacterial diseases. Prerequisites: MIC 381 and 420 or instructor approval.

MIC 585 Molecular Virology. (3) N

Selected topics concerning molecular aspects of eukaryotic virus replication and pathogenesis. Prerequisite: instructor approval.

MIC 591 Seminar. (1–3) F, S

Topics may be selected from the following:

- (a) Bacterial Ecology
- (b) Current Research in Microbiology
- (c) Enzymology
- (d) Genetic Engineering
- (e) Genetics
- (f) Immunology
- (g) Molecular Virology
- (h) Neuroimmunology
- (i) Pathogenic Bacteriology

Omnibus Graduate Courses: See page 51 for omnibus graduate courses that may be offered.

Molecular and Cellular Biology**Interdisciplinary Master's and Doctoral Programs**

Bertram L. Jacobs

Director

(LSE 411) 480/965-0743

mcbprgm@asu.edu

lsvl.la.asu.edu/mcb

Biology

Regents' Professor: Markow;

Professors: Capco, Chandler, Hazel, McGaughey, Satterlie;

Associate Professors: Goldstein, Smith;

Assistant Professors: Newfeld, Rawls

Chemistry and Biochemistry

Professors: Bieber, Blankenship, Lohr, Rose, Woodbury;

Associate Professor: Allen;

Assistant Professor: L. Bloom

Microbiology

Professors: Jacobs, Schmidt;

Associate Professors: Hoffman, Misra, Stout;

Assistant Professors: D. Bloom, Chang

Plant Biology

Professors: Backhaus, Hooper, Trelease, Vermaas;

Associate Professors: Frasch, Roberson, Stutz, Webber;

Assistant Professor: Pogson

The interdisciplinary M.S. and Ph.D. degrees in Molecular and Cellular Biology are administered by the Interdisciplinary Committee on Molecular and Cellular Biology. The participating faculty are drawn primarily from four core departments (the Departments of Biology, Chemistry and Biochemistry, Microbiology, and Plant Biology), with additional faculty from the Departments of Anthropology, and Physics and Astronomy. One striking aspect of studies in this broad area of biological science is the interdisciplinary nature of the field. Similar approaches and techniques are used for studies of biological systems whether they are viral, bacterial, plant, or animal.

The graduate degrees offered by the faculty through this program prepare students for careers that span traditional disciplinary boundaries. The broad-based training provides the necessary skills for professional careers in academic institutions, governmental institutions, and industry, particularly those related to health and chemical sciences.

Graduate Record Examination. All applicants are required to take the Graduate Record Examination (GRE). Submission of scores on the verbal, quantitative, analytical, and advanced sections of the GRE is required for admission to the M.S. and Ph.D. degree programs. The subject test in the sciences is highly recommended.

TOEFL and SPEAK Test. Students whose native language is not English are required to take the Test of English as a Foreign Language (TOEFL). A TOEFL score of 630 is required for admission to the MCB program. Students whose native language is not English must pass the Speaking Proficiency English Assessment Kit (SPEAK) test with

a score of at least 55 if they wish to be considered for teaching assistantship support.

MASTER OF SCIENCE

See "Master's Degrees," page 98, for general requirements.

Program of Study. Thirty semester hours are required. A minimum of 10 designated semester hours of MCB courses and six hours of Research and Thesis are required. The remaining courses are selected by the student in consultation with the supervisory committee.

Thesis Requirements. A written thesis based on original research is required.

Final Examinations. A final oral examination in defense of the thesis is required.

DOCTOR OF PHILOSOPHY

See "Doctor of Philosophy," page 101, for general requirements.

Program of Study. Eighty-four semester hours are required. A minimum of 12 designated semester hours of MCB courses, six semester hours of elective course work, and 24 semester hours of Research or Dissertation are required. The remaining courses are selected by the student in consultation with the supervisory committee.

Comprehensive Examinations. Written and oral comprehensive examinations are required.

Dissertation Requirements. A written dissertation based on original research of high quality that demonstrates proficiency in the area of specialization is required.

Final Examinations. The final oral examination in defense of the dissertation is required. Evidence must be presented that the research contribution is publishable in the primary literature.

RESEARCH ACTIVITY

Refer to individual programs (Biology, Chemistry and Biochemistry, Microbiology, and Plant Biology) for descriptions of research activities.

MOLECULAR AND CELLULAR BIOLOGY (MCB)

MCB 500 Research Methods in Molecular and Cellular Biology. (2) F, S
Rotation laboratory experiences in which students participate in research under the direction of an MCB faculty member. May be repeated for credit.

MCB 501 Seminar: Molecular and Cellular Biology Colloquium. (1) F, S
Presentation of current research by noted researchers in the field. May be repeated for credit.

MCB 555 Advanced Molecular and Cellular Biology I. (3) F
Study of structural and functional organization of biomolecules and cells, based on current literature. 3 hours lecture, discussion. May be repeated once for credit. Pre- or corequisites: BIO 543 (or equivalent); CHM 461.

MCB 556 Advanced Molecular and Cellular Biology II. (3) S
Continuation of MCB 555. 3 hours lecture, discussion. May be repeated once for credit. Pre- or corequisites: BIO 543 (or equivalent); CHM 462.

MCB 591 Seminar: Current Literature in Molecular and Cellular Biology. (1) F, S
Presentation and discussion of current research in the areas of molecular and cellular biology. May be repeated for credit.

MCB 700 Research Methods in Molecular and Cellular Biology. (2) F, S
Rotation laboratory experiences in which students participate in research under the direction of an MCB faculty member. May be repeated for credit.

MCB 701 Seminar: Molecular and Cellular Biology Colloquium. (1) F, S
Presentation of current research by noted researchers in the field. May be repeated for credit.

MCB 791 Seminar: Current Literature in Molecular and Cellular Biology. (1) F, S
Presentation and discussion of current research in the areas of molecular and cellular biology. May be repeated for credit.

Omnibus Graduate Courses: See page 51 for omnibus graduate courses that may be offered.

Music

Master's

Amy Holbrook

Master's Program Coordinator
(MUSIC E177) 480/965-3372

Doctoral

Jerry Doan

Doctoral Program Coordinator
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REGENTS' PROFESSORS

HICKMAN, PAGANO

PROFESSORS

ATSUMI, BACON, BRITTON, COSAND, CROWE, DOAN, FLEMING, HACKBARTH, HAMILTON, HARRIS, HOFFER, HUMPHREYS, KLIEWER-BRITTON, KOONCE, LOCKWOOD, MAGERS, MAROHNIC, METZ, OLDANI, PILAFIAN, REBER, ROGERS, RUSSELL, SELLHEIM, SHINN, SKOLDBERG, SPINOSA, SPRING, STOCKER, STRANGE, SUNKETT, SWAIM, THOMPSON, UMBERSON, WELLS, WILLIAMSON, WYTKO

ASSOCIATE PROFESSORS

BARROLL-ASCHAFFENBURG, CARPENTER, DeMARS, DREYFOOS, HAEFER, HOLBROOK, MARSHALL, MAY, MONTGOMERY, PETERSON, RAVE, REYNOLDS, ROCKMAKER, SMITH, SOLIS, STAUFFER, WILSON

ASSISTANT PROFESSORS

BRYAN, BUSH, LYMAN, McLIN, RIO

LECTURER

SHELLANS

The faculty in the School of Music offer graduate programs leading to the M.A. degree in Music with concentrations in ethnomusicology, music history and literature, and music theory.

The faculty also offer a graduate program leading to the professional Master of Music degree in Composition, Music

Education, and Performance and the professional Doctor of Musical Arts degree in Music with concentrations in choral conducting, composition, music education, and solo performance.

Graduate Diagnostic Examinations. All students admitted to graduate degree programs must satisfactorily complete examinations before any comprehensive examinations may be scheduled. In music theory, the areas are as follows:

1. aural skills;
2. form;
3. analytical skills: 19th-century music; and
4. analytical skills: contemporary music.

In music history, the areas are (1) medieval, renaissance, and baroque and (2) classical, romantic, and contemporary.

Undergraduate Deficiencies. Deficiencies are determined by the school. Removal of all deficiencies is the responsibility of the student and is considered additional to the minimum hours for graduation.

Graduate Assistantships. The deadline is February 15 for teaching assistantship applications.

MASTER OF ARTS

See "Master's Degrees," page 98, for general requirements.

Prerequisites. Applicants are expected to have a B.A. degree in Music or its equivalent from an accredited institution.

Admission. Application must be accompanied by evidence of scholarly achievement or potential (e.g., a term paper) and by letters of recommendation from two persons qualified in the field.

Program of Study

Ethnomusicology. A minimum of 30 semester hours of graduate credit is required, of which at least 16 semester hours must be in the field of ethnomusicology, including six semester hours of thesis, and at least six semester hours in music theory.

Music History and Literature. A minimum of 30 semester hours of graduate credit is required, of which at least two-thirds must be in the field of music history and literature.

Music Theory. A minimum of 32 semester hours of graduate credit is required, of which at least 18 must be in the field of music theory and at least 10 must be selected from the fields of music theory, music composition, and music history.

Course Requirements

Ethnomusicology. MUP 587 (two semesters), MHL 568, 591, 592, 599 (Thesis), and six semester hours of music theory.

Music History and Literature. MUP 582 (two semesters), MHL 532, 591 (two semesters), 599 (Thesis), and six hours of music theory.

Music Theory. MTC 520, 525, 527, 528, 599 (Thesis); six semester hours of music history.

Foreign Language Requirements. A passing grade on the foreign language reading examination in French or German is required.

Final Examinations. A final examination (written, oral, or both) is required. An oral examination in defense of the thesis is also required.

MASTER OF MUSIC

The faculty in the School of Music offer a graduate program leading to the professional degree Master of Music (M.M.). Three majors are available: Composition, Music Education, and Performance. For the Music Education major, concentrations are available in

1. choral music,
2. general music,
3. instrumental music, and
4. jazz studies.

For the Performance major, concentrations are available in

1. music theatre musical direction,
2. music theatre performance,
3. performance pedagogy,
4. piano accompanying, and
5. solo performance (voice, keyboard, instrumental).

Prerequisites. A Bachelor of Music degree or its equivalent from an accredited institution is required for admission to the M.M. program.

Admission. Admission to all concentrations under the major in Performance, with the exception of music theatre musical direction, is dependent on a successful audition, either in person or by taped performance. For admission to the major in Composition, the applicant must submit three original works showing technical facility in composition and letters of recommendation from two qualified persons in the field. For admission to the M.M. in Music Education degrees, the applicant must have completed all requirements for music teacher certification. Postbaccalaureate certification is available and may be completed concurrently with master's degree work.

Letters of recommendation from three qualified persons in the field are also required. For the jazz studies concentration, a video or audio tape of a recent jazz performance (solo or ensemble) by the applicant must be submitted, and a video or audio tape of a jazz ensemble directed by the applicant should also be submitted if available.

Students majoring in Performance with a concentration in solo performance (voice) and performance pedagogy (voice) are required to take a diction examination in French, German, and Italian during registration week of their first semester. Students who do not pass this examination are required to take the appropriate semester(s) of MUP 250.

For admission to the concentration in performance pedagogy (piano), a minimum of one semester of prior piano pedagogy study including significant intern teaching experience is required. In addition, the student must demonstrate evidence of teaching ability, either in person or by videotape.

Program of Study. The student must complete a minimum of 32 semester hours of graduate courses, of which at least one-third must be in the area of concentration.

Foreign Language Requirements. Solo performance (voice only) and performance pedagogy (voice only) require a total of 16 semester hours of college-level credit in more than one language chosen from French, German, or Italian. The concentration in piano accompanying requires two semesters of college-level study in French, German, or Italian and two semesters of diction (or the equivalent) in the remaining languages in that group. These requirements may be fulfilled in whole or in part through language instruction in secondary and/or undergraduate school or by other means (for more information, see the *General Catalog*). These language requirements are not part of the 32-hour program of study. However, hours toward the requirements may be taken concurrently with the program of study if a deficiency exists.

Final Examination. A final written or oral examination, or both, is required. An oral examination in defense of the thesis is required if the thesis is an option.

Composition

Composition. MTC 523 (four semester hours), 525, 599; six hours of music history.

Music Education

Choral Music. MUE 548, 549, 550 (or 579), 568, 570; two semester hours of ensemble; six semester hours of music history (including MHL 575); five hours of music theory. One MHL or MTC course must be in contemporary music.

General Music. MUE 548, 549, 550 (or 579), 551, 552; six semester hours of music history; five hours of music theory. One MHL or MTC course must be in contemporary music, and one MHL course or one ensemble must be in ethnomusicology.

Instrumental Music. MUE 548, 549, 550 (or 579), 564, 566; six semester hours of music history; five hours of music theory. One MHL or MTC course must be in contemporary music.

Jazz Studies. MUE 548, 549, 550 (or 579), 560, 562 (two semesters); MUP 509, 510, 517, 518, three semester hours of jazz ensemble; six semester hours of music history; five hours of music theory. One MHL or MTC course must be in contemporary music.

Performance

Solo Performance (Voice). MUP 527 (eight semester hours), 541, 551, 595, 596; performing ensembles (two hours); six hours of music history; five hours of music theory.

Solo Performance (Keyboard). MUP 527 (eight semester hours), 551 (or 581), 595, 596; performing ensembles (two hours); six hours of music history and literature; five hours of music theory.

Solo Performance (Instrumental). MUP 527 (eight semester hours), 551, 581, 595, 596; performing ensembles (two hours); six hours of music history; five hours of music theory.

Piano Accompanying. MUP 527 Studio Instruction (eight semester hours), 511 (or 521 Studio Instruction [four

hours]), 588 (four hours), 595, 596; six hours of music history; five hours in music theory.

Performance Pedagogy. MUP 527 (eight semester hours), 541 (voice only), 551 and/or 581, 595, 596; performing ensembles (two hours), (piano only: MUP 440 [or proficiency], 507, 508, 581 [four hours]); six hours in music history; five hours of music theory.

Music Theatre Musical Direction. MUP 511 Studio Instruction (four semester hours), 540, 551, 571 (two hours), 591, 595, 596; a three-hour graduate THP course designed for directors (as approved by supervisory committee); musical direction of two musical theatre productions; five hours of music history; five hours of music theory.

Music Theatre Performance. MUP 511 Studio Instruction (six semester hours), 551, 570 (three hours), 571 (three hours), 595, 596; a three-hour graduate THP course designed for actors (as approved by supervisory committee); leading roles in two musical theatre productions; five hours of music history; five hours of music theory.

DOCTOR OF MUSICAL ARTS

The Doctor of Musical Arts (D.M.A.) is a professional degree program designed for students desiring high levels of performance, academic proficiency, and preparation for teaching positions at the university level. The major is Music with four concentrations: choral conducting, composition, music education, and solo performance.

Admission. Students seeking admission normally hold the Master of Music degree. Applicants with other degrees are considered if they have received graduate training similar to that normally expected in a Master of Music degree program. The application for admission must be accompanied by an applicant's statement relating to goals, preparation, and educational background. The applicant must submit scores for the GRE (quantitative, verbal, and analytical) or the MAT. Three letters of recommendation are required. Applicants must perform a satisfactory audition or submit a tape recording of performances or compositions as appropriate to the concentration. The deadline is February 15 for teaching assistantship applications.

Supervisory Committee. When the program of study is filed, the supervisory committee is appointed by the dean of the Graduate College upon recommendation of the director and the graduate committee of the School of Music. The committee consists of five members; at least three should be from the major field.

Program of Study. A total of 90 semester hours beyond the bachelor's degree is required. Only 36 hours from a master's degree or other postgraduate work will be counted toward the 90 hour requirement.

Continuous Enrollment. Once admitted to a D.M.A. degree program, the student is expected to be enrolled continuously, excluding summer sessions, until all requirements for the degree have been fulfilled. This requirement applies to students admitted fall 1994 and thereafter. Continuous enrollment promotes steady progress toward the completion of the degree and an ongoing relationship between the student and faculty offering the program. If additional credit is not required toward the D.M.A. degree, the student may enroll for Continuing Registration 795. Continuing

Registration does not carry credit; no grade is given. If a program of study must be interrupted for one or more semesters, the student may apply for leave status, not to exceed one calendar year. A student on leave is not required to pay fees, but is not permitted to place any demands on university faculty or use any university facilities. A student who interrupts a program without obtaining leave status may be removed automatically from the Graduate College, under the assumption that the student has decided to discontinue the program. A student removed from the Graduate College for this reason may reapply for admission; the application is considered along with all other new applications to the degree program.

An application for leave status, endorsed by the members of the student's supervisory committee and the head of the academic unit, must be approved by the dean of the Graduate College. This request must be filed and approved no later than the last day of registration in the semester of anticipated absence.

Residency. In general, the D.M.A. degree student should expect to spend at least the equivalent of three academic years beyond the bachelor's degree in the program. At least two semesters following the first year (30–32 semester hours) of graduate study must be spent in continuous full-time residence at ASU. After the first year (30–32 semester hours), at least 54 hours must be completed in residence at ASU.

Foreign Language Requirements. Competency in at least one foreign language is required for solo performance and music composition concentrations. Some concentrations require two foreign languages.

Comprehensive Examinations. Near the completion of course work, the student must apply to the Graduate College, through the supervisory committee and the school director, for permission to take the comprehensive examinations. These written and oral examinations are designed to assess the student's competency in the major and supportive fields. Failure in the comprehensive examinations is considered final unless the supervisory committee recommends, and the dean of the Graduate College approves, a re-examination. A re-examination may be administered no sooner than three months and no later than one year from the date of the original examination. Only one re-examination is permitted.

Candidacy. Doctoral students should apply for admission to candidacy immediately after they have met all requirements for the degree, *except the dissertation*. These requirements include passing the comprehensive examinations and foreign language examination, if applicable, and meeting other requirements specified by the academic unit.

Dissertation, Research Papers, and Recitals. The music composition and music education concentrations require a dissertation of an original and creative nature. The choral conducting concentration requires a conducting recital plus either a dissertation or a series of projects and a research paper. The solo performance concentration requires at least three recitals following admission to the program and a research paper. All candidates must enroll for a total of 24 semester hours of credit in recital (MUP 796), research

(MUP 792), and dissertation (MUP 799) as appropriate to the concentration.

Final Examinations. The final oral examination in defense of the dissertation or research paper is scheduled by the Graduate College. The exam is conducted by the supervisory committee and others appointed by the dean of the Graduate College. All final oral examinations must be conducted at least one week before the degree conferral date.

Graduation. The student is eligible for graduation when the final oral examination has been passed, Graduate College scholarship requirements have been met, and the dissertation/research paper has been approved by the supervisory committee, the director of the school, and the dean of the Graduate College.

Applications for graduation should be made no later than the date specified in the Graduate College calendar.

Maximum Time Limit. D.M.A. candidates must complete all requirements within five years after the comprehensive exams have been passed.

MUSIC HISTORY/LITERATURE (MHL)

MHL 532 Music Bibliography. (3) F

Major historical and analytical writings; systematic and historical collections of music. Reading knowledge of a foreign language recommended.

MHL 535 Medieval Music. (3) S 2001

Music of Europe in the Middle Ages, Gregorian chant, religious, and secular monophony and polyphony to 1400.

MHL 536 Music of the Renaissance. (3) S 2000

Music in Europe, with emphasis on stylistic concepts and changes, c. 1400–1580.

MHL 544 World Music I. (3) F 1999

Music of traditional and folk cultures of Africa, Europe, and the Americas.

MHL 545 World Music II. (3) F 2000

Traditional, folk, and art music of the Pacific, Near East, and Asia.

MHL 547 Topics in American Music. (3) N

Selected topics in the history of music. Composers working in the Americas with emphasis upon music since 1900.

MHL 557 Topics in Symphonic Literature. (3) S 2000

An examination of the evolution of the symphony and symphonic poem from the early classic era through the 19th century, with emphasis on the analysis of selected works.

MHL 564 History of Music Instruments. (3) F 2000

Survey of the history and development of music instruments in traditional, folk, and art cultures.

MHL 566 Area Studies in Ethnomusicology. (3) S 2000

Study of the music of a particular culture, country, or area (e.g., music of Mexico, Latin America, China, Africa). May be repeated for credit.

MHL 568 Introduction to Ethnomusicology. (3) F 1999

Introduction to the theory and methodology of the discipline, including bibliography, fieldwork, transcription, analysis, and organology.

MHL 575 History of Choral Music. (3) F

Major choral works.

MHL 591 Seminar. (1–12) N

MHL 644 Notation of Polyphonic Music. (3) S 2000

Music notation from the 15th through 17th centuries, including problems of transcription into modern notation.

Omnibus Graduate Courses: See page 51 for omnibus graduate courses that may be offered.

MUSIC THEORY AND COMPOSITION (MTC)

MTC 516 Baroque Music. (3) S 2000

Detailed analysis of selected examples of music from the Baroque period.

MTC 517 Classic Music. (3) S 2001

Detailed analysis of selected examples of music from the Classic period.

MTC 518 Romantic Music. (3) F 2000

Detailed analysis of selected examples of music from the Romantic period.

MTC 519 Late 19th-/Early 20th-Century Music. (3) F 1999

Detailed analysis of selected examples of music from the late 19th and early 20th centuries.

MTC 520 Analytical Techniques. (3) S, SS

Analytical techniques systematically applied to music. Concentration on structural and compositional procedures.

MTC 523 Advanced Composition. (2–3) F, S

Advanced music composition, including complex techniques and larger structure. May be repeated for credit. Prerequisite: instructor approval.

MTC 525 Pedagogy of Theory. (3) F 2000

Practices and principles of teaching music theory. Emphasizes most desirable and practical offerings possible. Comparative studies of existing practices.

MTC 527 History of Music Theory. (3) F 1999

Theory from Pythagoras to the 16th century. Need not be taken in sequence with MTC 528.

MTC 528 History of Music Theory. (3) S 2000

Theory from the 17th century to the present. Need not be taken in sequence with MTC 527.

MTC 555 Computer Music Notation. (2) N

Instruction in preparing score and parts of music compositions using various music-notation software packages. Credit cannot be applied toward the graduate theory requirement. Lecture, lab. Prerequisite: instructor approval.

MTC 647 Directions in New Music. (3) N

Studies in contemporary idioms and aesthetics drawn from recent works of visiting composers; involves analytical discourse, critical writing, and applied concepts in composition. Lecture, discussion, exercise. Prerequisite: instructor approval.

MTC 723 Advanced Composition. (3) F, S

Special problems in writing in complex forms and textures. May be repeated for credit. Studio.

MTC 755 Music Composition Technology. (3) N

Advanced study in digital sampling, synthesis, sequencing, computer-generated sound, and computer/performer interfaces. May be repeated for credit. Lecture, lab. Prerequisites: MTC 436 and 437 or equivalents.

Omnibus Graduate Courses: See page 51 for omnibus graduate courses that may be offered.

MUSIC EDUCATION (MUE)

MUE 548 Introduction to Research in Music Education. (3) F, SS
Survey of research methods and literature in music education. Focus on interpretation and evaluation.

MUE 549 Foundations of Music Education. (3) A

A treatment of historical perspectives, philosophy-aesthetics identified with music education, and learning theories applied to music teaching/learning. Basic research and writing skills appropriate to graduate studies in music education.

MUE 550 Studies in Music Curricula. (3) A

Scope and sequence of musical experiences. Development of criteria for the evaluation of music curricula.

MUE 551 Advanced Studies in Elementary School Music. (3) A

For experienced teachers; organization and content of the general music classes in kindergarten and the first 6 grades of elementary school. Emphasis on teaching music reading and ear training to young children.

MUE 552 General Music, Music Theory, and Music History

Classes in the Junior and Senior High School. (3) A
Organization and content of school music classes which are not performance oriented.

MUE 553 Contemporary Elementary Music. (3) N

Identification and development of materials and techniques for teaching special units of music study to elementary (K–8) children.

MUE 560 Jazz Pedagogy. (3) S 2001

Study of pedagogy, repertoire, and technique of instruction in jazz styles, ensemble techniques, and performance practice for school ensembles. Lecture, lab, discussion, observation. Prerequisite: M.M., Music Education major.

MUE 562 Jazz Ensemble Rehearsal Techniques. (1) F, S

Conducting and rehearsal techniques for school jazz ensembles. Lab. Prerequisite: M.M., Music Education major.

MUE 564 Instrumental Music, Advanced Rehearsal Techniques.

(3) A

An in-depth analysis of instrumental techniques in preparation for a thorough discussion of band tuning problems and solutions. Discussion of productive conducting and rehearsal techniques for school music teachers.

MUE 566 Instrumental Literature for Schools. (3) A

Comprehensive study and analysis of all types of instrumental music.

MUE 568 Choral Music, Advanced Rehearsal Techniques. (3) A

Musical and vocal techniques necessary for presentation of choral literature. Analysis and experimentation with psychological, acoustical, and other problems of rehearsal and performance.

MUE 570 Choral Literature for Schools. (3) A

Comprehensive study and analysis of choral music for the high school with special emphasis on octavo literature.

MUE 579 Psychology of Music. (3) A

The nature of musicality and its evaluation. A review of recent research.

MUE 585 Vocal Acoustics and Production. (3) A

An in-depth approach to the psychological/physiological workings of the vocal mechanism.

MUE 733 Contemporary Issues and Research in Music Education. (3) A

Emphasis upon recent research relating to music instruction at all levels; current and historical issues in choral, general, and instrumental music.

MUE 744 Higher Education Instruction. (3) A

Philosophical and psychological principles of college/university teaching. Patterns of music teacher education and a projection of course outlines.

MUE 755 Philosophy and Aesthetics in Music Education. (3) SS

Philosophy and aesthetics as they influence curriculum content and teaching procedures.

Omnibus Graduate Courses: See page 51 for omnibus graduate courses that may be offered.

MUSIC PERFORMANCE (MUP)

MUP 507 Group Piano Practicum. (2) F

Curricula, materials, and teaching techniques for group teaching at the university and community college levels. Observation/supervised teaching in group piano.

MUP 508 Studio Observation. (1) F, S

Weekly observation of studio teaching by various piano faculty. Paper as final requirement. Prerequisite: M.M. performance/pedagogy piano student.

MUP 509 Jazz Keyboard Harmony. (1) F

Emphasis on jazz chords and chord progressions, harmonization, voicing, and analysis of transcriptions. Lab. Prerequisite: M.M., Music Education student.

MUP 510 Jazz Keyboard Harmony. (1) S

Continuation of MUP 509. Lab. Prerequisite: MUP 509.

MUP 511 Studio Instruction. (2) F, S

For majors in Music degree program. Bassoon, cello, clarinet, contrabass, cornet, euphonium, flute, guitar, harp, harpsichord, horn, oboe, organ, percussion, piano, saxophone, trombone, trumpet, tuba, viola, violin, voice. Minimum contact of 1 hour plus studio class weekly. May be repeated for credit. May not be taken for audit. Prerequisites: placement examination and audition.

MUP 517 Advanced Improvisation. (1) F

Improvisation techniques within the context of advanced jazz literature. Must be taken in sequence with MUP 518. Lab. Prerequisites: placement examination and audition.

MUP 518 Advanced Improvisation. (1) S

Continuation of MUP 517. Lab. Prerequisite: MUP 517.

MUP 521 Studio Instruction. (1) F, S, SS

For secondary or minor instrument instruction and nonmajors in the university. Bassoon, cello, clarinet, contrabass, cornet, euphonium, flute, guitar, harp, harpsichord, horn, oboe, organ, percussion, piano, saxophone, trombone, trumpet, tuba, viola, violin, voice. Minimum contact of 1/2 hour per week. May be repeated for credit. May not be taken for audit. Prerequisites: placement examination and audition.

MUP 527 Studio Instruction. (2 or 4) F, S

For Performance majors in Master of Music degree program only. Bassoon, cello, clarinet, contrabass, cornet, euphonium, flute, guitar, harp, harpsichord, horn, oboe, organ, percussion, piano, saxophone, trombone, trumpet, tuba, viola, violin, voice. Minimum contact of 1/2 hour per week. May be repeated for credit. May not be taken for audit. Prerequisites: placement examination and audition.

MUP 540 Advanced Conducting. (3) F

Score preparation and conducting techniques for instrumental music. Concentration on study of historical styles. Required of D.M.A. students in Instrumental Music.

MUP 541 The Art Song. (3) N

Seminar on solo song from its beginning to the present day.

MUP 544 Chamber Orchestra. (1) F, S

Important masterpieces from all periods of music will be performed throughout the year. May be repeated for credit. Prerequisite: instructor approval.

MUP 545 Symphony Orchestra. (1) F, S

Open on the basis of audition with the director. Masterpieces of symphony orchestra literature. Three times per week. May be repeated for credit.

MUP 546 Sinfonietta. (1) F, S

Symphonic orchestra that presents approximately six concerts annually, performing masterpieces of the classical repertoire. 3 times per week. May be repeated for credit. Prerequisite: audition with director.

MUP 550 Choral Union. (1) F, S

Open to all students in the university and to interested singers in the community by audition. Preparation and performance of the larger choral works. 2 hours per week. May be repeated for credit.

MUP 551 Repertoire. (2) N

Literature available for performance in all performing media. May be repeated for credit.

MUP 552 Concert Choir. (1) F, S

4 hours per week. May be repeated for credit. Prerequisite: instructor approval.

MUP 553 University Choir. (1) F, S

4 hours per week. May be repeated for credit. Prerequisite: instructor approval.

MUP 555 Men's Chorus. (1) F, S

Open to all male students in the university who can qualify on the basis of auditions. Rehearsal and performance of music for male voices. 3 hours per week. May be repeated for credit. Prerequisite: instructor approval.

MUP 557 Women's Chorus. (1) F, S

2 hours per week. May be repeated for credit. Prerequisite: instructor approval.

MUP 561 Marching and Concert Bands. (1) F, S

Open by audition only. Staging of formations and drills for football games and other events (fall); masterpieces of symphonic band literature (spring). Meets daily. May be repeated for credit.

MUP 570 Music Theatre: Techniques. (1) F, S

Exercises and improvisations for the singing actor emphasizing body awareness, isolations, and freedom of the vocal and breath mechanisms. Section 1 (Interpretation); Section 2 (Expression); Section 3 (Movement for Singers). Each Section: 3 hours per week. May be repeated for credit.

MUP 571 Music Theatre: Workshops. (1) F, S

Development of specific skills for the musical-dramatic interpretation. Section 1 (Role Preparation); Section 2 (Styles); Section 3 (Opera Scenes); Section 4 (Musical Comedy); Section 5 (Revue Ensembles). Each section: 1 hour lecture, demonstration, 1 lab per week. May be repeated for credit.

MUP 572 Music Theatre: Orchestras. (1) F, S

Open to all students who can qualify on the basis of auditions with the instructor. Participation in Lyric Opera Theatre productions. Section 1 (Orchestra); Section 2 (Chamber Orchestra); Section 3 (Chamber Ensemble). May be repeated for credit. Prerequisite: instructor approval.

MUP 573 Music Theatre: Performance. (1) F, S

Open to all students who can qualify on the basis of auditions with the instructor. Participation in Lyric Opera Theatre productions. Section 1 (Principal Roles); Section 2 (Chorus). May be repeated for credit. Prerequisite: instructor approval.

MUP 574 Music Theatre: Production. (1) F, S

Participation in Lyric Opera Theatre productions. Section 1 (Vocal Performance); Section 2 (Technical Music Theatre); Section 3 (Problems in Production) to be taken concurrently with MUP 373, Section 2. May be repeated for credit.

MUP 576 New Music Ensemble. (1) F, S

Rehearsal and performance of music written in the last 20 years. May be repeated for credit. Prerequisite: instructor approval.

MUP 577 Brass Choir. (1) F, S

Public performance of music written for brass instruments. 2 hours per week. May be repeated for credit. Prerequisite: instructor approval.

MUP 579 Chamber Music Ensembles. (1) F, S

String, brass, woodwind, percussion, keyboard, vocal, and mixed ensembles. 2 hours per week. May be repeated for credit. Prerequisite: instructor approval.

MUP 581 Performance Pedagogy and Materials. (2) N

Principles and methods of performance techniques for each performance field. May be repeated for credit.

MUP 582 Collegium Musicum. (1) F, S

Singers and instrumentalists specializing in the performance of early and unusual music. 2 hours per week. May be repeated for credit. Prerequisite: instructor approval.

MUP 585 Percussion Ensemble. (1) F, S

Rehearsal and performance of standard and original repertoire for the percussion ensemble and related instruments. 2 hours per week. May be repeated for credit. Prerequisite: instructor approval.

MUP 586 Stage Band. (1) F, S

Rehearsal and performance of literature for the stage band. 4 hours per week. May be repeated for credit. Prerequisite: instructor approval.

MUP 587 Ethnomusicology Ensembles. (1) F, S

Performance learning experience for the music of various cultures of the world. May be repeated for credit. Prerequisite: knowledge of instrument or instructor approval.

MUP 588 Piano Accompanying. (1) F, S

Performance majors with a concentration in piano accompanying (others at the discretion of the instructor). Piano accompaniments found in vocal and instrumental literature; discussion of styles and performance practices; experience in public performance. 2 hours per week. May be repeated for credit.

MUP 591 Seminar. (1–12) N**MUP 596 Solo Performance.** (1) F, S

For Master of Music candidates in applied music only. May be full recital, major operatic role, solo performance with orchestra, ensemble, or lecture recital.

MUP 597 Solo Performance. (1) F, S

See MUP 596.

MUP 671 Choral Repertoire. (3) N

Examination of large choral/orchestral works to determine their musical and textual characteristics from a conductor's point of view.

MUP 727 Studio Instruction. (2 or 4) F, S

For D.M.A. candidates only. Minimum contact of 1 hour per week. May be repeated for credit.

MUP 796 Solo Performance. (1–15) F, S

For D.M.A. candidates only. May be repeated for credit.

Omnibus Graduate Courses: See page 51 for omnibus graduate courses that may be offered.

Natural Science

MASTER OF NATURAL SCIENCE

The Master of Natural Science (M.N.S.) degree offers the opportunity for interdisciplinary graduate training in the natural sciences (biological sciences, mathematics, and physical sciences) and cognate areas. The degree program is especially suited for individuals who desire professional training rather than research training. Because of designed flexibility, the degree also offers the opportunity for individualized professional graduate programs depending upon the backgrounds and goals of the students. The major is Natural Science and the student is expected to emphasize course work in two or more areas of concentration. The program must be interdisciplinary. Additional information about this program can be found under the various majors in the natural sciences and by contacting faculty offering the following concentrations:

1. biology,
2. chemistry,
3. geology,
4. mathematics,
5. microbiology,
6. physics, and
7. plant biology.

Admission. See “Admission to the Graduate College,” page 89. A prerequisite for admission is the availability of resources for the proposed program and a faculty member in one of the departments to serve as graduate advisor. The submission of scores on the GRE (verbal, quantitative, and analytical) is required of all applicants.

Supervisory Committee. The supervisory committee, consisting of three faculty members, is appointed by the dean of the Graduate College upon the recommendation of the chair of the academic unit in which the graduate advisor serves as a faculty member. The supervisory committee is formed soon after the student has been admitted to the degree program. The graduate advisor and student suggest names of persons to serve on the supervisory committee. The composition of the supervisory committee must reflect the interdisciplinary nature of the program.

Program of Study. A program of study is recommended by the supervisory committee after conferring with the student. The minimum number of semester hours required for the degree is 30. An additional number of semester hours may be required by the supervisory committee depending upon the background of the student and the nature of the proposed program. In some cases undergraduate courses may be required in order to remove deficiencies.

Foreign Language Requirements. None.

Thesis Requirements. A thesis is optional.

Final Examinations. A final written or oral examination, or both, is required. Each examination is administered by the supervisory committee.

Nursing

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PROFESSORS

DURAND, KENNEY, PERRY, THURBER

ASSOCIATE PROFESSORS

ADAMS, BAGWELL, BRILLHART, DIRKSEN, GALE, ISMEURT, KILLEEN, KOMNENICH, MATTSON, MOORE, PRIMAS, ROOT, SHEEHY

ASSISTANT PROFESSORS

ALPERS, BOYCHUK, CESAROTTI, CLARKE-STEFFEN, GARRITY, LONG, McCARTHY, PICKENS, RODRIGUEZ, SEHESTED, SOUSA, ZUNKEL

CLINICAL ASSOCIATE PROFESSORS

BECK, BELL, FARGOTSTEIN, HAGLER, JASPER, KASTENBAUM, SCOGGIN, STILLWELL, WHITE

CLINICAL ASSISTANT PROFESSORS

P. JOHNSON, W. JOHNSON, MORRIS, SHEARMAN, WOTRING

INSTRUCTOR

ROSDAHL

The faculty in the College of Nursing offer a graduate program leading to the M.S. degree in Nursing. Concentrations are available in one of the following areas:

1. adult health nursing,
2. community health nursing,
3. community mental health/psychiatric nursing,
4. family health nursing,
5. nursing administration, and
6. parent-child nursing with the tracks of the childbearing family and nursing of children.

A post-master's Family Nurse Practitioner certificate program is available. The College of Nursing and the School of Health Administration and Policy also offer a concurrent M.H.S.A./M.S. in Nursing (with a concentration in nursing administration) degree program enabling students to pursue concurrent work in health services administration and nursing administration. For more information, see “Master of Health Services Administration,” page 212.

The purpose of the graduate program is to provide an academic environment that fosters scholarship, critical thinking, creativity, and prepares nurses for leadership as nurse specialists and beginning researchers. The graduate program offers advanced level courses that can be used as a base for doctoral study and for functional role development in teaching, management, or practice as a nurse practitioner.

The master's program is designed to prepare graduates to

1. synthesize advanced knowledge using concepts, theories, principles, and research from nursing, humanities, and sciences to develop advanced nursing practice knowledge which emphasizes the holistic approach;
2. demonstrate leadership, management, and teaching abilities in advanced nursing practice;
3. assume leadership, responsibility, and accountability for holistic therapeutic interventions within or across levels of care for diverse clients including individuals, families, groups, or communities;
4. participate in professional nursing organizations and political arenas;
5. participate in research and utilize research findings;
6. communicate scholarly ideas and professional knowledge to colleagues, other disciplines, and the public;
7. provide leadership in collaboration with clients and other health care professionals in the planning and delivery of holistic health care that is responsive to changing needs and societal trends;
8. examine critically the health of populations and related health care issues; and
9. demonstrate lifelong personal and professional learning.

Functional Areas. The curriculum also provides creative study in teaching, management, and clinical nurse practitioner role, including adult, pediatrics, women's health, psychiatric, and family. In addition, students may pursue special interests, such as health problems of selected groups, or unique aspects of the student's area of concentration.

MASTER OF SCIENCE

See "Master's Degrees," page 98, for general requirements.

Admission. See "Admission to the Graduate College," page 89.

Admission to graduate status in the College of Nursing is based upon meeting the following requirements:

1. junior or senior status or a cumulative GPA equal to 3.00 (4.00 = A);
2. a baccalaureate degree in nursing accredited by a nationally recognized accrediting agency;
3. current Arizona license to practice as a registered nurse and/or to enroll in some nursing practicum courses;
4. satisfactory completion of the Graduate Record Examination in the past five years with scores of 500 or higher in each of the three areas preferred;
5. one year of work experience in a relevant area of professional nursing (additional years may be required for nurse practitioner roles);
6. a descriptive statistics course in a college or university with a grade of "C" or higher, and an inferential statistics course with a grade of "B" or higher;
7. recommendations from three professional persons knowledgeable about the applicant's academic and nursing leadership potential;
8. an interview with a representative of the specialty area;
9. eligibility for admission to the Graduate College;
10. completion of the TOEFL with a score of 550 or higher and of all requirements for the Commission on Foreign Graduate Nursing Schools (CFGNS) if considered an international student; and
11. completion of a baccalaureate level health assessment course within the preceding five years for all nurse practitioner programs.

Applicants who reside and work, or plan to reside and work in rural or medically underserved areas are encouraged to apply for admission. Applications to the program are due February 1.

Supervisory Committee. The dean of the Graduate College, upon recommendation of the College of Nursing associate dean for Graduate Programs and Research, appoints the supervisory committee. The supervisory committee recommends the program of study, administers any special qualifying examinations, administers the final oral examination, and approves the thesis or the nonthesis option project.

Program of Study. The program of study for the M.S. degree consists of a minimum of 40 semester hours for the nursing administration and community health areas and 47–53 hours for nurse practitioner role specialty areas.

The program of study for the M.S. degree in Nursing requires the completion of a strong research component. This requirement can be accomplished by either of two pathways: (1) completion of the required research course and six hours of thesis or (2) completion of the nonthesis option that includes the required research course (three hours), the research utilization course (three hours), the applied project course (one hour), and a presentation of the completed requirements. The completed project and presentation are evaluated by the student's supervisory committee.

Foreign Language Requirements. None.

Degree Requirements. The student must successfully complete the following as defined by the supervisory committee and as approved by the dean of the Graduate College:

1. the program of study,
2. a comprehensive written examination as required,
3. a thesis and final oral examination in defense of the thesis *or* nonthesis option project.

RESEARCH ACTIVITY

The faculty and student research projects of the College of Nursing reflect a wide array of research interests. Studies have focused on the nursing profession, the nursing process, and the broad spectrum of health promotion, health maintenance, and developmental processes pertinent to nursing and health care.

Examples of faculty research include research in the area of minorities, such as studies on the utilization of health care by Latino mothers and their children; Latino and non-Latino caregivers of the elderly; African American women and cardiovascular disease; health care of Native Americans; and battering in pregnant Latino women. Additional research focuses on the special health needs of homeless children; care of the elderly, including home health care;

sociocultural influences on functional health in women; chronic illness in children and adults; family violence; various women's health issues; pediatric infectious diseases and family communication; children's temperament; biomedical ethics, clinical decision making, and community health nursing.

NURSING (NUR)

NUR 500 Research Methods. (3) F, S

Research methods including research conceptualization and design in nursing. Prerequisite: graduate-level inferential statistics course.

NUR 501 Advanced Adult Health Assessment/Promotion. (3) F

Designed to expand adult health assessment/promotion skills through knowledge/strategies essential for developing and interpreting data. Lecture, demonstration. Prerequisites: college core courses except thesis/project; undergraduate health assessment course. Corequisite: NUR 580.

NUR 502 Management and Maintenance of Adults with Chronic Health Alterations: Theory. (3) S

Includes theory/research that guides the management/maintenance of adults with chronic health alterations. Psychophysiological interrelationships of illnesses emphasized. Lecture, seminar. Prerequisites: NUR 501, 580; admission to the graduate Nursing program; all flexible core courses except thesis/project.

NUR 503 Management and Maintenance of Adults with Acute Health Alterations: Theory. (3) S

Emphasizes theoretical research foundations essential for advanced practice involving care of adults with acute episodic alterations in health. Lecture, seminar. Prerequisite: NUR 501. Pre- or corequisite: NUR 580.

NUR 512 Community Health Nursing: Advanced Theory I. (3) F

Students identify and analyze theoretical perspectives and models guiding advanced community health nursing practice. Lecture, seminar. Prerequisite: all graduate program core courses. Corequisite: NUR 580.

NUR 513 Community Health Nursing: Advanced Theory II. (3) S

Drawing from their internship, students critically examine the application of theory to advanced community health nursing/public health practice. Lecture, seminar. Prerequisite: NUR 512. Corequisite: NUR 580.

NUR 521 Community Mental Health/Psychiatric Nursing: Advanced Mental Health Assessment. (3) F

Students gain knowledge of theories related to holistic health assessment for the promotion of physical/psychological health and develop skill in mental health assessments. Lecture, seminar, lab. Prerequisite: all graduate program core courses.

NUR 522 Community Mental Health/Psychiatric Nursing: Advanced Theory I. (3) F

Analysis of issues, theories, and research in restoration and promotion of mental health. Emphasizes developing conceptual framework for psychiatric nursing. Prerequisite: NUR 521. Corequisite: NUR 580.

NUR 523 Community Mental Health/Psychiatric Nursing: Advanced Theory II. (3) S

Focus of this course is development of theoretical basis for intervention and a knowledge base for collaboration and consultation in the mental health area. Prerequisite: NUR 522. Corequisite: NUR 580.

NUR 524 Psychoneuroimmunology Approaches to Practice. (3) SS

Overview of theories, concepts, and research in psychoneuroimmunology including physiological aspects and application to a holistic nursing model. Seminar. Prerequisite: graduate standing.

NUR 531 Nursing of Children: Theory I. (3) F

Focus on current practices, research, and issues related to health promotion and disease prevention for children and adolescents. Lecture, seminar. Prerequisite: all core and flexible courses except thesis and/or applied project. Corequisite: NUR 580.

NUR 532 Nursing of Children: Theory II. (3) S

Focus on concepts, theories, and research as basis for strategies related to management of illness and health maintenance for children. Lecture, seminar. Prerequisite: NUR 531. Corequisite: NUR 580.

NUR 533 Nursing of Children with Special Needs: Theory II. (3) S

Focus on concepts, theories, and research related to acute and chronic health deviations of children. Lecture, seminar. Prerequisite: NUR 531 or instructor approval. Corequisite: NUR 580.

NUR 534 Women's Health: Theory I. (4) F

Focuses on theories, principles, and research related to managing the health of normal perinatal women and families. Cooperative learning strategies. Prerequisite: all graduate program core courses. Corequisite: NUR 580.

NUR 535 Women's Health: Theory II. (4) S

Focuses on management of nursing care for high-risk perinatal women and women with common health problems. Cooperative learning strategies. Prerequisite: NUR 534. Corequisite: NUR 580.

NUR 542 Nursing Administration Theory I. (1–3) F

Critical analysis of leadership theories, organizational dynamics, and nursing administration processes. Seminar, case study. Prerequisite: all graduate program core courses.

NUR 544 Nursing Administration Theory II. (1–3) S

Synthesis of knowledge from previous courses to develop advanced nursing role. Analysis of resource and quality management and informatics. Lecture, seminar. Prerequisite: NUR 542.

NUR 551 Theoretical Foundations of Advanced Practice Nursing. (3) F, S

Designed to facilitate student exploration and examination of the foundations of advanced nursing practice. Lecture, seminar. Prerequisite: enrollment in graduate Nursing program.

NUR 552 Health Care Issues and Systems. (3) F, S

Analysis of organization, financing, service delivery and outcomes of the health system. Emphasizes policy issues, roles, and challenges for nurses. Lecture, seminar.

NUR 553 Life Span Development. (3) F

Critical examination of concepts, theories, issues, and research related to developmental periods throughout the life span. Biological and health, cognitive, psychological, and sociocultural influences are analyzed. Lecture, discussion. Prerequisite: admission to the graduate Nursing program or instructor approval.

NUR 554 Population-Based Health Care. (3) F, S

Identification and assessment of specific community health needs and health care patterns of target populations. Promotion, protection, and improvement of health is addressed when planning health care services. Lecture, seminar. Prerequisite: admission to the graduate Nursing program or instructor approval.

NUR 558 Advanced Pediatric Health Assessment. (2) S

Expansion of basic health assessment skills and development of clinical problem-solving skills for advanced practice nurses. Assessments of infants, children, and adolescents included. Lecture, lab. Prerequisites: admission to the graduate Nursing program; undergraduate health assessment within the last five years.

NUR 559 Advanced Health Assessment. (3) S

Expansion of basic health assessment skills and development of clinical problem-solving skills for advanced practice nurses. Assessments of infants, children, adolescents, and adults included. Lecture, lab. Prerequisites: admission to the graduate Nursing program; undergraduate health assessment within the last five years.

NUR 561 Advanced Practice Nursing Role. (2) SS

Focuses on the examination and implementation of the role of the advanced practice nurse, emphasizing major components and sub-components of the role. Lecture, seminar. Prerequisite: admission to the graduate Nursing program or instructor approval.

NUR 562 Family Nurse Practitioner Theory I: Health Promotion, Management, and Maintenance. (4) F

First didactic role specialty course. Focus on concepts and strategies to promote, manage, and maintain health of child, adult, and family. Corequisite: NUR 580.

NUR 563 Family Nurse Practitioner Theory II: Health Promotion, Management, and Maintenance. (4) S

Second didactic role specialty course utilizing knowledge from previous courses to formulate therapeutic promotion, management, and maintenance for individuals across the life span. Corequisite: NUR 580.

NUR 564 Applied Pharmacotherapeutics for Advanced Practice. (3) S

Lifespan course for advanced nurse practitioners to expand knowledge of pharmacotherapeutic concepts and principles. Lecture, discussion, case studies. Prerequisite: admission to the graduate Nursing program.

NUR 565 Applied Physiology/Pathophysiology in Advanced Practice. (3) S

Advanced nurse practitioner course designed to expand previously acquired anatomy and physiology knowledge and discern pathological alterations across the lifespan. Lecture, seminar, case studies. Prerequisites: admission to the graduate Nursing program or instructor approval; undergraduate anatomy and physiology.

NUR 566 Pediatric Physiology/Pathophysiology. (3) S

Analysis of the patterns of heredity, cellular differentiation, and the development of systems in the infant to adolescent. Prerequisite: admission to the graduate Nursing program or instructor approval.

NUR 571 Teaching in Nursing Programs. (3) N

Analysis of theories, issues, and research related to teaching in nursing. Focus on the process of teaching/learning. Seminar, cooperative learning. Prerequisite: graduate standing. Corequisite: teaching practicum.

NUR 578 Gestalt Therapy I. (3) F

An introduction to theory and methodology of Gestalt therapy and its uses for mental health promotion and restoration.

NUR 579 Gestalt Therapy II. (3) S

Focus is on further development of Gestalt therapy and its application in working with various client populations. Prerequisite: NUR 578.

NUR 580 Practicum (Electives). (1–4) N

Clinical application of theories, concepts, and principles such as health promotion, health management, health maintenance, teaching, management, and special clinical studies.

NUR 580 Advanced Nursing Practicum I, II. (2–6) F, S

Clinical application of theories, concepts, and principles. The areas of concentration include the following:

- (a) Adult Health Nursing
- (b) Community Health Nursing
- (c) Community Mental Health/Psychiatric Nursing
- (d) Family Health Nursing
- (e) Nursing Administration
- (f) Parent-Child Nursing with the Tracks of the Childbearing Family and Nursing of Children

Conferences. Prerequisites: admission to the graduate Nursing program; instructor approval. Corequisite: NUR 501 or 502 or 503 or 512 or 513 or 522 or 523 or 531 or 532 or 533 or 534 or 535 or 562 or 563 or 584.

NUR 582 Advanced Human Physiology. (3) F

Analyzes major theories and concepts of human physiology. Interrelationship of physiology and health is explored.

NUR 584 Community Health Nursing Internship. (3) S

Students operationalize community health nursing/public health content in leadership roles in a variety of community agencies. Clinical internship. Prerequisites: NUR 512, 580. Corequisite: NUR 513.

NUR 585 Stress Reduction. (3) N

Theory, application, and evaluation of mind/body relaxation methods, including physiological effects. Research findings emphasized. Daily student practice. Prerequisite: graduate standing or instructor approval.

NUR 586 Advanced Pathophysiology. (3) S

Manifestation of altered human physiology and disease. Systems theory is used to analyze the relationships of disease and physiology.

NUR 589 Research Utilization. (3) F, S

Emphasis on the synthesis and application of research to an identified clinical nursing problem. Prerequisite: NUR 500. Corequisite: NUR 593.

NUR 591 Seminar. (2–4) N

Advanced topics, including curriculum development and health promotion. Prerequisite: instructor approval in selected courses.

NUR 593 Applied Project. (1) F, S

Preparation of a supervised applied project that is a graduation requirement in some professional majors. Corequisite: NUR 589. Completion of NUR 551 is recommended.

NUR 598 ST: Special Topics. (2–4) N

Special study, including issues in health care and organizations, management in nursing, ethical issues, and clinical nurse specialist role. Prerequisite: instructor approval in selected courses.

NUR 599 Thesis. (1–6) F, S, SS

Research proposal development, data collection and analysis, thesis writing, and thesis oral defense. Six hours required.

Omnibus Graduate Courses: See page 51 for omnibus graduate courses that may be offered.

Performance

See “Music,” page 251.

Philosophy

Brad Arment

Chair

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REGENTS' PROFESSOR

MURPHY

PROFESSORS

CREATH, FITCH, HUMPHREY, MAIENSCHIN, WHITE

ASSOCIATE PROFESSORS

ARMENDT, BLACKSON, COHEN, de MARNEFFE,
GULESERIAN, KOBES, MCGREGOR, REYNOLDS

ASSISTANT PROFESSOR

DEVLIN

The faculty in the Department of Philosophy offer a graduate program leading to the M.A. or Ph.D. degree in Philosophy. For the specific requirements of the Ph.D., contact the department.

MASTER OF ARTS

See “Master’s Degrees,” page 98, for general requirements.

Prerequisites. At least 15 semester hours of upper-division course work in philosophy, including history of philosophy, epistemology, metaphysics and the equivalent of PHI 333 Introduction to Symbolic Logic are required. No course credits in which a grade of less than “B” has been earned may count toward meeting this 15-semester-hour requirement. Persons otherwise qualified for admission but lacking the above prerequisites may make up this deficiency by enrolling as a nondegree graduate student and taking those philosophy courses necessary to complete the prerequisite. If some or most of the prerequisites have already been met, the student may be admitted into the program under “provisional status” or under “regular status with deficiencies.” All applicants for admission to the program must submit scores for the general section of the Graduate Record Examination.

Program of Study. The M.A. degree program in Philosophy is designed to prepare students either to teach philosophy at the community college level, to enter doctoral programs in philosophy at other institutions, or to be employed in any areas that require critical, analytical thinking (such as medicine, law, government, or publishing). The program seeks to maintain a balance between a breadth of course offerings in the traditional areas of philosophy—metaphysics

ics, ethics, epistemology, logic, and history of philosophy—and opportunities for study in current philosophical developments, such as the philosophy of science, philosophy of language, and philosophical psychology. The program of study includes at least 30 semester hours of approved graduate-level courses, not including PHI 599 Thesis. An additional six hours of PHI 599 Thesis is required. The details of each student's program are worked out with the director of graduate studies.

Course Requirements. Each student is required to take an approved graduate-level course of three semester hours or more in each of the following areas and to obtain at least a “B” in each course: metaphysics/epistemology, value theory and logic; and any two of the following: history of early philosophy, history of modern philosophy, and history of contemporary philosophy.

Foreign Language Requirements. None.

Thesis Requirements. A thesis is required. This written work must demonstrate the ability to carry out independent research in philosophy.

Final Examinations. A final oral examination in defense of the thesis is required.

RESEARCH ACTIVITY

The department offers a solid program in traditional and contemporary philosophy. Areas of recent and current faculty research include the following: belief ascription, the nature of singular propositions, time and time travel, modality and belief, philosophical problems of cognitive psychology, reference and attribution, God and modality, God and evil, divine freedom, theories of punishment and criminal law, freedom and coercion, mercy and legal justice, evolution and morality, Kantian autonomy, liberalism, social justice and basic rights, growth and character of experimentation, the rise of American biology, the roles of research traditions and working hypotheses in science, the character of theoretical entities, observation and justification, coherence theories of knowledge, foundational theories of knowledge, theories of rational choice, knowledge of oneself, the riddles of induction, skepticism, analyticity, the notion of following rules, Plato, Aristotle, ancient theories of freedom and determination, critical theory, 19th-century idealism, actualism, causality, space, time and continuity, Kant, Carnap, Quine, and Rawls.

A selection of books and forthcoming books of the faculty include the following: *Perception, Reason, and Knowledge* (editor); *Fundamentals of Logic* (co-author); *Introduction to Symbolic Logic*; *Dear Carnap, Dear Van: The Quine-Carnap Correspondence and Related Work* (editor); *Analyticity: The Carnap-Quine Debate*; *Naming and Believing*; *Welches sind die wirklichen Fortschritte, die die Metaphysik seit Leibnizens und Wolf's Zeiten in Deutschland gemacht hat?* (translator, editor); *Perpetual Peace and Other Essays* (translator); *Transforming Traditions in American Biology, 1880–1915*; *Defining Biology: Lectures From the 1890's* (editor); *The Coming of Age of American Biology*; *The Emergence of Biology in America* (co-editor); *Kant: The Philosophy of Right*; *Retribution, Justice and Therapy: Essays in the Philosophy of Law*; *Evolution, Morality and the Meaning of Life*; *The Philosophy of Law: An Introduction to Jurisprudence* (co-author); *Agency and*

Integrity: Philosophical Themes in the Ancient Discussions of Determinism and Responsibility; *Retribution Reconsidered*; *The Continuous and the Discrete: Ancient Physical Theories from a Contemporary Perspective*; *Inquiry, Forms, and Substances: A Study in Plato's Metaphysics and Epistemology*; *Partisan or Neutral? The Futility of Public Political Theory*.

The department has also developed interdisciplinary programs linking philosophy with other disciplines, e.g., philosophy of law and history and philosophy of science and technology.

PHILOSOPHY (PHI)

PHI 401 Rationalism. (3) N

Examination of classical philosophical rationalism, as in Descartes, Spinoza, Malebranche, or Leibniz. Contemporary rationalist thought may also be examined. Prerequisites: PHI 302; 1 course from among PHI 305, 309, 312, 316, 317.

PHI 402 Empiricism. (3) N

Examination of representatives of either classical or contemporary philosophical empiricism, e.g., Bacon, Hobbes, Locke, Butler, Berkeley, Reid, Hume, Mill, Carnap, and Ayer. Prerequisites: PHI 302 and 305 (or 309 or 312 or 316 or 317). *General Studies: HU*.

PHI 403 Contemporary Analytic Philosophy. (3) A

Aims and methods of such 20th-century philosophers as Frege, Moore, Russell, Wittgenstein, Carnap, Ayer, Wisdom, Ryle, Austin, Strawson, Quine, and Sellars, with application to metaphysics and epistemology. Prerequisites: PHI 302; 1 course from among PHI 312, 314, 315, 316, 317, 401, 402. *General Studies: HU*.

PHI 413 Advanced Symbolic Logic. (3) N

Properties of formal systems axiomatizing propositional and 1st-order predicate logic. May also include modal logic, number theory, and limits of logicism. Prerequisite: PHI 333.

PHI 420 Topics in Philosophy. (3) A

Course descriptions on file in department. Topics may be selected from the following:

- History of Philosophy
- Metaphysics/Epistemology
- Philosophy of Language/Logic
- Philosophy of Science
- Value Theory

Courses may be repeated for credit. Prerequisite: one relevant upper-division PHI course or instructor approval.

PHI 591 Seminar. (1–3) A

Topics may be selected from the following:

- Aesthetics
- Epistemology
- Ethics
- History of Philosophy
- Logic
- Metaphysics
- Philosophy of Language
- Philosophy of Law
- Philosophy of Science
- Social and Political Philosophy

Omnibus Graduate Courses: See page 51 for omnibus graduate courses that may be offered.

Physical Education

MASTER OF PHYSICAL EDUCATION

The faculty in the Department of Exercise Science and Physical Education offer a program leading to the Master of Physical Education (M.P.E.) degree. The M.P.E. degree is designed to prepare scholarly professionals (i.e., teachers of physical education). Emphasis is placed on improving

instructional effectiveness and developing a quality physical education curriculum in a school setting. Three areas of study are available: elementary, secondary, and adapted physical education.

Admission. Applicants who hold a bachelor's degree in education and who are certified to teach may apply to the M.P.E. degree directly. Applicants with a bachelor's degree in physical education but who are not certified to teach will apply to the postbaccalaureate/M.P.E. degree. Deficiencies will be assessed where applicable.

Program of Study. A minimum of 33 semester hours of course work is required for the M.P.E. program, with 18 hours of required core courses, six hours of cognate area, and nine hours of recommended electives. A total of 58 semester hours is required of students completing both the postbaccalaureate program and the M.P.E.

Foreign Language Requirements. None.

Final Examinations. A final written comprehensive examination is required.

Physics

Howard G. Voss
Chair

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REGENTS' PROFESSOR SPENCE

PROFESSORS

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MENÉNDEZ, NIGAM, PAGE, REZ, RITCHIE, SANKEY,
SCHEINFELD, SCHMIDT, SMITH, STARRFIELD, TILLERY,
TSEN, TSONG, VENABLES, VOSS,
WINDHORST, WYCKOFF

ASSOCIATE PROFESSORS

AANNSTAD, ACHARYA, ALARCON, BENIN,
CHAMBERLIN, CULBERTSON, HERBOTS,
HESTER, MARZKE

The faculty in the Department of Physics and Astronomy offer graduate programs leading to the M.S. and Ph.D. degrees in Physics. In the M.S. program, options are available in physics, physics with an emphasis in astronomy, interdisciplinary physics, technical physics, or physics teaching. In the Ph.D. program, options are available in physics, physics with an emphasis in astronomy, or applied physics.

Students enrolled in the Ph.D. degree program may be awarded an M.S. degree in passing.

The faculty in the Department of Physics and Astronomy also participate in the program leading to the Master of Natural Science degree (see "Master of Natural Science,"

page 257) when one of the concentrations is physics, and in the interdisciplinary program leading to the Ph.D. degree in the Science and Engineering of Materials (see "Science and Engineering of Materials," page 281).

Students admitted to the Master of Education degree program with a major in Secondary Education may elect physics or science education as the subject matter field. A Doctor of Education degree program option is also available. The M.Ed. (see "Master of Education," page 174) and Ed.D. (see "Doctor of Education," page 175) are offered and administered through the College of Education.

The master's and doctoral programs are designed to prepare students for professional research careers in governmental, industrial, or academic institutions and for teaching at the university, college, or secondary school levels.

An evaluation of the progress of all graduate students is made during the spring semester by the Graduate Program Committee. Students whose progress is considered to be unsatisfactory are placed on probation. Failure to maintain a GPA of 3.00 in courses taken while enrolled as a graduate student, exclusive of research, thesis, and dissertation, is an indication of unsatisfactory progress and may result in dismissal from the program.

Courses can include up to six hours of 400-level courses (see "Graduate Credit Courses," page 94). Timely attempts at examination are also required.

Teaching experience in undergraduate physics and astronomy laboratories and recitations is valuable training for graduate students and is considered part of the graduate program.

Departmental colloquia are an integral part of the graduate program. Regular attendance at colloquia is expected of all graduate students intending to earn graduate degrees.

MASTER OF SCIENCE

See "Master's Degrees," page 98, for general requirements.

Admission. To be admitted without deficiencies, entering graduate students should have adequate undergraduate preparation equivalent to an undergraduate major of 30 semester hours in physics and 20 semester hours in mathematics. Courses in analytic mechanics, electromagnetism, and modern physics, including quantum mechanics, are particularly important. Students applying for admission must submit scores for the verbal, quantitative, and analytical sections of the Graduate Record Examination (GRE).

Applicants for financial support must submit a score on the physics advanced examination of the GRE. Subsequent financial support in the form of teaching or research assistantships is contingent upon satisfactory performance in course work, timely completion of the final examination for the M.S. degree as described below, and need and availability of such support. Students on probation are offered financial support only under exceptional circumstances.

Program of Study. The faculty in the Department of Physics and Astronomy offer the M.S. degree under two options: Track I—emphasizing physics, and Track II—emphasizing one of the following related fields:

1. astronomy and astrophysics,
2. interdisciplinary physics (e.g., with chemistry),
3. technical physics, or

4. physics teaching.

A supervisory committee is formed for each student, usually during the first year of study. In each case an appropriate program of study is selected with the approval of the supervisory committee. A research project resulting in a thesis is required of all students enrolled in the M.S. program.

Track I

Physics. An individual program of study, including courses in physics, astronomy, mathematics, or related subjects, is selected with the approval of the supervisory committee to make up a coherent program of graduate study. The courses and research project are to be conducted primarily within the Department of Physics and Astronomy.

Track II

Astronomy and Astrophysics. The AST graduate courses are taken plus the required graduate physics courses for the Track II M.S. program. The research project must be in the area of astronomy and astrophysics, conducted under the supervision of one or more faculty members of the Department of Physics and Astronomy who specialize in this subject.

Interdisciplinary Physics. The courses taken are approximately half in physics and half in some other subject area. The research project must be in an interdisciplinary area and conducted under the joint supervision of one faculty member from the Department of Physics and Astronomy and one faculty member from another department.

Technical Physics. The research project involves active collaboration with some industrial or government laboratory under the supervision of a faculty member from the Department of Physics and Astronomy and may be conducted either in the Department of Physics and Astronomy or in the outside laboratory. At least half the courses taken must be in physics.

Physics Teaching. The course of study and research are designed to prepare for a career in physics teaching, with appropriate modifications for teaching at the high school or community college level. At least half the courses taken must be in physics. Students participate in directed, evaluated teaching experiences.

Foreign Language Requirements. None.

Thesis Requirements. A thesis is required of all students obtaining the M.S. degree. Every student must obtain at least six semester hours in PHY 592 or PHY 599. However, no more than nine semester hours in these courses can be counted toward the 30 semester hours required for the M.S. degree.

Final Examinations. The final examination for the M.S. degree is an oral examination on the subject of the student's thesis and on graduate course work taken.

DOCTOR OF PHILOSOPHY

See "Doctor of Philosophy," page 101, for general requirements.

Admission. This program is designed for students of high ability who show promise for independent research. An applicant holding a baccalaureate degree should have the same undergraduate preparation as for admission to the

master's program. An applicant presenting acceptable graduate credit, earned at this or another institution must demonstrate mastery of this material on the "Written Comprehensive Examination," and the "Oral Comprehensive Examination," page 264.

Students applying for admission must submit scores for the verbal, quantitative, and analytical sections of the GRE.

Applicants for financial support must submit a score on the physics advanced examination of the GRE. Subsequent financial support in the form of teaching or research assistantships is contingent upon satisfactory performance in course work, timely completion of examinations, including the written and oral Ph.D. comprehensive examinations as described below, and need and availability of such support. Students on probation are offered support only under exceptional circumstances. The period for which a Ph.D. candidate may receive financial support through the Department of Physics and Astronomy will not normally exceed six years.

Program of Study. In order to accommodate the needs for training in preparation for the wide variety of occupations of professional physicists and astrophysicists, in areas ranging from academic faculty to industrial research to administrative positions, doctoral degree programs are offered under two tracks: physics (Track I) and astrophysics, applied physics, or interdisciplinary physics (Track II). The goal is to provide, through course work and independent study, competence at advanced levels in fundamental, applied and interdisciplinary branches of physics and astronomy, and demonstrated ability in independent research.

Students enrolled in the Ph.D. program may obtain an "M.S. degree in passing" by satisfactorily filing and completing an M.S. Program of Study, obtaining a GPA of at least 3.00 in a set of core courses which total 24 semester hours, and passing a written comprehensive examination. The core courses shall be those designated for one of the tracks in the Ph.D. program. Graduate core courses satisfactorily completed at other institutions may be waived upon petition by the Graduate Program Committee. Up to nine semester hours of classroom-based courses may be substituted for core courses that are waived by the Graduate Program Committee.

Each student's progress is overseen by a supervisory committee appointed for the student usually during the first year of study. This committee also approves the student's program of study.

Track I

Physics. The student's individual program includes courses selected, with the approval of the supervisory committee, to make up a coherent program for the achievement of these goals. The program may be directed toward either theoretical or experimental aspects, and frequently includes courses in cognate fields, particularly mathematics, depending on the student's selected field.

Track II

Applied Physics. Under advisement by the supervisory committee, a program of study is selected with a major portion in physics and a minor portion (nine semester hours or more to be passed with at least a "B" average) in another area. The supervisory committee should include appropriate representation from the minor area.

Astronomy and Astrophysics. The following six AST 598 graduate courses are required for all students enrolled in the astronomy and astrophysics graduate program:

AST I	Interstellar Medium and Gaseous Astrophysics
AST II	Galactic Structure
AST III	Stellar Interiors and Stellar Evolution
AST IV	Extragalactic Astronomy
AST V	Astronomical Data Taking and Data Reduction
AST VI	Cosmology and High-Energy Astrophysics

Course Requirements. The following basic core of courses, or their equivalents, is required of both Track I and Track II students:

PHY 501	Methods of Theoretical Physics	3
PHY 521	Classical Mechanics	3
PHY 531	Advanced Electricity and Magnetism	3
PHY 541	Statistical Physics	3
Total		12

In addition, the following courses are required of all Track I students:

PHY 502	Methods of Theoretical Physics	3
PHY 532	Electrodynamics	3
PHY 576	Quantum Theory	3
PHY 577	Quantum Theory	3
Total		12

Additional course work in both tracks is selected with the advisement and approval of the supervisory committee.

Foreign Language Requirements. None.

Comprehensive Examinations. The following examinations are required of all students intending to earn the Ph.D. degree.

Master of Science Degree in Passing. Students enrolled in the Ph.D. degree may be awarded an M.S. degree in passing.

Written Comprehensive Examination

Track I. The subject matter of this examination is classical and quantum mechanics, statistical mechanics, and electricity and magnetism, as represented by the courses PHY 521, 531, 532, 541, 576, and 577. The examination is given in two four-hour sessions on separate days, but there is no division of subject matter for the separate sessions.

Track II. This examination consists of parts A and B.

Part A emphasizes quantum mechanics, classical mechanics, and electricity and magnetism, as represented by the courses PHY 416, 521, and 531, and is written in a four-hour examination period.

For all Track II students except astronomy and astrophysics students, Part B is a written examination prepared by the student's supervisory committee and approved by the graduate examination committee. The Part B Track II examination for astronomy and astrophysics students is prepared by the astrophysics subcommittee of the graduate examination committee, and is based mostly on the course material presented in the AST courses. Part B of the Track II exam is given within three days after the Part A exam. The Part B exam for astronomy and astrophysics students is graded by the astrophysics faculty; Part B for all other Track II students is graded by their supervisory committee, under the supervision of the graduate examination committee.

The written comprehensive examination is normally given twice yearly, approximately during registration weeks of the fall and spring semesters. Ph.D. candidates must attempt the examination before the beginning of their fifth semester as full-time students in the physics graduate program and must pass the examination before the beginning of the sixth semester.

Oral Comprehensive Examination

Ph.D. candidates are required to pass the oral comprehensive examination by the end of their sixth semester as full-time students in the physics graduate program. The examination is administered and graded by the student's supervisory committee. It tests the student's general knowledge of one of the following four broad areas of current activity in physics:

1. astronomy and astrophysics,
2. atomic and molecular physics,
3. nuclear and particle physics, and
4. solid-state and many-body physics.

The area tested is to be chosen by the student at the time of scheduling of the examination. The student may request to be examined on specific subjects in addition to one of the above areas. In all cases, a student's specific dissertation topic, should it exist at the time of the examination, is to be excluded from the material covered by the examination.

Dissertation Requirements. A dissertation representing an original contribution to the field, as a result of independent work suitable for publication in a refereed physics or astronomy journal, is required.

Final Examinations. A final oral examination that covers, but is not necessarily limited to, the subject of the dissertation is required.

RESEARCH ACTIVITY

The Department of Physics and Astronomy is engaged in a large number and a broad spectrum of research activities. The following is a list of current and recent research interests of the faculty.

Applied Physics. Mechanisms of inelastic effects of particle-solid interactions; surface characterization and depth-profiling by secondary ion mass spectrometry and sputter-induced photon spectroscopy; surface structure determination by low-energy ion-scattering spectrometry; and scanning tunneling microscopy.

Astronomy and Astrophysics. Comets, hydrodynamic studies of compact stellar objects and of novae outbursts; ultraviolet observations of novae in eruption; stellar atmosphere studies of supernovae, novae, and cool stars; pulsating white dwarfs and hot, evolved stars; studies of the interstellar medium, ionized regions and dust in our galaxy; normal galaxies; 21 cm HI studies of galaxies; stellar populations; dynamics and kinematics of galaxies; classification of spiral galaxies; clusters of galaxies; galaxy formation and evolution; distribution of matter in space; quasars and active galaxies.

Experimental Condensed Matter Physics. Lattice dynamics of crystals near the covalent-ionic boundary; superionic conductors; optical studies at very high pressures; NMR and related magnetic measurements in small particles and metal

ammonia compounds; resonance Raman spectroscopic studies of electron-phonon interactions and Raman and Brillouin scattering studies of phonon-phonon interactions; picosecond and frequency domain Raman studies of semiconductors; dielectric measurements of various polymer systems; scattering by transverse waves in polymers; tandem interferometer studies of polymer dynamics; EXAFS studies of local environments in solids; magnetic and structural properties of compositionally layered materials; magnetic properties of metallic thin films; organic low-dimensional conductors; and spin glasses.

Theoretical Condensed Matter Physics. Resonance Raman scattering; development of techniques for photoacoustic measurement of the photophysical properties of biological molecules; electronic structure of solids; band gap levels in semiconductors due to defects and surfaces; dynamics and transport properties of perfect and imperfect crystals; electron-phonon interaction, phonons in superfluid He; and ab initio calculations of the structural and electronic properties of semiconductor surfaces.

Diffraction Physics. Development of techniques and the theoretical basis for electron microscopy and electron diffraction; the design and construction of electron optical instruments and attachments; determination of the structures of crystals and of their defects and disorder by the scattering of electrons and the generation of secondary radiation using ultra high-resolution microscopy; scanning transmission electron microscopy; microdiffraction, and micro-analysis; the structure and reactions of solid surfaces studied by high resolution imaging, diffraction, and spectroscopies; channeling phenomena and their application in the analysis of crystals; the electronic states of surfaces and defects in solids; scanning Auger spectroscopy; growth of overlayers on surfaces.

Theoretical High Energy and Particle Physics. Dispersion relation phenomenology; pion-nucleon scattering and associated reactions; current algebra; models of chiral symmetry breaking; electromagnetic interactions of hadrons; gauge field theories; and unified gauge field theories.

Experimental Nuclear Physics. Meson physics, including pion-induced reactions (such as pion-nucleon and pion-nucleus scattering, charge exchange, and absorption), pion decay and meson photoproduction; proton-nucleus scattering and reactions at medium energies; polarization measurements, including observables for polarized targets; electron scattering and electro-nuclear reactions in few-body systems; studies of nucleon resonances with real and virtual photons; studies of subnuclear degrees of freedom.

Theoretical Nuclear Physics. Charge exchange reactions of pions with light nuclei; three-body problems; kaonic and antiprotonic atoms; electron-nucleus interactions; and nuclear form factors.

Science Education. Theoretical and experimental work related to the development of advanced logical and analogical reasoning, and problem solving heuristics and concepts through science instruction; attitudes towards science; role of peer interaction; evaluation of preservice and in-service teacher education programs; role of cultural influences.

Theoretical Physics. Local observables in quantum theory; electron theory; and applications of the WKB method.

PHYSICS (PHY)

PHY 412 Classical Particles, Fields, and Matter III. (3) F

Electromagnetic fields of moving charges, Maxwell's equations, harmonic phenomena, oscillations, waves, electromagnetic radiation, covariant electromagnetism, introduction to general relativity. Prerequisites: PHY 311, 333. Corequisite: PHY 416 or instructor approval.

PHY 416 Quantum Physics III. (3) F

Introduction to the quantum theory of atoms, molecules, solids and nuclei, Dirac's equation. Prerequisites: PHY 311, 315. Corequisite: PHY 412 or instructor approval.

PHY 420 Research Paper. (1) F, S

Scientific report writing. Culminates in a paper based on library or laboratory research or both. Taken in conjunction with other courses as approved. Conference. Prerequisite: instructor approval. *General Studies: L2.*

PHY 441 Statistical and Thermal Physics I. (3) F

Statistical and experimental basis of heat, temperature, and entropy. Mechanical and statistical basis of the laws of thermodynamics. Applications of macroscopic thermodynamics. Phase equilibrium. Prerequisites: PHY 311, 315.

PHY 442 Statistical and Thermal Physics II. (3) S

Principles and applications of statistical mechanics. Quantum statistics of ideal gases and simple solids. Equilibrium of phases and chemical species. Transport theory. Irreversible processes and fluctuation. Prerequisite: PHY 441.

PHY 452 Physical Optics. (3) F

Principles of reflection, refraction, diffraction. Additional topics from contemporary optics may include Fourier transform spectroscopy, linear systems theory, holography. 2 hours lecture, 2 hours lab. Prerequisites: PHY 302, 311, 315. Corequisite: PHY 412.

PHY 462 Nuclear and Particle Physics. (3) S

Static properties of nuclei, natural and induced radioactivity, nuclear reactions, nuclear models and energy levels, mesons and hyperons, and interaction of photons and electrons with matter. Prerequisites: PHY 311, 315.

PHY 465 Advanced Laboratory II. (2) F, S

Continuation of PHY 334. Students are encouraged to substitute laboratory research project in consultation with faculty sponsor. Prerequisite: PHY 334.

PHY 466 Advanced Laboratory III. (1-3) F, S

Continuation of PHY 465. Prerequisite: PHY 465.

PHY 480 Methods of Teaching Physics. (3) S

Evaluation of various approaches to the teaching of high school physics. Preparation of demonstrations and experiments. Organization of a laboratory. Designed for secondary school physics teachers. Prerequisite: instructor approval.

PHY 481 Solid-State Physics. (3) S

Structure, elastic properties, and dynamics of crystals; electron motions in crystals under applied fields. Prerequisites: PHY 311, 315.

PHY 501 Methods of Theoretical Physics. (3) F, S

Provides mathematical foundations for graduate students in basic and applied physics. Complex variables, vector spaces, operators, matrices, ordinary differential equations, integral equations and transforms, and special functions. May include additional topics.

PHY 502 Methods of Theoretical Physics. (3) F, S

Continuation of PHY 501. Prerequisite: PHY 501.

PHY 521 Classical Mechanics. (3) F

Variational principles, Lagrange's and Hamilton's equations, rigid body motion, canonical transformations, Hamilton-Jacobi theory.

PHY 523 Relativity. (3) N

Special and general theories of relativity. Prerequisite: PHY 532 or instructor approval.

PHY 531 Advanced Electricity and Magnetism. (3) F

Electrostatics and magnetostatics; potential theory and theory of constitutive relations; Maxwell's equations; the wave equation, plane electromagnetic waves, cavities, and wave guides.

PHY 532 Electrodynamics. (3) S

Special theory of relativity, covariant formulation of electromagnetic interactions; inhomogeneous wave equations, Lienard-Wiechert potentials, and radiation fields; interactions of charged particles and electromagnetic waves, scattering, dispersion. Prerequisites: PHY 412 and 531 or instructor approval.

PHY 541 Statistical Physics. (3) F

Probability theory and principles of statistical inference; evaluating experimental data; foundations of statistical mechanics; general laws of thermodynamics from microscopic theories; calculation of specific properties of bulk matter.

PHY 551 X-ray and Electron Diffraction. (3) S

Fresnel and Fraunhofer diffraction in integral formulation; diffraction of X-rays and neutrons by crystal lattices; structures of solids, including crystal structure analysis; theory and techniques of electron microscopy/diffraction of crystalline/noncrystalline specimens. Prerequisite: PHY 481 or instructor approval.

PHY 561 Nuclear Physics. (3) F, S

Two nucleon interaction, Clebsch-Gordon coefficients, internucleon forces, meson theory and high energy scattering, nuclear binding energy, nuclear models, transition probability estimates, nuclear reactions, and beta decay. Prerequisite: PHY 576 or instructor approval.

PHY 562 Nuclear Physics. (3) F, S

Continuation of PHY 561. Prerequisite: PHY 561 or instructor approval.

PHY 568 Elementary Particle Physics. (3) N

Classification of particles; phenomenology of strong, electromagnetic and weak interactions, cross sections, and decay rates; isotopic spin and higher symmetries; structure of reaction amplitudes. Prerequisite: PHY 577.

PHY 569 Elementary Particle Theory. (3) N

Continuation of PHY 568. Prerequisite: PHY 568.

PHY 576 Quantum Theory. (3) F, S

Abstract approach to quantum mechanics in Hilbert space; observables and their corresponding operators, eigenstates, and eigenvalues; quantum dynamics; approximation methods; systems of identical particles; angular momentum and group representation theory; collision processes; relativistic quantum theory. Prerequisite: PHY 521.

PHY 577 Quantum Theory. (3) F, S

Continuation of PHY 576. Prerequisite: PHY 576.

PHY 578 Relativistic Quantum Theory. (3) F, S

Relativistic 1-particle equations, Klein-Gordon equation, Dirac equation, 2d quantization, theory of scattering, S-matrix, Feynman diagrams, quantum electrodynamics, and renormalization procedures. Prerequisite: PHY 577.

PHY 579 Relativistic Quantum Theory. (3) F, S

Continuation of PHY 578. Prerequisite: PHY 578.

PHY 581 Solid-State Physics. (3) F

Quantum theory of solids, including phonons, lattice specific heats, band structure models, Fermi surfaces, thermal expansion, plasmons, electron-phonon interactions, and scattering by lattice defects. Pre- or corequisite: PHY 576.

PHY 582 Solid-State Physics. (3) S

Elements of transport theory, thermal conduction, electronic conduction in metals, mobility in semiconductors, Hall effect, magnetoresistance, and selected topics of current research. Prerequisite: PHY 581.

PHY 587 Quantum Optics. (3) F, S

Quantization of the electromagnetic field. Quantum theory of coherence, photon counting, photon states, lasers, density operators, and atomic Raman scattering. Prerequisite: PHY 576.

PHY 588 Quantum Optics. (3) F, S

Continuation of PHY 587. Prerequisite: PHY 587.

PHY 598 ST: Special Topics. (1–4) F, S

Continuation of PHY 587. Prerequisite: PHY 587.

(a) Quantum Mechanics (3) S

Omnibus Graduate Courses: See page 51 for omnibus graduate courses that may be offered.

ASTRONOMY (AST)**AST 421 Astrophysics I.** (3) F

Selected astrophysical topics, including: stellar evolution, star formation, interstellar medium, galactic structure, extragalactic astronomy, high-energy astrophysics, and cosmology. Prerequisites: AST 321, 322; PHY 311, 314.

AST 422 Astrophysics II. (3) S

Same range of astrophysical topics as for AST 421 but different specific topics will be emphasized in a given year. Prerequisites: AST 321, 322; PHY 311, 314.

AST 598 ST: Special Topics. (1–4) N

- (a) Astronomical Data Taking and Data Reduction
- (b) Cosmology and High-Energy Astrophysics
- (c) Extragalactic Astronomy
- (d) Galactic Structure
- (e) Interstellar Medium and Gaseous Astrophysics
- (f) Stellar Interiors and Stellar Evolution

Omnibus Graduate Courses: See page 51 for omnibus graduate courses that may be offered.

Plant Biology

J. Kenneth Hooper

Chair

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PROFESSORS

BACKHAUS, HOOBER, KLOPATEK, NASH, PINKAVA,
SOMMERFELD, TRELEASE, VERMAAS

ASSOCIATE PROFESSORS

CLARK, DAY, FRASCH, MARTIN, PIGG, ROBERSON,
STROMBERG, STUTZ, SZAREK, TOWILL, WEBBER

ASSISTANT PROFESSOR

POGSON

ACADEMIC PROFESSIONALS

BINGHAM, LANDRUM, LOBRUTTO, SHARP

The faculty in the Department of Plant Biology offer programs leading to the M.S. and Ph.D. degrees in Plant Biology. Among other areas of study, two concentrations are available: ecology and photosynthesis.

Select faculty collaborate with the faculty in the Departments of Biology, Chemistry and Biochemistry, and Microbiology in offering programs leading to the M.S. and Ph.D. degrees in Molecular and Cellular Biology (see “Molecular and Cellular Biology,” page 250).

The faculty participate in the programs leading to the Master of Natural Science degree (see “Master of Natural Science,” page 257) when the primary or secondary area of concentration is in plant biology. Students interested in pursuing the M.N.S. degree through an interdisciplinary program emphasizing any of these areas should contact the Department of Plant Biology for additional information.

Applicants for these degree programs must submit scores on the Graduate Record Examination (GRE) (aptitude). GRE scores in the advanced subject area are recommended.

The graduate programs are designed to prepare students for careers in teaching and in research on various aspects of plant biology, in educational institutions, industry, or government agencies.

MASTER OF SCIENCE

Prerequisites. Completion of the requirements for an undergraduate major in the plant sciences, biology, or related discipline, and an adequate background in related courses in chemistry, mathematical, and physical sciences.

Program of Study. A minimum of 30 semester hours of graduate credit is required. The program must include at least three semester hours of research, three semester hours of thesis, one semester of the core course PLB 502 Perspectives in Plant Biology and one hour of participatory seminar (PLB 591). The program is planned by the student in consultation with the supervisory committee.

Foreign Language Requirements. None.

Comprehensive Examinations. Not required.

Thesis Requirements. A thesis is required.

Final Examinations. A final research seminar and an oral examination covering the thesis and related subject matter are required.

DOCTOR OF PHILOSOPHY

See "Doctor of Philosophy," page 101, for general requirements.

Program of Study. A minimum of 84 semester hours of graduate credit is required. The program must include at least 24 hours of research and dissertation credit and at least 30 hours of formal graduate course work. One semester of the core course PLB 502 Perspectives in Plant Biology and two hours of participatory seminar (PLB 591) are also required. Courses numbered 590 or 790 (Reading and Conference) are not considered formal courses. The program is planned by the student in consultation with a program committee that also administers and evaluates the comprehensive examinations.

Foreign Language Requirements. Completion at the undergraduate level of a one-year course with a grade of "C" or higher is required. Additional study may be required by the student's supervisory committee.

Comprehensive Examinations. Written and oral comprehensive examinations administered and evaluated by the student's program committee are required.

Dissertation Requirements. A dissertation based on original work of high quality, demonstrating proficiency in the student's area of interest, is required. (See "Doctoral Degrees," page 100.)

Final Examinations. A final oral examination in defense of the dissertation is required. It is administered by a dissertation committee consisting of three to five members who previously served on the student's program committee.

RESEARCH ACTIVITY

Major areas of research by the faculty, professional staff, and graduate students in Plant Biology include emphasis in the following subject areas:

Biochemistry/Cell Biology/Physiology. Cell fractionation and protein biochemistry, organelle biogenesis and metabolism in oil seeds, enzyme cytochemistry, structures and mechanisms of enzymes in photosynthetic light reactions using magnetic resonance spectroscopy and X-ray crystallography, photobiology of vascular and nonvascular plants, physiology of the fern haplophase.

Ecology/Environmental Science. Environmental studies spanning organismic to regional levels of organization,

including effects of enhanced UV-B radiation upon plants, leaf optics, leaf gas exchange and photosynthesis, adaptations to environmental stresses (life cycle, physiology, reproduction, and structure), evolutionary biology of cacti and leaf succulents, lichenology, quantitative ecology, effects of air pollution on plants and ecosystems, dendroecology, mineral cycling and restoration, landscape ecology, human impacts on ecosystems and ecosystem response to perturbation, interdisciplinary studies of riparian ecosystems.

Molecular Genetics/Molecular Biology. Targeted mutagenesis of photosynthesis genes in cyanobacteria and plants, functional and structural analysis of genetically engineered mutants, transformation of green algae, chloroplast gene expression, and biogenesis of thylakoid membrane-protein complexes.

Nonvascular Plants/Fungi. Fungal and algal cell wall chemistry, ultrastructure and storage products, developmental morphology and life cycles of algae and fungi, phytoplankton ecology and water quality, and apical growth in fungi.

Organismic Research. Paleobotany, paleopalynology, particularly of Cretaceous and Tertiary horizons, and anatomically preserved plants from Carboniferous coal swamps and from the Permian and Triassic of Gondwana, origin and diversification of seed plants.

Systematics/Taxonomy. Cytogenetics and hybridization studies in the Cactaceae, floristics of the southwestern U.S. and northern Mexico, chemosystematics of plants, particularly the Compositae, and chemical ecology.

Urban Horticulture. Tissue-culture of drought-tolerant plants, molecular basis for rubber formation, plant pathology, particularly of the physiology of plant-fungal pathogen interactions, landscape horticulture, environmental stress physiology, computer simulation modeling, and nursery production and marketing.

The research mission of the department is supported by well-equipped research laboratories, greenhouses, environmental and radioisotope rooms, computer laboratory and personal computers, photographic and darkroom facilities, herbarium, the electron microscopy laboratory, and the electron paramagnetic resonance spectroscopy facility.

PLANT BIOLOGY (PLB)

PLB 400 Lichenology. (3) S 2001

Chemistry, ecology, physiology, and taxonomy of lichens. 2 hours lecture, 3 hours lab. Prerequisite: BIO 182 or equivalent.

PLB 402 Mycology. (3) S

Fungal morphology and systematics with an introduction to fungal cell biology, ecology, economic significance, and growth and development. 2 hours lecture, 3 hours lab. Prerequisite: BIO 182 or MIC 206 or equivalent.

PLB 404 Phycology. (4) S

The algae (both fresh water and marine forms), emphasizing field collection and identification of local representatives. Morphological, ecological, and economic aspects of the algae. 3 hours lecture, 3 hours lab. Prerequisite: BIO 182 or instructor approval.

PLB 406 Vascular Plant Structure. (4) S

Comparative form and evolutionary trends in the major groups of vascular plants. 3 hours lecture, 3 hours lab. Prerequisite: PLB 300 or equivalent.

PLB 407 Plant Fossils and Evolution. (4) S 2001

A broad survey of plant life of the past, including the structure of plant fossils, their geologic ranges, geographic distribution, and paleo-environment. 3 hours lecture, 3 hours lab or field trip. Prerequisite: BIO 182 or equivalent.

PLB 408 Pollen and Spores. (3) N

Significance of fossil and extant pollen, spores, and other palynomorphs to ecology, evolution, stratigraphy, and systematics. 2 hours lecture, 1 hour lab. Prerequisite: instructor approval.

PLB 410 Angiosperm Taxonomy. (3) S

Principles underlying angiosperm phylogeny. 2 hours lecture, 3 hours lab. Prerequisite: PLB 310 or instructor approval.

PLB 411 Trees and Shrubs of Arizona. (3) F

Identification of woody plants from desert, chaparral, and forest habitats in Arizona. 1 hour lecture, 3 hours lab, field trips. Prerequisite: BIO 182 or equivalent or instructor approval.

PLB 412 Cytogenetics. (3) F

Chromosomal basis of inheritance. Cross-listed as BIO 441. Credit is allowed for only BIO 441 or PLB 412. Prerequisite: BIO 340.

PLB 413 Cytogenetics Laboratory. (2) F

Microscopic analysis of meiosis, mitosis, and aberrant cell division. 6 hours lab. Cross-listed as BIO 442. Credit is allowed for only BIO 442 or PLB 413. Pre- or corequisite: BIO 441 or PLB 412.

PLB 414 Plant Pathology. (3) S

Identification and control of biotic and abiotic factors that cause common disease problems to plants. Prerequisite: BIO 182. *General Studies: L2.*

PLB 502 Perspectives in Plant Biology. (3) F

Introduce major areas of research within the department with the goal of broadening knowledge to enable multidisciplinary research and communication. Prerequisite: instructor approval.

PLB 591 Seminar. (1–12) N**ENVIRONMENTAL SCIENCE AND ECOLOGY****PLB 420 Plant Ecology: Organisms and Populations.** (3) S 2001

Factors and controls on the physiological ecology and organization of plants and plant populations using empirical and theoretical approaches. 2 hours lecture, 3 hours lab. Prerequisite: BIO 320 or PLB 322 or equivalent.

PLB 421 Plant Ecology: Communities and Ecosystems. (3) S

Plant community organization, field sampling techniques and the structure and function of terrestrial ecosystems emphasizing the role of vegetation. 2 hours lecture, 3 hours lab. Prerequisite: BIO 320 or PLB 322 or equivalent.

PLB 422 Plant Geography. (3) N

Plant communities of the world and their interpretation, emphasizing North American plant associations. Cross-listed as GPH 422. Credit is allowed for only GPH 422 or PLB 422. Prerequisite: BIO 182 or GPH 111.

PLB 430 Statistical Analyses in Environmental Science. (3) S 2000

ANOVAS, 1-way classification of factorial and partially hierarchic designs; introductory multivariate statistics. Prerequisite: MAT 210 or equivalent.

PLB 432 Computer Applications in Biology. (3) F

Computer analysis techniques in biology emphasizing data entry, management and analysis, and graphic portrayal. Employs mainframe and microcomputers. 2 hours lecture, 3 hours lab. Cross-listed as BIO 406. Credit is allowed for only BIO 406 or PLB 432. Prerequisites: BIO 182 and MAT 117 (or 210) or instructor approval. *General Studies: N3.*

PLB 434 Landscape Ecological Analysis and Modeling. (3) S

Technical methods of landscape ecological analyses. Includes mathematical and statistical examination and modeling of landscape ecological patterns and processes. Prerequisites: BIO 320 and 406 or PLB 432 (or equivalent).

PLB 520 Plant Structural Adaptation. (2–3) F 2000

Adaptive traits of leaf size/unique growth form on energy transfer efficiency; stomatal architecture and water-use efficiency; applications of stable isotopes. Prerequisite: BIO 320 or PLB 306 (or 308) or equivalent.

PLB 522 Plant Photosynthetic Adaptation. (3) F

Evolution and ecology of C4 and CAM; adaptive traits improving competitive ability in natural environments; comparative physiology of desert plants. Prerequisite: PLB 308 or instructor approval.

PLB 524 Methods in Environmental Plant Physiology. (3) S 2001

Techniques to measure and quantify microclimate and mass transfer. Supporting principles. 2 hours lecture, 3 hours lab. Prerequisite: BIO 320 or PLB 308.

MOLECULAR BIOSCIENCES/BIOTECHNOLOGY**PLB 440 Photobiology.** (3) F 2000

Principles underlying the effects of light on growth, development, and behavior of plants, animals, and microorganisms. Cross-listed as BIO 464. Credit is allowed for only BIO 464 or PLB 440. Prerequisites: CHM 231 (or 331); 12 hours of courses in life sciences.

PLB 442 Algal and Fungal Physiology. (3) N

Cellular physiology and biochemistry of algae and fungi; responses of these organisms to chemical and physical stimuli and their processes of morphogenesis. Prerequisites: BIO 182 (or equivalent); CHM 231.

PLB 444 Plant Growth and Development. (3) S 2001

Molecular basis of development, role of signal transduction pathways/gene regulation in control of organ formation, pollination, germination and growth. Prerequisite: BIO 353 (PLB 340 recommended).

PLB 540 Plant Metabolism. (3) N

General plant metabolism and typical plant products, emphasizing biosynthesis and functions of storage products, cell wall constituents, plant acids, pigments, hormones, and numerous secondary products. Prerequisite: PLB 340 or CHM 231 or instructor approval.

PLB 550 Plant Molecular Biology. (2) S 2001

Biochemistry and molecular biology of plant organelles, including protein targeting, plant viruses, and molecular designs for plant improvements. Prerequisite: instructor approval.

PLB 552 Plant Genetic Engineering. (3) S

Plant transformation utilization of transgenic plants, transient gene expression assays, and applications of plant genetic engineering. Prerequisite: instructor approval.

PLB 553 Plant Genetic Engineering Laboratory. (2) S

Plant transformation, utilization of transgenic plants, transient gene expression assays, and applications of plant genetic engineering. 6 hours lab. Prerequisite: instructor approval.

PLB 554 Plant Biotechnology. (3) N

Aseptic, clonal propagation of plants and in vitro culture of cells, organs, and tissues. 2 hours lecture, 3 hours lab. Prerequisite: PLB 308 or 340 or 370.

PLB 558 Molecular Mechanisms of Photosynthesis. (3) S

Structure and function of photosynthetic complexes; mechanism of energy conversion in plants, bacteria, and model systems. Cross-listed as CHM 568. Credit is allowed for only CHM 568 or PLB 558. Prerequisite: instructor approval.

URBAN HORTICULTURE**PLB 472 Greenhouse/Nursery Management.** (3) N

Greenhouse structures, environment, and nursery operation. Includes irrigation, nutrition, and other principles relative to container-grown species. Prerequisite: ERS 130 (or 225 or 226).

Omnibus Graduate Courses: See page 51 for omnibus graduate courses that may be offered.

Political Science

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PROFESSORS

BALL, BERMAN, CHAUDHURI, DAGGER, JONES,
 McDONOUGH, McGOWAN, SIMON,
 WALKER, YOUNGBLOOD

ASSOCIATE PROFESSORS

ASHLEY, CRITTENDEN, DANTICO, DOTY, HERRERA,
 KAHN, KENNEY, MITCHELL, SIMHONY

ASSISTANT PROFESSORS

C. ELMAN, M. ELMAN, GOLDSTEIN, NEVIT,
 REDDICK, WARNER

ASSOCIATE INSTRUCTIONAL PROFESSIONAL KEATING

The faculty in the Department of Political Science offer graduate programs leading to the M.A. and Ph.D. degrees in Political Science. Concentrations are available in American politics, comparative politics, international relations, and political theory.

Students admitted to the Master of Education degree with a major in Secondary Education may also elect political science as the subject matter field.

MASTER OF ARTS

See "Master's Degrees," page 98, for general requirements.

Admission. The M.A. degree provides advanced education for those students preparing for teaching, research, or applied careers in political science. It may be taken as a terminal program or as a step toward eventual fulfillment of the requirements for the Ph.D.

In addition to the materials sent to the Graduate College, the following items should be submitted to the director of graduate studies of the Department of Political Science by April 15 in order to ensure recommendations for admission to the M.A. program beginning the following fall:

1. scores from the verbal, quantitative, and analytical sections of the Graduate Record Examination (GRE);
2. three letters of recommendation from persons who can evaluate the applicant's academic performance and potential;
3. a career overview statement which describes the applicant's educational objectives; and
4. a writing sample that best represents the applicant's thinking and writing skills.

Applicants for financial aid should submit these items and complete the application form for graduate assistantships by February 15.

Undergraduate course work in political science is not a prerequisite for admission.

It is assumed, however, that M.A. students have a basic understanding of elementary statistics and the undergraduate content of the political science fields of concentration that they wish to study. Students without such a background should allow sufficient time to acquire it.

Program of Study. A minimum of 30 semester hours is required for the Master of Arts degree. All candidates must take POS 501, 503, and the core course in each subfield. The core courses (POS 502, 530, 550, and 560) must be taken prior to enrolling in upper-level courses in the subfield. Six additional hours must be taken in graduate-level courses and seminars. Each student is expected to take seminars each semester in his/her major field, minor field, and an elective until course work is completed. If the thesis option is followed, the program must include a combination of at least six semester hours of research (POS 592) and the thesis (POS 599) credit. A maximum of six semester hours in approved courses taken outside the department or six hours of independent study (POS 590) courses may count towards the 30-hour requirement.

Foreign Language Requirement. None

Thesis Option Requirements. M.A. students seeking admission to the Ph.D. program are expected to complete the thesis early in their fourth semester. A copy of the *Format Manual* is available in the Graduate College. A careful review of this document well in advance of preparation for the final copy of the thesis is recommended. An oral examination in defense of the thesis is required.

Non-Thesis Option Requirements. The program of study must include 27-hours of approved course work and at least one three-hour reading and conference course (POS 590) in the fourth semester to enhance the student's research capabilities. A research paper must be defended by the end of the third semester before a faculty committee appointed by the Director of Graduate Studies.

DOCTOR OF PHILOSOPHY

See "Doctor of Philosophy," page 101, for general requirements.

Admission. In addition to meeting Graduate College requirements, an applicant for the Ph.D. program must take the verbal, quantitative, and analytical sections of the GRE; supply a career overview statement that describes the applicant's educational objectives; submit three letters of recommendation from persons who can evaluate the applicant's undergraduate and graduate work; and provide a sample of writing. These items should be submitted to the director of graduate studies of the Department of Political Science by February 15. Applicants for financial aid should also complete and submit the application form for graduate assistantships by February 15.

It is assumed that Ph.D. students have a basic understanding of elementary statistics and the content of the areas of concentration that they wish to study. Students without such a background should allow sufficient time to acquire it.

Program of Study. A minimum of 60 semester hours of graduate courses beyond the baccalaureate degree and

approved by the student's supervisory committee shall constitute the formal course preparation, followed by a minimum of 24 semester hours of research and dissertation work. The supervisory committee has three members, including the committee chair from the student's major field, and two members from a minor field. As part of the 60 semester hours, the student must take POS 501, 503, and 603. A maximum of 12 semester hours of approved course work outside the department and 12 semester hours of approved independent study courses (POS 590 and 790) may count toward the 60 semester hours. Grades of "A," "B," or "Y," must be obtained in all course work counted for the Ph.D. degree.

Master's in Passing. For students without an M.A. who are admitted directly into the Ph.D. program, the department offers a Master's in Passing. Students opting for the Master's in Passing must, in the third semester of residence, pass an oral examination of their work. The examination will be conducted by a committee composed of members of the Graduate Committee who represent each student's primary and secondary subfields. Students who pass the oral examination and have completed 30 hours of course work toward the Ph.D. are then awarded the M.A.

Foreign Language and Research Requirements. Each Ph.D. student must show proficiency in a foreign language. The supervisory committee may also require up to six additional semester hours to build the student's research skills.

Comprehensive Examination. The student is required to take three examinations from the fields and subfields of American politics, international relations, comparative politics, and political theory. In the major field, the student takes a written general examination. Additionally, the student takes a written field or subfield examination in one of the remaining fields of political science. An oral examination over the dissertation proposal follows the written examinations.

Dissertation Requirements. The dissertation must be an original contribution to knowledge and demonstrate the student's proficiency as an independent investigator. The dissertation proposal is approved by the chair of the department upon the recommendation of the student's dissertation committee. The department chair also approves the dissertation committee. This committee must have a minimum of three members from the department of political science, including a chair from the student's major field.

Final Examinations. A final oral examination is required. This examination is the occasion for the student to defend the dissertation, both as to methods and conclusions, and to demonstrate general competence in the area of concentration.

RESEARCH ACTIVITY

The political science faculty and curriculum are organized into four areas of concentration. The faculty in each area offer courses and conduct research from a variety of methodological orientations, all with a common thread of theoretically-oriented scholarship.

American Politics. Faculty emphasize political behavior and use survey research, experimental designs, and content analysis to collect data and conduct statistical analyses of mass

voting patterns, campaign strategies, party politics, the role of the media in political communication, and elite-mass linkages. Other faculty emphasize public law and policy while some conduct research at the state and local levels of government. They analyze aggregate and interview data, archival materials and legal texts with a focus on campaign finance regulations, intergovernmental relations, gender issues, electoral reform, third parties, and interest groups.

International Relations. One group of faculty focus upon foreign policy theory and international security, using event chronologies, institutional differences, archival materials, and public records to guide comparative analyses of foreign policy decision-making by different types of regimes, case studies of leaders and their decision-making strategies, and policy analyses of issues in the Asia-Pacific region. Another cluster of faculty emphasize critical theory and international political economy, employing archival sources, statistical data, and texts of legal norms and state practices to conduct analyses of global inequalities in wealth and income, the evolution of statecraft, and the impact of hierarchically-ordered gender and race categories in North-South relations.

Political Theory. Faculty research interests in the area of political theory cover a range of topics in the history of political thought and contemporary political theory. Historical topics include Rousseau, conceptual history, and positive idealisms of the 19th and 20th centuries. Research in contemporary political theory includes autonomy and freedom; rights and obligations; citizenship, civic virtues, and the idea of the common good; various issues in democratic political theory (with particular attention to education); aspects of political and legal theory regarding corporate personality; conceptions of self in various cultures; analysis of myths in aboriginal societies (particularly Native Americans); punishment; justice; community; language and politics; social ecology; and peace and nonviolence.

Comparative Politics. Faculty in the area of comparative politics investigate a variety of topics in several regions of the globe. Research interests include the political economy of uneven development in Africa, democratization processes within formerly authoritarian regimes in Europe, Latin America, and East Asia, church and state relations in the Philippines, ethnic minority problems in Brazil, problems of federalism in India, and party leadership in France and Italy.

Many of these research interests have recently been the basis for graduate seminars (POS 691) and for special topics courses (POS 598). Moreover, students have the opportunity to do advanced work in these areas through reading and conference courses (POS 590 and 790) and independent research (POS 592 and 792).

Research Facilities. The department has its own political data laboratory for research and teaching purposes. Both faculty and students have access to data processing equipment and machine-readable data collections. The ASU Library collection has extensive holdings in all of the fields of political science. The facilities of the ASU School of Public Affairs, School of Justice Studies, Latin American Studies Center, and the Center for Asian Studies are accessible to graduate students in political science.

POLITICAL SCIENCE (POS)

POS 501 Methods of Political Science. (3) A

Problems of method and knowledge in political science, strategies of political inquiry, and issues in philosophy of social science.

- POS 502 Philosophy of Political Inquiry.** (3) A
Problems of knowledge and method in political science, with attention to both empirical and evaluative analysis.
- POS 503 Empirical Political Inquiry.** (3) A
Research methods and techniques of the discipline, emphasizing empirical foundations and analytic methods employed in subfields. Prerequisites: POS 401 (or equivalent); instructor approval.
- POS 530 American Politics.** (3) A
Examines major debates in the study of American political processes and institutions. Covers parties, media, elections, public opinion, interest groups, and the three branches of government. Seminar.
- POS 545 Themes in Political Thought.** (3) N
Examination of a particular theme or problem in political thought from both a historical and contemporary perspective. Seminar. Course may be repeated with approval of the director of graduate studies. Prerequisite: instructor approval.
- POS 550 Comparative Politics.** (3) A
Surveys major approaches across topical areas such as revolutions, authoritarianism, policy processes, interest groups, and electoral politics. Focus varies with instructor. Seminar.
- POS 560 International Relations.** (3) A
Surveys major theoretical approaches and debates in international relations. Seminar.
- POS 563 Comparative Asian Security Policies.** (3) N
Analyzes domestic and international constraints, belief systems, and economic components in security decisions by major powers and Asian nations. Seminar. Prerequisite: instructor approval.
- POS 591 Seminar.** (3) A
(a) American Politics
(b) Comparative Politics
(c) Global Politics
(d) Political Theory
- POS 598 ST: Special Topics.** (3) A
(a) American Politics
(b) Comparative Politics
(c) Global Politics
(d) Political Theory
- POS 601 Advanced Experimental Research.** (3) N
Introduces experimental and quasi-experimental research designs in political research, including laboratory techniques and topics in the analysis of variance. Prerequisite: POS 503 or equivalent.
- POS 602 Advanced Survey Research.** (3) N
Presents design and conduct of political surveys, including sampling, instrument design, scaling, and statistical and graphical analysis of survey data. Prerequisite: POS 503 or equivalent.
- POS 603 Polimetrics I.** (3) A
Introduces theory and practice of linear regression analysis. Provides skills to read, understand, and evaluate professional literature using regression analysis. Prerequisites: POS 401 and 503 or instructor approval.
- POS 604 Polimetrics II.** (3) A
Apply quantitative techniques to research topics producing publishable papers through exposure to time-series, logit and probit, and simultaneous equations. Prerequisites: POS 401 and 503 and 603 or instructor approval.
- POS 606 Qualitative and Textual Analysis.** (3) S 2001
Method and theory for the analysis of qualitative materials, systematic approaches for case studies, content analysis, critical analysis of texts. Discussion, seminar.
- POS 635 State Politics and Public Policy.** (3) N
Introduction to comparative state policy emphasizing policy or performance differences among the states and the reasons for these differences. Seminar. Prerequisites: POS 530 and 603 or instructor approval.
- POS 636 Electoral Behavior.** (3) N
Introduces fundamental concepts of electoral behavior. Emphasizes presidential elections and examines why people vote and how their votes are determined. Seminar. Prerequisites: POS 530 and 603 or instructor approval.
- POS 638 Law and Politics.** (3) N
Emphasizes research into such topics as constitutional law, women and the law, American legal system, judicial process, and judicial selection. Seminar. Prerequisite: instructor approval.

- POS 651 Politics of Change and Development.** (3) N
Examines contending approaches to national, social, and political change. Seminar. Prerequisite: instructor approval.
- POS 660 The Modern World System.** (3) N
Theoretically driven, historical analysis of the organization and operation of the international political economy since the 16th century. Seminar. Prerequisite: instructor approval.
- POS 661 The State.** (3) N
Examines theories of state, state-society relations, and interstate politics emphasizing questions of sovereignty, territoriality, violence, representation, democracy, and change. Seminar. Prerequisite: instructor approval.
- POS 662 International Organization.** (3) N
History, practical political significance, and future of international institutions, transnational regimes, and other approaches to international organization. Seminar. Prerequisite: instructor approval.
- POS 664 War, Peace, and Conflict Processes.** (3) N
The systematic analysis of the causes of war, the preconditions for peace, and approaches to the resolution of conflict. Seminar. Prerequisite: instructor approval.
- POS 665 Foreign Policy Theory.** (3) N
Examines foreign policy theory and methods. Development and critique of research designs analyzing foreign policy processes within and among nations. Seminar. Prerequisite: instructor approval.
- POS 691 Seminar.** (1–12) N
- POS 792 Research.** (3) F, S
Projects in various areas of political science. Prerequisite: doctoral student.
- Omnibus Graduate Courses:** See page 51 for omnibus graduate courses that may be offered.

Psychology

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REGENTS' PROFESSORS

CIALDINI, EISENBERG, RUSSO

PROFESSORS

AIKEN, BARRERA, BRAUN, BRAVER, CASTRO, CHASSIN, HOMA, KAROLY, KENRICK, KILLEEN, KNIGHT, LANYON, LINDER, OKUN, PARKINSON, PRESSON, REICH, SADALLA, SANDLER, SOMERVILLE, VAN ORDEN, WEST, WOLCHIK, ZAUTRA

ASSOCIATE PROFESSORS

CASTANEDA, CHARTIER, FABRICIUS, FEHR, GOLDINGER, GONZALES, LESHOWITZ, MacKINNON, MILLSAP, NAGOSHI, NEISEWANDER, NEMEROFF, NEUBERG, ROSSI, SAENZ, STONE

ASSISTANT PROFESSORS

DAVIS, GEST, KHOO, McBEATH

LECTURERS

BARTON, PALMER, WEIGAND, WOSINSKI

The faculty in the Department of Psychology offer graduate programs leading to the Ph.D. degree in Psychology. Concentrations are available in clinical, developmental, environmental, quantitative, and social psychology, as well

as in cognitive/behavioral systems and behavioral neuroscience.

Although there is no formal M.A. program as such, doctoral students are required to complete an M.A. degree as part of their doctoral training.

All applicants are required to submit scores on the Graduate Record Examination (verbal, quantitative, and analytical sections; advanced section is required for clinical psychology), transcripts, three letters of reference, and a statement of purpose.

Program of Study. A minimum of 30 semester hours is required for the master's degree.

Foreign Language Requirements. None.

Thesis Requirements. A thesis is required.

Final Examinations. A final oral examination in defense of the thesis is required.

DOCTOR OF PHILOSOPHY

See "Doctor of Philosophy," page 101, for general requirements.

Application Deadline. Completed applications for admission in the fall semester, including all letters and supporting documents, should be received by January 1.

The Department of Psychology requires all applicants to provide scores from the aptitude sections of the GRE for clinical psychology. A score from the advanced test in psychology is required. These scores are not used exclusively to determine admission but are viewed in the context of other supporting materials, such as GPAs and letters of recommendation.

Program of Study. At present the Department of Psychology offers the Ph.D. degree in the following research areas: clinical, developmental, environmental, cognitive/behavioral systems, behavioral neuroscience, quantitative, and social psychology. A minimum of 60 semester hours of course credit beyond the bachelor's degree is required, plus 24 semester hours of credit in research and dissertation.

In addition to a core curriculum, students take courses related to their area of interest as determined in consultation with their supervisory committees.

First-Year Evaluation. At the end of the first year of study, each student receives a comprehensive evaluation by the faculty based upon performance in courses and in professional or laboratory assignments and upon the evidence of professional responsibility and ethical behavior.

Foreign Language Requirements. None.

Comprehensive Examinations. Written and oral examinations are required near the end or upon completion of all course work. After passing the comprehensive examinations and meeting other requirements (e.g., dissertation prospectus), the student is eligible to apply for candidacy.

Dissertation Requirements. The dissertation must be an original contribution to knowledge, demonstrating the student's proficiency as an independent investigator. (See "Doctoral Degrees," page 100.)

Final Examinations. A final oral examination in defense of the dissertation is required.

RESEARCH ACTIVITY

Clinical. Three areas of emphasis: child-clinical, community, and health psychology. Topics include risk factors for mental health and substance abuse problems of children and adolescents; mental health of minority groups; stress and coping processes; self-regulation and goal systems; the interface of psychology and the law; women's health, cardiovascular reactivity, affect and health; development and testing of preventive interventions for children at risk; validation of cognitive, behavioral, and systems interventions for families in crisis; health promotion and relapse prevention in Hispanic populations; contagion theory, social support; adjustment to separation and divorce; measurement of self-deception; and processes underlying ethical judgments in professional contexts.

Developmental. Prosocial behavior, empathy, and moral development; sex roles; spatial cognition; child language and drawing; cooperation and competition; inference and reasoning; child and adolescent health psychology; development of ethnic identity; children's theory of mind; social psychology of aging; dynamics of college departure among adults.

Environmental. Psychology of resource conservation, memory for architectural form, information storage and spatial cognition, house form and identity, urbanization, territoriality, person-situation interaction, and aversive environments.

Cognitive Systems. Perception: perception of space and motion, psychophysics, speech perception, word recognition. Cognition: memory, categorization, attention, effective thinking. Modeling: dynamic systems models of cognition and perception.

Behavior and Behavioral Neuroscience. Neuroscience: biochemical and neural concomitants of behavior, behavioral recovery after brain damage, neurodegenerative diseases, drug abuse. Learning: experimental analysis of behavior, reinforcement theory. Modeling: quantitative models of behavior.

Social. Persuasion and influence, attraction and relationships, prejudice and stereotyping, altruism, evolutionary psychology, impression formation and social cognition, ethnic and gender identity, social dilemmas and social traps, self-presentation, individual differences and personality, family relationships, behavioral genetics, perceptions of control, social development.

Applied Social Psychology. Health psychology, family relationships, alcohol and drug use, social psychology of sport and exercise, aging, prevention research and evaluation, gender roles and mental health, environmental psychology, criminal justice. Students interested in this area may choose it as a subspecialization in social psychology.

Quantitative. Field research methods; design innovations in intervention research, self-selection biases, treatment non-compliance, mediation of intervention effects. Applied statistics: categorical data analysis, latent growth modeling, multilevel modeling, structural equation modeling, missing data, multiple regression analysis, time series, meta-analysis, graphics and exploratory data analysis, statistical methods applied to health promotion and disease prevention research. Measurement: psychometric theory, factor analy-

sis, item response theory, group differences in test performance, cognitive models in test performance, measurement invariance and bias, cross-ethnic, cross-race, and cross-gender measurement equivalence, longitudinal measurement.

PSYCHOLOGY (PSY)

PSY 420 Analysis of Behavior. (3) N

Research, applications, and philosophy of the analysis and control of human behavior. Prerequisite: PSY 290. *General Studies: L2.*

PSY 424 Genetic Psychology. (3) S

Introduction to the concepts, methodologies, and findings of behavioral genetics for Psychology majors. Prerequisites: PGS 100; PSY 230, 290. *General Studies: L2.*

PSY 425 Biological Bases of Behavior. (3) N

Critical study of physiological psychology; brain mechanisms underlying motivation, and learning. Prerequisite: PSY 325. *General Studies: L2.*

PSY 426 Neuroanatomy. (4) N

Structure and function of mammalian brain, including sheep brain dissection. 3 hours lecture, 3 hours lab. Prerequisite: PSY 325 or equivalent. *General Studies: L2.*

PSY 434 Cognitive Psychology. (3) S

The human organism as a processor of information, from perception to cognition. Abstract concepts, semantic memory, attention, and mental imagery. Prerequisite: PSY 323 or 324 or instructor approval. *General Studies: L2.*

PSY 437 Human Factors. (3) F

Emphasis on human factors in high technology systems. Specific topics include systems development, systems analysis techniques, displays, and controls. Prerequisites: PSY 290 and upper-division standing or instructor approval. *General Studies: L2.*

PSY 470 Psychopharmacology. (3) F, S

Basis of drug action at physiological and behavioral levels. Psychological and medical applications and limitations of drugs used in the treatment of mental illness. Prerequisites: PSY 325; 1 semester each of biology and chemistry.

PSY 501 Supervised Teaching. (4) F

Experience in and examination of perspectives on teaching undergraduate psychology. Prerequisites: graduate standing in psychology; instructor approval.

PSY 506 Survey of Research in Environmental Psychology. (3) F

Major topics and paradigms in the study of person-environment relationships. Prerequisite: instructor approval.

PSY 512 Advanced Learning. (3) N

Principles and theories of learning, emphasizing research literature. Prerequisite: instructor approval.

PSY 524 Advanced Physiological Psychology. (3) N

Contributions of physiological processes and brain function to fundamental behavioral processes. Prerequisite: instructor approval.

PSY 528 Sensation and Perception. (3) N

Principles of sensory and perceptual processes, emphasizing research literature. Prerequisite: instructor approval.

PSY 529 Correlation and Psychometric Theory. (3) S

Principles of correlational techniques, including regression and multiple correlation. Psychometric theory, including reliability and validity. Prerequisite: instructor approval.

PSY 530 Intermediate Statistics. (3) F

Continuation of PSY 529. Psychological statistics, emphasizing the analysis of variance and the design of experiments. Prerequisite: PSY 529 or instructor approval.

PSY 535 Cognitive Processes. (3) N

Theoretical/empirical treatment of the human organism as a processor of information, including abstraction, memory structure, problem solving, and thinking. Prerequisite: instructor approval.

PSY 541 Research in Cognitive Development. (3) N

Theoretical and empirical issues in the study of children's knowledge and cognitive processes. Comparison of research in Piagetian and other traditions. Prerequisite: admission to Psychology Ph.D. program or instructor approval.

PSY 542 Social Development. (3) N

Major issues in the area of social development are topics for review and critique. Theory, research, and content are covered. Prerequisite: instructor approval.

PSY 550 Advanced Social Psychology. (3) F, S

Theory and research concerning interpersonal perception, decision making, attitude formation and change, group processes, social motivation, and interaction processes. Prerequisite: instructor approval.

PSY 551 Advanced Social Psychology. (3) F, S

Continuation of PSY 550. Prerequisite: PSY 550 or instructor approval.

PSY 553 Social Influence. (3) N

Research literature relevant, for example, to attitude formation and change, conformity, obedience, power, compliance, and altruism. Prerequisite: PSY 551 or instructor approval.

PSY 555 Experimental and Quasi-Experimental Designs for Research. (3) N

Review of research techniques. Laboratory and field research analyzed; applications to specific topics. Prerequisite: instructor approval.

PSY 569 Advanced Study of Personality. (3) N

Personality as a theoretical concept in psychology, including definitional problems, behavioral and traditional approaches, the measurement of personality, and current research issues. Prerequisite: instructor approval.

PSY 572 Psychological Assessment. (3) F

Theory and research on assessment of personality, psychopathology, and intelligence, and construction of psychological assessment instruments. Prerequisite: admission to clinical Ph.D. program or instructor approval.

PSY 573 Psychopathology. (3) F

Theory and research relating to the contribution of psychological, social, physiological, and genetic factors to the development and persistence of abnormal behavior. Prerequisite: admission to Psychology Ph.D. program or instructor approval.

PSY 574 Psychotherapy. (3) S

A detailed survey of the theoretical and empirical literature relating to verbal psychotherapy and interviewing methods. Structured role-playing practice in the major procedures. Prerequisite: admission to the clinical Ph.D. program or instructor approval.

PSY 578 Child Psychopathology. (3) N

Major theories and research related to the development of deviant behaviors in children, including some supervised experience in child assessment. Prerequisite: PSY 572 or instructor approval.

PSY 582 Community Psychology. (3) SS

Community systems, intervention techniques, consultation models, history and current status of community mental health movement, and conceptualization of the roles of community psychologists in social system intervention. Prerequisite: advanced standing in Psychology Ph.D. program or instructor approval.

PSY 588 Consultation Methods. (3) N

Several theories and strategies of organizational consultation. The development of consultative skills through simulation and practical experience. Prerequisite: advanced standing in Psychology Ph.D. program or instructor approval.

PSY 624 Clinical Neuroscience. (3) S

An examination of the biological underpinnings of psychological disorders at the molecular, cellular, and system levels (schizophrenia, depression, anxiety, etc.). Lecture, pro-seminar. Prerequisites: graduate standing; instructor approval.

Omnibus Graduate Courses: See page 51 for omnibus graduate courses that may be offered.

PSYCHOLOGY (PGS)

PGS 414 History of Psychology. (3) F, S

Historical development of psychology from its philosophical beginnings to the present. Prerequisites: PGS 101; PSY 230, 290. *General Studies: L2/SB.*

PGS 461 Interpersonal Influence. (3) N

Principles and procedures that affect the process of social influence, consideration of attitudinal, compliance inducing, and perceptual influences. Prerequisite: PGS 350. *General Studies: SB.*

Omnibus Graduate Courses: See page 51 for omnibus graduate courses that may be offered.

Public Administration

Master's Program

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Director

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PROFESSORS

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PERRY, WESCHLER

ASSOCIATE PROFESSORS

ALOZIE, BROWN, DeGRAW, LAN, VINZANT

ASSISTANT PROFESSORS

CAMPBELL, DELORENZO, McCABE

DISTINGUISHED RESEARCH FELLOW

PFISTER

The faculty in the School of Public Affairs prepare students and practitioners for leadership in public service. Faculty also engage in research and service programs that advance understanding of public affairs and serve the public's policymaking needs.

Faculty participate in offering an interdisciplinary degree leading to the Doctor of Public Administration (D.P.A.).

MASTER OF PUBLIC ADMINISTRATION

Faculty in the School of Public Affairs offer a 42-semester-hour professional Master of Public Administration (M.P.A.) degree.

The M.P.A. is an interdisciplinary, professional degree designed to prepare students for public service, public management, and policy analysis at the local, state, and national levels of government. The M.P.A. degree is accredited by the National Association of Schools of Public Affairs and Administration (NASPAA).

Admission. Applicants to the M.P.A. program are considered for admission irrespective of undergraduate major, although students may be required to complete additional courses and/or workshops to prepare themselves for the core courses.

The applicant's undergraduate GPA, GRE scores (verbal, quantitative, and analytical), letters of recommendation, statement of educational and career goals, and professional experience are all considered in the admissions process. In addition, TOEFL scores (550 or higher) are required for international students. Admission may be limited by space availability.

Applications for admission can be sent at any time. Students requesting graduate assistantships and tuition scholarships should have their application files completed by March 1.

All applicants must submit the following materials to the Graduate College:

1. an official application;
2. official transcripts of all undergraduate and graduate work;
3. scores on the GRE (verbal, quantitative, and analytical; special subject tests not required); and
4. TOEFL scores for international students.

All applicants must submit the following materials to the School of Public Affairs:

1. three letters of recommendation, at least two of which should be written by faculty who can evaluate the applicant's academic performance;
2. a written statement of applicant's educational and career goals, which also is used as a sample of the applicant's writing abilities; and
3. resume or additional documents as the applicant sees fit.

Program of Study. The M.P.A. program consists of 42 hours of graduate credit. Students take 27 of these hours in nine core classes in the School of Public Affairs, and 15 additional hours in elective courses.

No more than nine semester hours of ASU graduate courses taken before admission to the school and approved by the M.P.A. Committee can be included in the Program of Study.

Students enrolling in core courses must demonstrate minimum competency in statistics, American government, and computer applications. Courses taken to fulfill the competency do not count toward the 42-hour degree program. Competency in statistics or American government is met with a grade of "B" or higher in approved courses, passing a diagnostic test approved by the M.P.A. Committee, or earning a grade of "B" or higher in such approved courses as PAF 401, POS 401, PSY 230, QBA 221, and SOC 390 for statistics and POS 310 for American government. Competency in computer applications is met by enrollment in university short courses and training seminars.

Internship. A public service internship is recommended for M.P.A. students without previous administrative experience in government. The purpose of the internship is to provide students with practical and professional experience in a specific career area. Students work in and for public organizations applying the knowledge, skills, and abilities acquired in their program of study. During the internship experience, students can develop a professional network that will aid them in their pursuit of a career in government or non-profit organizations. Students can apply three hours of internship credit to the degree program. To receive course credit for an internship, students are required to attend class sessions and submit a paper to the internship coordinator.

Foreign Language Requirements. None.

Comprehensive Examination. None.

Thesis Requirements. None.

Capstone Requirement. The M.P.A. degree requires students to demonstrate competency for public service by synthesizing and applying core course knowledge, skills, and abilities to public service problems. Students demonstrate their public service competency by earning an "A" or a "B" in the M.P.A. capstone course, PAF 509 Public Service.

Morrison Institute for Public Policy

As an integral part of the School of Public Affairs, the Morrison Institute is an applied public policy research center that conducts research on public policy, informs policy-makers and citizens about issues, and advises leaders on choices and actions. In partnership with government officials, university faculty, and the private sector, the Morrison Institute conducts research, policy forums, program evaluations, and strategic planning for public, private, and non-profit clients. The Institute produces publications on a wide range of topics, including urban growth, education, natural resources, governmental systems and relations, health care, social services, quality of life, and economic development.

Advanced Public Executive Program (APEP)

APEP is a continuing education program designed to provide public-sector executives with analytical approaches and skills in leadership, policy analysis, total quality management, media relations, organizational development, team-building, and communication. Located at the ASU Downtown Center, APEP sponsors the Certified Manager Program (CPM), the Institute for Public Executives, Total Quality Management in the Public Sector, the County Elected Officials' Certification Program, and presents custom-tailored professional development programs for public-sector managers.

PUBLIC AFFAIRS (PAF)

PAF 401 Statistics. (3) F, S

Survey of statistical concepts and techniques with application to public administration. Does not count toward program of study. Satisfies statistics prerequisite requirement for PAF 501 and 502.

PAF 501 Public Service Research. (3) F, S

Philosophy, scope, and methods; public service research design, values, and ethics. Prerequisite: an approved course in statistics.

PAF 502 Computer Applications. (3) F, S

Computer applications in public affairs; software packages for data analysis, decision making, information dissemination, and problem solving. Prerequisite: PAF 501.

PAF 503 Public Affairs. (3) F, S

The development and context of American public administration and policy, the role of administration in governance, and values and ethics in administration.

PAF 504 Public Affairs Economics. (3) F, S

The basics of public sector economics, microeconomic and macroeconomic concepts applied to public sector decisions and policies.

PAF 505 Public Policy Analysis. (3) F, S

Institutional and formal analysis of policy processes, decision making, and problem solving; values, ethics, and the uses of policy analysis. Prerequisites: PAF 504; satisfaction of the statistics requirement.

PAF 506 Public Budgeting and Finance. (3) F, S

The legal, social, economic, political, institutional, and ethical foundations of governmental finance, budgets, and budgeting. Prerequisites: PAF 502, 504.

PAF 507 Public Human Resource Management. (3) F, S

Personnel systems, behavior and management of people in public organizations, collective behavior, unionism, conflict management, motivation, productivity, and ethics.

PAF 508 Organization Behavior. (3) F, S

Theory and application in the management of organizational behavior with emphasis on leadership and the public service.

PAF 509 Public Service. (3) F, S

Capstone application of core course knowledge, skills, and abilities required for public service. Prerequisites: PAF 501, 502, 503, 504, 505, 506, 507, 508.

PAF 510 Governmental Budgeting. (3) N

Theories, applications, and consequences of budget decision making. Prerequisite: PAF 504.

PAF 511 Governmental Finance. (3) N

Sources of funding, management of funds and debts, and general pattern of expenditures in states, counties, cities, and districts. Prerequisite: PAF 504.

PAF 520 Public Management. (3) N

The management process in government and public agencies, with emphasis on the executive leadership within the public sector.

PAF 521 Organization Theory. (3) N

Organization theory and current research emphasis with application to public administrative organizations.

PAF 522 Public Labor Relations. (3) N

Rise of public unionism, managerial policy toward unionism, conflict resolution, impact of unionism on budgets, personnel policies, and public policy.

PAF 523 The City and County Manager. (3) A

The manager's role and resources in the differing forms of administrative, legislative, and community sectors.

PAF 525 Public Program Management. (3) N

Governmental service programming: formulating, financing, operating, evaluating, and reporting. Analysis of interagency relationships and the role and conduct of research in the programming process.

PAF 526 Public Sector Human Resource Development. (3) N

Concepts and techniques of organizational development in the public sector, including staffing, supervisor training, executive development, resource planning, and employee training.

PAF 529 Organization Change and Development. (3) N

Exploring the nature and management of change and development as a tool to achieve organizational goals; effecting planned change.

PAF 530 Management of Urban Government. (3) N

Administrative practices and behavior within the urban political administrative environment. Functional areas such as citizen participation, urban planning, urban transportation, and the conflicts between urban politics and administrative efficiency.

PAF 531 Community Conflict Resolution. (3) N

Interdisciplinary approach to understanding the dynamics of community conflict. Strategic considerations in policy design and advocacy; potential reaction to conflict. Relevant models and research findings generated by both case studies and comparative methods.

PAF 532 Urban Planning Administration. (3) N

Historical and present day uses of urban planning and procedures for its implementation. Basic principles and practices.

PAF 533 Urban Growth Administration. (3) N

Examines the process of urban growth and change. Partnership roles played by public and private sectors in management are emphasized.

PAF 535 Urban Housing Policy. (3) N

Comprehensive consideration of the revitalization of American cities with major emphasis upon the housing process and related institutions and services.

PAF 536 Urban Policy Making. (3) N

Analysis of the opportunities and costs of influencing public policy and the roles of officials and bureaucracies in decision making.

PAF 540 Advanced Policy Analysis. (3) A

Emphasizes the structure of policy problems, forecasting policy alternatives, optimizing resources, and reducing uncertainty in policy making. Prerequisite: PAF 505 or instructor approval.

PAF 541 Program Evaluation. (3) N

Various methodologies available for the evaluation of public policies and programs. Prerequisite: PAF 501 or instructor approval.

PAF 546 Environmental Policy and Management. (3) N

Analysis of environmental policy and planning issues and principles related to the analysis and management of natural and urban/regional resources.

PAF 547 Science, Technology, and Public Affairs. (3) N

The influence of science and technology on governmental policy making, scientists as administrators and advisors, governmental policy making for science and technology, government as a sponsor of research and development.

PAF 548 Women, Politics, and Public Policy. (3) N

Explores how political philosophy, politics, and public policy affect and are affected by women.

PAF 549 Diversity Issues and Public Policy. (3) N

Examination of public policy issues concerning or affecting women, black, Latino, Asian, and American Indian communities, as well as those groups' impact on the policy process.

PAF 550 Information Management. (3) N

Concepts and theory of information and information technology in public sector organizations.

PAF 551 Computers in Administration. (3) N

Experience in use of computer technology for public administration problem solving.

PAF 552 Public Information Systems. (3) N

Systems analysis concepts and theory as applied to administration. Alternative modes of information organization and their impact on public decision making.

PAF 555 Research Data Management. (3) N

Techniques and problems associated with data management in a research environment. Database management systems, security and integrity, accessibility, and cost.

PAF 556 Database Management Systems. (3) N

Concept and use of modern database management systems in an administrative organization. Advantages and disadvantages of this approach.

PAF 561 Comparative Administration. (3) N

Literature on comparative public administration theory. Bureaucracies and their impact on the political development process. Selected nations are studied.

PAF 562 Intergovernmental Relations. (3) A

Evolution, growth, present status, and characteristics of the U.S. federal system of government. Federal-state relations, state-local relations, regionalism, councils of government, interstate cooperation, grants-in-aid, and revenue sharing.

PAF 563 Report Preparation. (3) N

Intensive practice in written and oral presentation of reports to conferences with problems in public administration. Visual aid techniques.

PAF 564 Political Economy. (3) A

Classical and contemporary literature and historical development of governmental and economic arrangements, with special emphasis on the role of the state.

PAF 591 Seminar. (1–12) F, S

Topics may include but are not limited to the following:

- (a) Business and Government
- (b) Emergency Management
- (c) General Public Administration
- (d) Information Management
- (e) Public Finance Administration
- (f) Public Management
- (g) Public Policy Analysis
- (h) Urban Affairs and Urban Planning

Omnibus Graduate Courses: See pages 51–52 for omnibus graduate courses that may be offered.

Public Administration

Interdisciplinary Doctoral Program

Nicholas O. Alozie

Director, Executive Committee

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Agribusiness

Professors: Edwards, Thor

Communication

Professor: Petronio

Economics

Professor: Hogan

Geography

Professor: Burns

Health Administration and Policy

Professor: Johnson

Journalism and Telecommunication

Professor: Merrill

Justice Studies

Regents' Professors: Altheide, Palumbo;
Professors: Hepburn, Musheno, Schneider

Management

Professor: Bohlander

Planning and Landscape Architecture

Professors: Mushkattel, Pijawka

Political Science

Professor: Berman

Psychology

Associate Professor: Castro

Public Affairs

Professors: Cayer, Hall, Mankin, McGaw, Monteil,
Perry, Weschler;

Associate Professors: Alozie, Brown, Lan, Vinzant;
Assistant Professors: Campbell, DeLorenzo, McCabe

Recreation Management and Tourism

Associate Professor: Virden

Social Work

Professors: Kettner, MacEachron

Sociology

Professor: Nagasawa;

Associate Professor: Benin

DOCTOR OF PUBLIC ADMINISTRATION

The Committee on Public Administration offers an interdisciplinary graduate program leading to the Doctor of Public Administration degree.

The purpose of the Doctor of Public Administration (D.P.A.) degree program is to prepare skilled professional public administrators for high-level positions in the public sector, and to foster the next generation of public administration scholars in research and university teaching. The program is designed to emphasize both normative and conceptual content pertaining to value assessments, theoretical assumptions, ethics, and modes of decision making, as well as practitioner problem-solving skills in budgeting, public personnel management, public finance, planning, program evaluation, and policy analysis.

The D.P.A. degree program is interdisciplinary in nature and is offered by faculty from various colleges. One of the unique features of this interdisciplinary program is that, because it utilizes faculty research and teaching interests from a number of academic units, a student may tailor a course of study to fit individual needs and goals. The D.P.A. degree program is administered by an executive committee appointed by and responsible to the dean of the Graduate College.

Admission. Applications are reviewed by an admissions committee appointed by the director of the executive committee. Recommendations for admission are made by the director of the executive committee to the dean of the Graduate College. Minimum Graduate College admission requirements, as stated on page 93, must be met. Additionally, each applicant must provide a letter of career goals and statement of reasons for seeking the D.P.A. degree, a GRE

test score, a professional résumé, and six letters of recommendation (three from faculty and three from professional public administrators). International students must submit both TOEFL and TSE scores. Admissions recommendations are made only once each year, with admitted students beginning their studies in the fall semester. To assure consideration for the ensuing fall semester, submit applications for admission, graduate assistantship, and tuition waiver by February 15. Only applicants already holding a master's degree are considered. If deficiencies exist in public administration course work at the master's level, appropriate classes are prescribed.

Program of Study. When the program of study is filed, a supervisory committee consisting of at least three persons is appointed by the dean of the Graduate College upon the recommendation of the director of the executive committee. The chair of the supervisory committee serves as the student's graduate advisor. The supervisory committee advises the student in developing a program of study and assumes primary responsibility in assessing the student's progress in the program. The program consists of a minimum of 66 semester hours of graduate work beyond the master's degree. Of the 66 semester hours, at least 24 must be dissertation and research credit. A minimum of 30 semester hours of approved course work, exclusive of dissertation and research, must be taken at ASU after admission to the program. A sequence of four core courses is required of all students, followed by a screening examination. In addition to the four core courses, an approved program of study must have a course listed in each of the following areas: quantitative research methods, qualitative research methods, political economy, and democratic theory and governance.

Residency. The minimum residency requirement for the D.P.A. degree consists of 30 semester hours of doctoral program credit within a period of 24 consecutive months.

Comprehensive Examinations. Upon completion of course work, and before dissertation research, the student is given a written examination in each of the areas of specialization. The written examinations are followed by a single oral examination. If the student should fail one or more components of the examination, a re-examination may be administered no sooner than three months and no later than one year from the date of the original examination. Approval for this re-examination must be obtained from the supervisory committee, the director of the executive committee, and the dean of the Graduate College. A second failure is considered final and dismissal from the program is recommended to the Graduate College.

Candidacy. Doctoral students should apply for admission to candidacy immediately after they have met all requirements for the degree, *except the dissertation*. These requirements include passing the comprehensive examinations and other requirements specified by the executive committee.

Dissertation Requirements. A dissertation is required of each student. The dissertation must consist of a fully documented written analysis demonstrating a high level of skill and competence. Each student must register for a minimum of 24 hours of dissertation and research. The dissertation is supervised by a committee of at least three faculty members appointed by the dean of the Graduate College. (Each stu-

dent is required to complete at least two colloquium hours of 799 as part of the dissertation proposal.)

Final Examinations. The final oral examination in defense of the dissertation is scheduled by the dean of the Graduate College and conducted by the student's dissertation committee. A candidate must pass the final examination within five years after completing the comprehensive examination. Any exception must be approved by the dissertation committee, the director of the executive committee, and the dean of the Graduate College.

Graduation. The student is eligible for graduation when the Graduate College scholarship requirements have been met, the final oral examination has been passed, and the dissertation has been approved by the supervisory committee and accepted by the director of the executive committee and the dean of the Graduate College.

Applications for graduation should be made no later than the date specified in the Graduate College calendar.

PUBLIC AFFAIRS (PAF)

PAF 600 Research Design and Methods. (3) A

Advanced methods of research design and data collection. Prerequisites: formal graduate-level course work in statistics and in research methods.

PAF 601 Seminar: Policy Analysis and Evaluation. (3) A

Normative and conceptual issues of policy formulation, implementation, and evaluation; methods of policy analysis and evaluation.

PAF 602 Seminar: Foundations of Public Administration. (3) A

Ethical, social, legal, and philosophical foundations of public administration.

PAF 603 Seminar: Organization and Behavior in the Public Sector. (3) A

Structure, organization, conduct, and performance of public sector institutions in the administration of public policy. Prerequisite: PAF 602.

Omnibus Graduate Courses: See pages 51–52 for omnibus graduate courses that may be offered.

Recreation

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PROFESSORS

ALLISON, HALEY, YOSHIOKA

ASSOCIATE PROFESSORS

TEYE, VIRDEN

ASSISTANT PROFESSORS

ASHCRAFT, BAKER, MARTINEZ, PRITCHARD,
SCHNEIDER, SONMEZ

MASTER OF SCIENCE

The faculty in the Department of Recreation Management and Tourism offer a program leading to the M.S. degree in Recreation.

The M.S. degree program is designed to prepare students to analyze critical topics and issues pertinent to the field of leisure and recreation. Its four areas of concentration are: outdoor recreation, recreation administration, social/psychological aspects of leisure, and tourism and commercial recreation.

Students choose between two academic options: the thesis option or the nonthesis option that includes the completion of an applied project.

Admission. Students applying to the M.S. program must have achieved a GPA of 3.00 or the equivalent in the last two years of work leading to the bachelor's degree. Applicants should submit their application, application fee, and all undergraduate transcripts to the Graduate College prior to February 15. To be considered for fall admission, candidates must have their Graduate Record Examination (or Miller's Analogy Test) scores, a statement of professional and academic goals, and three letters of recommendation sent to the Department of Recreation Management and Tourism by March 1. Only complete application files will be reviewed by the graduate faculty for admission and assistantship consideration. Students without undergraduate academic work in the recreation/tourism disciplines will be required to take six semester hours of deficiency course work in addition to the M.S. degree requirements. Deficiency course work may be taken in conjunction with M.S. degree classes.

Program of Study. Completion of the M.S. degree in Recreation on the average requires approximately two years of study. Students may select a thesis or nonthesis option. The thesis option is a research-oriented degree and is recommended for students planning to continue graduate studies beyond the master's degree. The nonthesis option is intended for students seeking additional knowledge and expertise relevant to professional career development in the recreation field. Advisement and direction in both options are under the direct supervision of a faculty member.

Program Requirements: Thesis Option. The thesis option requires the successful completion of a minimum of 30 semester hours, of which six to nine hours can be taken outside of the Department of Recreation Management and Tourism. Included in the 30 semester hours are six hours of thesis (REC 599), which must be defended in an oral examination before a supervisory committee of at least three faculty members.

REC 500 Research Methods I	3
REC 501 Research Methods II	3
REC 552 Historical and Philosophical Foundations of Leisure	3
REC 555 Social and Psychological Aspects of Leisure Behavior.....	3
REC electives (within the major).....	6-9
Electives (outside the major)	6-9
Thesis	6
Minimum total	30

Program Requirements: Nonthesis Option. The nonthesis option consists of 39 semester hours, of which 12 semester hours may be taken outside the department. This option includes three hours of applied project (REC 593). The applied project should reflect a substantive analysis of a pro-

fessionally oriented topic related to the student's area of concentration. Before final approval, the student's project must be defended in an oral examination and must receive the written approval of two department faculty members who serve on the supervisory committee.

REC 500 Research Methods I	3
REC 552 Historical and Philosophical Foundations of Leisure	3
REC 555 Social and Psychological Aspects of Leisure Behavior.....	3
REC 593 Applied Project	3
REC 598 Special Topics	3
REC Electives (within the major).....	12
Electives (outside the major)	12
Minimum total	39

Foreign Language Requirements. None.

Thesis Requirements. A thesis is an option.

Final Examinations. A final oral examination in defense of the thesis or an applied project is required.

RESEARCH ACTIVITY

The study of leisure and recreation is a multidisciplinary field of research, scholarship, and program development. Recent scholarly activity of departmental faculty and students reflects this approach. Major research areas include the following: international travel and tourism; philosophy of leisure; recreation resource planning; social and psychological analyses of leisure behavior; leisure and youth development; travel and tourism policy and planning; urban recreation administration; outdoor recreation and wilderness management; cross-cultural analysis of play and leisure; gender differences in leisure behavior patterns; non-profit agency leadership/management.

RECREATION (REC)

REC 500 Research Methods I. (3) A

Introduction to recreation research methods, with emphasis on methodological questions, research issues, and techniques relevant to contemporary social research. Prerequisite: 500-level or higher approved statistics course.

REC 501 Research Methods II. (3) N

Advanced treatment of methodological issues, analysis of data, computer applications, and thesis proposal development. Prerequisite: REC 500.

REC 540 Recreation Services for the Aged. (3) N

An applied orientation to the social/psychological theories of recreation and the aged.

REC 552 Historical and Philosophical Foundations of Leisure. (3) A

An analysis of the fundamental historical and philosophical concepts, issues, and problems confronting the leisure studies profession.

REC 555 Social and Psychological Aspects of Leisure Behavior. (3) A

An empirical and theoretical analysis of social, cultural, and psychological foundations of leisure behavior.

REC 558 Integrative Seminar. (3) A

Advanced exploration and assessment of current trends within the leisure studies profession. This course has variable topics, including, but not limited to: cross-cultural analysis of leisure, urban recreation, planning and resources, sociocultural dimensions of tourism development, wilderness management. Prerequisite: REC 552.

REC 569 Current Issues in Tourism. (3) A

General survey of the tourism literature with an emphasis on relevant theories, concepts, and current research.

REC 570 Social Aspects of Outdoor Recreation Management. (3)
A

An analysis of the social aspects of natural resource recreation management and planning. Prerequisite: REC 370 or equivalent.

Omnibus Graduate Courses: See page 51 for omnibus graduate courses that may be offered.

Religious Studies

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PROFESSORS

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COUDERT, GEREBOFF, MOORE, MORRISON, SCHOBER,
SWANSON, WOODWARD

ASSISTANT PROFESSORS

CLAY, FESSENDEN, UMAR

LECTURER

DAMREL

The faculty of the Department of Religious Studies offer a graduate program leading to the M.A. degree in Religious Studies. This program is designed to serve three main purposes. It offers intensive training in research methods and in select special fields for students who seek to qualify for doctoral programs at leading universities. It serves as specialized training for those who plan to teach religious studies subject matters in colleges and high schools or who wish to bring cultural and cross-cultural analytical tools to professions such as business, social work, government, and journalism. It allows qualified persons in nonacademic occupations the opportunity to acquire competence in the study of religions, broadly defined, and in areas of special interest.

Course offerings and faculty appointments reflect the commitment of the department to a balance of Western and Asian, historical and conceptual, methodological, and subject-oriented areas of study. This programmatic diversity is maintained in a context of scholarly collegiality involving both faculty and graduate students.

MASTER OF ARTS

See "Master's Degrees," page 98, for general requirements.

The graduate program leading to the M.A. degree provides two options: (1) a thesis option and (2) a portfolio option. While admission requirements and procedures are identical for both options, requirements for degree completion vary as indicated.

Admission. In order to be eligible for admission to the graduate program in Religious Studies, an applicant must meet Graduate College requirements. See "Master's Degrees," page 98, and provide the following:

1. The student must submit test scores from the Graduate Record Exam (older returning students may petition the department to have this requirement waived).
2. The student must have completed the equivalent of 15 hours of undergraduate work in the study of religions, including advanced courses in both Western and Asian or other non-Western religions. Students without the necessary background in religious studies may remove deficiencies by taking additional specified courses (which may or may not count toward the fulfillment of degree requirements) at the beginning of their program of study.
3. The student must request three academic letters of reference to be sent to the graduate coordinator of the department.
4. The student must submit an essay of approximately 1,000 words outlining the academic background, career goals, and specific area of interest in religious studies in relation to fields offered by the faculty.

Complete applications are due by February 1. Students will receive notification from the department by April 1. Graduate assistantship awards are also announced on or about April 1. Late applications and applications for spring semester are reviewed on an individual basis.

GRADUATE PROGRAM REQUIREMENTS

Thesis Option. This option is recommended for students intending to seek admission to a doctoral program upon completion of the M.A. degree or planning to teach in the discipline at community colleges. For the thesis option the student must satisfy the following requirements:

1. reading knowledge of French, German, or another language relevant to the proposed thesis topic is normally required. At the discretion of the student's supervisory committee, the requirement may be waived for students who either are not planning to enter a doctoral program or are planning to pursue doctoral work that does not require proficiency in foreign languages;
2. 24 hours of course work, including six hours in methods and theory (REL 501, 502); three hours of research in the field of the thesis topic (REL 592); and six hours of graduate seminar (REL 591), offered each semester on varying topics within the academic study of religion;
3. a thesis that earns six semester hours of Thesis 599 credit; and
4. an oral defense of the thesis.

Portfolio Option. This option is recommended for students intending to augment their primary area of expertise and professional training in fields such as journalism, law, teaching K-12, counseling, social work, the ministry, and others. For the portfolio option, the student must satisfy the following requirements:

1. reading knowledge of a foreign language relevant to the proposed area of concentration. At the discretion of the student's supervisory committee, the requirement may be waived;

2. 30 hours of course work, including six hours in methods and theory (REL 501, 502); six hours of graduate seminar (REL 591); four courses in a major area of concentration; and two courses in a minor area;
3. a portfolio consisting of three papers: one on theory and method, one on the student's minor area of study, and one on the major area of study. Although portfolio papers may germinate from ideas generated in graduate seminars, they will be of publishable quality and make substantive contributions to the scholarship of the field. Credit towards completing the portfolio may be earned as part of the required credit hours outlined in (2); and
4. an oral defense of the portfolio.

RESEARCH ACTIVITY

Areas of faculty research include the following: American folk religion, American civil religion, and American spirituality (Wentz); African American religions (Moore); Islam (Woodward, Damrel, Umar); medieval and folk Hinduism (Feldhaus); popular religion and culture in Japan from medieval times to present (Foard); Rabbinic Judaism and religion and ethics (Gereboff); Jewish philosophy and theology (Samuelson); North and South Native American religions, including issues in cross-cultural contact (Morrison, Swanson); Religion and Science (Samuelson, Coudert); Russian and East European religions (Clay); modern religious thought and religion and the public/private boundary (Cady); religion and gender (Fessenden); the religions of Southeast Asia, including issues of modernization (Schober, Woodward); and religion and nationalism (Damrel, Clay, Woodward, Umar).

RELIGIOUS STUDIES (REL)

REL 410 Judaism in Modern Times. (3) N

Variety of expressions of Judaism and Jewishness in the modern period. Topics may include American Judaism or religious responses to the Holocaust. *General Studies: HU, H.*

REL 415 The Jewish Mystical Tradition. (3) A

Examination of some of the esoteric lore of Judaism. Movements and literature such as Hasidism and Kabbalah are studied. *General Studies: HU.*

REL 420 Religion in American Life and Thought. (3) A

The influence of religion on American society, culture, and ideas; the distinctive character of religion in America. Prerequisite: REL 320 or 321 or equivalent. *General Studies: L2/HU.*

REL 426 American Preachers and Preaching: The Sermon in America. (3) N

The life and work of notable American preachers. The emergence of the preacher as representative of American religion. Prerequisite: REL 320 or 321 or equivalent. *General Studies: L2/HU.*

REL 427 American Religious Thought. (3) N

The thought of representative American religious thinkers, i.e., Jonathon Edwards, William Ellery Channing, Horace Bushnell, and Reinhold Niebuhr. Prerequisite: REL 320 or 321 or equivalent. *General Studies: HU, H.*

REL 444 Religion in Japan. (3) F

Religion in Japanese history, especially the development of Japanese Buddhism, and religion in the modern transformation of Japan. Prerequisite: instructor approval. *General Studies: HU, G, H.*

REL 460 Studies in Islamic Religion. (3) A

Issues in the interpretation and understanding of Islamic texts, history, society, culture, and rituals. Prerequisites: REL 365 and Religious Studies major or instructor approval. *General Studies: HU, G.*

REL 470 Religion in the Middle Ages. (3) A

Religious aspects of medieval life and thought; variety of forms of dissent, heresy, and reform movements from the 4th to 13th centuries. *General Studies: HU, H.*

REL 471 Reformation and Modern Christianity. (3) A

Protestant Reformation to contemporary Christian movements; includes factors in the dissolution of the Medieval Christian synthesis, variety of reform movements and reformation patterns, Catholic counter-reform measures, formation of liberal theology, ecumenical movement, and the World Council of Churches. *General Studies: HU, H.*

REL 486 Modern Critics of Religion. (3) A

Major theories and critiques of religion among modern social, philosophical, and religious thinkers. *General Studies: HU.*

REL 494 ST: Special Topics in Religious Studies. (3) N

Open to all students, freshmen by instructor approval only. Topics may be selected from various areas.

REL 498 PS: Pro-Seminar in Religious Studies. (3) A

For students with a major or minor emphasis in Religious Studies.

REL 501 Research Methods in Religious Studies. (3) F

An exploration of the major themes and methods in the study of religion, with primary focus on classical texts. Lecture, discussion.

REL 502 Research Methods in Religious Studies. (3) F, S

An exploration of the major themes and methods in the study of religion, with primary focus on contemporary texts. Lecture, discussion.

REL 591 Seminar. (3) N

Topics on methodological issues in the study of religion. Prerequisite: Religious Studies graduate student or instructor approval.

REL 598 ST: Special Topics. (3) F, S

Topics are selected from the following areas:

- (a) Christianity, Greco-Roman Religion
- (b) Comparative Western, Ancient Near East, Judaism
- (c) Islam
- (d) Native American Religion
- (e) Problems in Religious Studies
- (f) Religion in America
- (g) Religion in East Asia
- (h) Religion in South Asia
- (i) Study of Religion, Comparative Religion
- (j) Western Religious Thought, Ethics

May be repeated for credit.

Omnibus Graduate Courses: See page 51 for omnibus graduate courses that may be offered.

Renaissance Studies

See "Medieval and Renaissance Studies," page 248.

Scholarly Publishing

Certificate Program

Beth Luey

Director

(SS 225H) 480/965-5775

aabel@asuvm.inre.asu.edu

www.asu.edu/clas/history/graduate/ScholarlyPublishing.html

SENIOR INSTRUCTIONAL PROFESSIONAL

LUEY

Graduate students in any discipline may pursue a Certificate in Scholarly Publishing in conjunction with their degree programs. The program is also open to students who already hold graduate degrees. Students gain an understanding of the structure of scholarly publishing (scholarly books, journals, reference books, college textbooks, and scholarly

electronic media), its role and responsibility in society, the legal and ethical issues that impinge upon it, and its economics. They also learn to perform the responsibilities of editors, designers, or producers of scholarly publications. Course work includes a required core, required courses in editing or design, and electives from a variety of disciplines. The certificate requires 28 hours of course work, including six internship hours. Some courses may be applied to both the certificate and the student's degree program. Applicants are strongly urged to submit Graduate Record Examination aptitude scores; a writing sample is required. Application deadline is February 1. For more information, contact the director, Scholarly Publishing Program, SS 225H, 480/965-5775.

SCHOLARLY PUBLISHING (PUB)

PUB 501 Introduction to Scholarly Publishing. (3) F

An introduction to the purpose, organization, and operation of scholarly publishing, including its history, societal role, and current issues. Lecture, discussion. Prerequisite: graduate standing.

PUB 502 Scholarly Editing. (3) F

Publishing procedures, proofreading, and manuscript editing of scholarly books, textbooks and scholarly journals. Lecture, discussion. Prerequisite: admission to scholarly publishing certificate program. Pre- or corequisite: PUB 501.

PUB 503 Advanced Scholarly Editing. (3) S

Advanced manuscript editing, acquisitions, developmental editing, and indexing of scholarly books, textbooks, and scholarly journals. Lecture, discussion. Prerequisites: PUB 501, 502.

PUB 510 Research in Scholarly Publishing. (3) S

Individual or group research projects on issues in scholarly publishing, including legal, economic, design, technological, and related topics. Directed research, discussion. Prerequisites: PUB 501; admission to scholarly publishing certificate program.

PUB 584 Scholarly Publishing Internship. (1–6) A

Structured, supervised, practical experience with a scholarly publisher or other appropriate publishing enterprise. Internship. Prerequisites: PUB 501; 9 hours in scholarly publishing core; instructor approval.

PUB 598 ST: Special Topics in Scholarly Publishing. (1) S

One-week short courses covering special topics in scholarly publishing, to be taught by visiting publishing professionals. Lecture, discussion. Prerequisites: PUB 501; admission to scholarly publishing certificate program.

Omnibus Graduate Courses: See page 51 for omnibus graduate courses that may be offered.

Science and Engineering of Materials

Interdisciplinary Doctoral Program

James Adams

William Petuskey

Codirectors

(PS A323) 480/965-2460

sem@asu.edu

www.asu.edu/graduate/SEM

Center for Solid-State Science

Professor: Carpenter

Senior Research Scientist: Crozier

Research Scientist: McCartney;

Associate Research Scientists: McKelvy, Sharma

Assistant Research Scientist: Kim

Chemical, Bio, and Materials Engineering

Professors: Adams, Dey, Krause, Mahajan

Chemistry and Biochemistry

Regents' Professor: Buseck;

Professors: Glaunsinger, McMillan, Petuskey;

Assistant Professor: Kouvetakis

Electrical Engineering

Regents' Professor: Ferry;

Professors: Kozicki, Schroder, Zhang

Mechanical and Aerospace Engineering

Professor: Sieradzki

Physics and Astronomy

Professors: Bennett, Rez, Sankey, Scheinfein, Smith, Tsong, Venables;

Associate Professors: Culbertson, Herbots, Marzke

The Committee on the Science and Engineering of Materials offers an interdisciplinary graduate program leading to the Ph.D. 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 comprising the program are from several academic research units in the College of Liberal Arts and Sciences and the College of Engineering and Applied Sciences: the Center for Solid-State Science; the Departments of Chemical, Bio, and Materials Engineering; Chemistry and Biochemistry; Electrical Engineering; Mechanical and Aerospace Engineering; Physics and Astronomy.

DOCTOR OF PHILOSOPHY

The Ph.D. degree in the Science and Engineering of Materials is an interdisciplinary program of study that integrates courses offered by faculty representing various disciplines noted above, 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 Graduate College. 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 (verbal, quantitative, analytical), a professional resume, 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 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 Ph.D. 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 22 semester hours of selected courses in the science and engineering of 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	Materials Thermodynamics	3
CHM 545	Quantum Chemistry I	3
	or EEE 591 PS: Quantum Mechanics for Engineers (3)	
	or PHY 471 Quantum Mechanics (3)	
MSE 514	Physical Metallurgy	4
MSE 550	Materials Characterization	3
PHY 481	Solid-State Physics	3
SEM 598	Graduate Student Seminar	3
Total		22

Students may choose one of the following concentrations in their program of study: (1) high-resolution nanostructure analysis and (2) solid-state device materials design, or 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 comprising the high-resolution nanostructure analysis concentration are 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 is fully one-third 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 ASU's strongest materials research and education specialities and is an important part of the SEM Program. Required courses are as follows:

SEM 556	Electron Microscopy Laboratory	3
SEM 557	Electron Microscopy Laboratory	3
SEM 558	Electron Microscopy I	3
SEM 559	Electron Microscopy 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 in depth 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 Design of Engineering	3
IEE 572	Design of Engineering Experiments	3
MSE 518	Integrated Circuit Materials Science	3
Total		15

Preliminary/Qualifying Examination. The student must take a preliminary examination at the end of the first year in the program. Under exceptional circumstances, the student can petition to the Curriculum and Examination Committee to postpone taking the exam until the third or fourth semester. The examination is principally for diagnostic purposes and unsatisfactory performance may require additional course work or study. The examination addresses topics central to the science and engineering of materials, such as classical thermodynamics, physical metallurgy, materials science and materials characterization, kinetics and diffusion, structure, continuum mechanics and defects in solids, quantum mechanics and chemistry, solid structure, inorganic chemistry, statistical thermodynamics, and experimental methods. Results of the examination are used by the student's advisor and/or faculty supervisory committee in formulating a program of study for the student. Students with thorough undergraduate preparation in physical chemistry, engineering physics, solid-state physics, engineering science, solid-state device engineering, physical metallurgy, physical ceramics, applied mathematics, and similar backgrounds are best prepared for study of the science and engineering of materials.

Foreign Language Requirements. None.

Comprehensive Examinations. 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 examines the student's knowledge in the core course subjects as well as those topics covered in the preliminary examination. 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 will define the problem, describe its significance in the field, propose a method of investigation leading to a solution of the problem, and defend 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 directly related to the student's dissertation topic. The student must prepare and deliver to the members of the supervisory committee a written proposal describing the research proposition not less than two weeks prior to 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 the Graduate College. Upon successful completion of this examination, the student is

expected to apply to the dean of the Graduate College for formal admission to candidacy for the degree.

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 at least 24 semester hours of research and dissertation credit as part of the requirement.

Final Examinations. The final oral examination in defense of the dissertation is conducted by the student's dissertation committee and others appointed by the dean of the Graduate College.

RESEARCH ACTIVITY

The faculty in the Science and Engineering of Materials Program have established vigorous research programs in the field. Current results are discussed regularly by faculty, research staff, graduate students, and external invited speakers in several regular seminar series. Students in the program have the opportunity to participate and interact directly with speakers.

Areas of current research include the structure and properties of semiconductors such as the following: silicon and gallium arsenide; fabrication of ultrasmall solid-state electronic devices; the structure of the free surfaces of crystalline solids; the structure and properties of intercalated layer compounds; the effects of ion implantation on solids (lattice defect formation, mixing, phase transformations); environmental effects on spectral emissivity of solids; the effects of high pressure on solids; study of phase transformation mechanisms in many different types of solids; atomic structure of interfaces in metal matrix/ceramic and crystal/polymer composites. Several different laboratories containing specialized equipment and computing facilities are available to students conducting research in the program. These include the following: the Facility for High Resolution Electron Microscopy; the Center for Solid-State Electronics Research; electron spin and nuclear magnetic resonance spectroscopy laboratories; several materials preparation laboratories; a Raman spectroscopy laboratory; atomic absorption, X-ray fluorescence, and mass spectroscopic laboratories; X-ray diffraction laboratories; optical microscopy laboratories; computer-controlled high temperature mechanical deformation facilities for constant or variable strain rate plasticity and fracture research; creep research; high temperature electron emission and thermionic energy conversion research.

Courses applicable to the Science and Engineering of Materials interdisciplinary program are taught by faculty in related departments such as chemistry and biochemistry, physics and astronomy, electrical engineering, chemical, bio and materials engineering, mechanical and aerospace engineering, and mathematics. For descriptions of these courses, see the listings under appropriate headings in this catalog.

SCIENCE AND ENGINEERING OF MATERIALS (SEM)

SEM 556 Electron Microscopy Laboratory. (3) F
Lab support for SEM 558. Cross-listed as MSE 556. Credit is allowed for only MSE 556 or SEM 556. Pre- or corequisite: MSE/SEM 558.

SEM 557 Electron Microscopy Laboratory. (3) S
Lab support for SEM 559. Cross-listed as MSE 557. Credit is allowed for only MSE 557 or SEM 557. Pre- or corequisite: MSE/SEM 559.

SEM 558 Electron Microscopy I. (3) F
Microanalysis of the structure and composition of materials using images, diffraction, and X-ray and energy loss spectroscopy. Knowledge of elementary crystallography, reciprocal lattice, stereographic projections, and complex variables is required. Cross-listed as MSE 558. Credit is allowed for only MSE 558 or SEM 558. Prerequisite: instructor approval.

SEM 559 Electron Microscopy II. (3) S
Microanalysis of the structure and composition of materials using images, diffraction, and X-ray and energy loss spectroscopy. Knowledge of elementary crystallography, reciprocal lattice, stereographic projections, and complex variables is required. Cross-listed as MSE 559. Credit is allowed for only MSE 559 or SEM 559. Prerequisite: instructor approval.

SEM 594 Vacuum System Science and Engineering. (3)
Vacuum concepts, equipment, and systems are studied to give the student an operational knowledge of modern vacuum technology. Equal emphasis will be placed on theoretical and practical instruction. Class time is equally distributed between lecture and laboratory sessions. Lab sessions will 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.

SEM 700 Research Methods. (1–6)

SEM 790 Reading and Conference. (1–6)

SEM 791 Seminar. (1)

SEM 792 Research. (1–12)

SEM 799 Dissertation. (1–12)

Omnibus Graduate Courses: See page 51 for omnibus graduate courses that may be offered.

Social and Philosophical Foundations of Education

Mary Lee Smith
Program Coordinator
(ED 104) 480/965-6248
delps@asu.edu

PROFESSORS

APPLETON, GLASS, RENDÓN, SMITH, STOUT

ASSOCIATE PROFESSORS

CASANOVA, HARTWELL-HUNICUTT

MASTER OF ARTS

The faculty in the Division of Educational Leadership and Policy Studies offer a graduate program leading to the M.A. degree in Social and Philosophical Foundations of Education. Students may also select policy analysis as an area of study.

Applicants for admission to the M.A. degree program must submit scores on the Graduate Record Examination. Candidates for the M.A. degree must pass a written comprehensive examination, in addition to writing a thesis or equivalent. An oral examination in defense of the thesis or equivalent is required.

RESEARCH ACTIVITY

Faculty research incorporates both qualitative and quantitative methodologies. Studies are being conducted on minority education, including cultural pluralism, multicultural and bilingual education, and education of women. Philosophical, sociological, historic, economic, and comparative approaches are employed. Research also focuses on the theory of evaluation and educational policy. In addition to the social and philosophical foundations of education faculty, students have the opportunity to collaborate on research projects with the faculty in higher education, educational administration and supervision, and policy studies.

EDUCATIONAL POLICY STUDIES (SPF)

SPF 501 Culture and Schooling. (3) F, S

Introduction to social science concepts of culture and the cultural milieu in which schooling takes place in the United States. Lecture, recitation.

SPF 510 Introduction to Organization and Administration of American Public Schools. (3) F, S

Organizational structure and administration of public education are explored through the application of legal and ethical concepts and relevant information of the social sciences. Cross-listed as EDA 510. Credit is allowed for only EDA 510 or SPF 510.

SPF 511 School and Society. (3) F, S, SS

Interrelationship of school and society and the role of education in social change.

SPF 520 Cultural Diversity in Education. (3) S

Philosophic and sociological investigation of cultural diversity in the United States and how it relates to education.

SPF 533 Comparative Education in the Western World. (3) N

Educational practices and traditions in the leading nations of Europe and the Soviet Union.

SPF 544 Philosophical Foundations of Education. (3) F

Theories of education in ancient, medieval, and modern classical and contemporary philosophies.

SPF 566 History of Education. (3) S

Development of educational institutions and ideas in the Western World, from ancient times to the 20th century.

SPF 612 Evaluation Theory. (3) F

Explores the major theories of evaluation (inquiry leading to value judgments) in educational policy through examination of cases.

SPF 622 Organizational Theory. (3) S

Major views of organizations and their influence on role definition and participant behaviors in educational organization. Seminar, discussion. Cross-listed as HED 688. Credit is allowed for only HED 688 or SPF 622.

SPF 711 Social and Historical Foundations of Education. (3) N

Problems of American education and their sociohistorical context.

Omnibus Graduate Courses: See page 51 for omnibus graduate courses that may be offered.

Social Work

Elizabeth A. Segal
Interim Director
 (WHALL 135) 480/965-3304
 social.work@asu.edu
 ssw.asu.edu

PROFESSORS

ASHFORD, COUDROGLOU, DALEY, KETTNER,
 LeCROY, MacEACHRON, MARTINEZ-BRAWLEY,
 MORONEY, SEGAL

ASSOCIATE PROFESSORS

GUSTAVSSON, LEYBA, MONTERO, NICHOLS, PAZ,
 RISLEY-CURTISS, WALLER, ZORITA

ASSISTANT PROFESSORS

BELL, BRZUZY, GERDES, HURDLE, MARSIGLIA, NAPOLI,
 STEINER, STROMWALL, VILLEREA

ACADEMIC PROFESSIONALS

GONZALEZ-SANTIN, JOHNSTON, KNUTSON-WOODS

The faculty in the School of Social Work offer programs leading to the Master of Social Work degree and the Ph.D. degree in Social Work.

MASTER OF SOCIAL WORK

The professional program leading to the Master of Social Work degree prepares social workers for advanced direct practice, planning administration, and community practice. The program is designed to prepare social workers capable of responding effectively to the needs of special populations in the Southwest—the ethnic groups of the region; the aged; urban and rural poor; children at risk; the disabled; and women who are victims of poverty, discrimination, and violence—in its curriculum and its practicum assignments. The Master of Social Work degree program is accredited by the Council on Social Work Education.

Application Procedures. Students applying to the graduate program in Social Work must follow the procedures for admission to the Graduate College (see “Admission to the Graduate College,” page 89). In addition the applicant must submit the following to

ACADEMIC SERVICES
 SCHOOL OF SOCIAL WORK
 ARIZONA STATE UNIVERSITY
 PO BOX 871802
 TEMPE AZ 85287-1802

1. application to the graduate Social Work program,
2. statement of educational and career goals in sufficient detail to indicate compatibility with the educational objectives and capabilities of the School of Social Work,
3. three letters of reference using the reference letter forms provided by the School of Social Work, and
4. test scores from either the GRE or the MAT.

Admission

Regular Admission. In addition to the requirements listed above, the school also requires one of the following:

1. a liberal arts undergraduate degree;
2. a B.S.W. from a Council on Social Work Education accredited school of social work; or
3. another undergraduate degree, with 30 semester hours in liberal arts courses at the undergraduate or graduate level.

The 30 semester hours described in item three above must include course work from the social/behavioral sciences, natural sciences, and humanities. The distribution should approximate the current policy for the B.S.W. program: 18 hours in social and behavioral sciences, six hours in natural sciences with at least one course in human biology, and six hours in humanities.

All students are required to successfully complete a course in human biology prior to enrollment in the graduate program. Additionally, all students must have successfully completed a course in statistics before admission. If the statistics requirement has not been met, then an equivalent course must either be successfully completed by December 31 or prior to registering for SWG 519.

Provisional Admission. Applicants with lower test scores or grades below minimum levels may be considered for provisional admission if there is counterbalancing evidence suggesting the potential of outstanding performance in the M.S.W. program. Normally, final determination of removal of provisional status is made by the time the student has completed 12 hours of approved graduate study. The provisional student does not begin field work until this status has been changed. However, the student carries the same academic load as a regularly admitted student and is expected to meet the same standards for continuation in the program.

All students are required to successfully complete a course in human biology before enrollment in the graduate program. Additionally, all students must have successfully completed a course in statistics either prior to admission or by the end of the first year in the M.S.W. program.

Applications to the M.S.W. program are accepted from November 1 to March 1 preceding the fall semester to which the applicant is seeking admission. All applicants are reviewed for admission for the fall semester only.

Program of Study. The standard program consists of 60 hours including both classroom instruction and field practicum. It is divided into a foundation year (core curriculum) and a concentration year. During both years, students spend two days a week in a practicum setting. The foundation curriculum is the same for all students and must be completed before entering the concentration year. The following are the required foundation courses:

SWG 501 Human Behavior in the Social Environment I	3
SWG 502 Human Behavior in the Social Environment II	3
SWG 510 Foundation Practice I	3
SWG 511 Foundation Practice II	3
SWG 519 Research Methods in Social Work	3
SWG 531 Social Policy and Services I	3
SWG 533 Diversity and Oppression in Social Work Context	3

SWG 541 Field Practicum I	3
SWG 542 Field Practicum II	3
SWG 580 Community and Organizational Change	3

In the second year, students concentrate in either direct practice or planning, administration and community practice. Six to nine hours of electives are available for students either to take additional course work in their concentration or to increase knowledge and skill in such areas as health and mental health, family and child welfare, or aging.

The following are required concentration courses:

Direct Practice (DP)

SWG 606 Assessment of Mental Disorders	3
SWG 611 Social Work with Families	3
SWG 619 Practice-Oriented Research	3
SWG 621 Integrative Seminar	3
SWG 632 Social Policy and Services II	3
SWG 641 Advanced Practicum: Direct Practice I	3
SWG 642 Advanced Practicum: Direct Practice II	3
One of the following five approved advanced courses	3
SWG 613 Social Work with Individuals (3)	
SWG 614 Social Work with Families in Transition (3)	
SWG 616 Social Work with Chemically Dependent Families (3)	
SWG 617 Social Work Practice with Children and Adolescents (3)	
SWG 618 Family Violence (3)	
Electives	6
Total	30

Planning, Administration and Community Practice (PAC)

SWG 623 Agency Research in Social Work	3
SWG 632 Social Policy and Services II	3
SWG 643 Advanced Practicum/PAC I	3
SWG 644 Advanced Practicum/PAC II	3
SWG 680 Program Planning in Social Services	3
SWG 681 Social Work Administration	3
or SWG 682 Community Participation Strategies (3)	
Electives	12
Total	30

Electives may be selected from offerings at the School of Social Work or courses offered through other departments with the approval of the M.S.W. program coordinator. The total semester hours for each concentration equals 30.

Transfer Credit. Upon recommendation of the admissions committee, the first year of graduate study (up to 30 graduate semester hours) earned at another CSWE accredited school of social work may be transferred and applied toward the M.S.W. degree at ASU. Under these circumstances, the student must complete the second full year of graduate study (at least 30 semester hours of graduate work) at ASU, resulting in a 60-hour program composed of the work from both schools. A full report from the school at which the intended transfer credit was obtained is required.

In other cases, with the approval of the M.S.W. program coordinator, up to six semester hours of graduate work completed at another university may be transferred as elective credit.

Consideration for acceptance of prior graduate credits must be applied for at the time of admission. The grades of all transfer credit must be a "B" or higher.

Nondegree Course Work. A maximum of nine graduate semester hours earned as a nondegree student in the ASU School of Social Work or six semester hours earned at another graduate degree program at ASU may be applied toward the program of study as elective credit. A combination of credit earned as a nondegree student—at ASU or transferred from another university—may not exceed nine hours.

Course work toward a master's degree must be completed within six consecutive years. The six-year period begins with the first course included on the student's approved program of study.

Consideration for acceptance of nondegree work must be applied for at the time of admission.

Exemptions and Waiver Examinations. The number of hours required to complete the M.S.W. degree ranges from 40 to 60 semester hours, with 60 hours representing the standard program. In addition to transferring credit (see policy on transfer credit), admitted students may meet requirements of up to 20 hours of credit towards the degree by (1) exempting up to nine hours of foundation course work without examination or (2) successfully completing examinations in any of the foundation courses except field practicum.

Exemptions. Only students from B.S.W. programs accredited by the Council on Social Work Education can be considered for exemptions. In order to be eligible for an exemption from any course, students must have received their B.S.W. degree no more than five years prior to the date of admission or must demonstrate current continuing education credits. Admitted B.S.W. students from ASU are exempted from the courses listed below without examination if they meet the stated GPA requirements. B.S.W. students from other accredited programs may also be exempted from the same courses, but must submit their course content material (course description, syllabus, and outline) for review by the M.S.W. program coordinator for an equivalency review to determine exemption. B.S.W. students may be exempted from the following courses:

1. SWG 519, if the student has at least a "B" in SWU 320 or 420 or an equivalent social work course;
2. SWG 531, if the student has at least a "B" in SWU 432 or equivalent social work courses; and/or
3. SWG 533, if the student has at least a "B" in SWU 374 or 474 or an equivalent social work course.

Waiver Examinations. Students who believe they have successfully completed equivalent undergraduate courses or have related work experience covering content taught in the courses listed below can request to take a written waiver examination.

SWG 501 Human Behavior in the Social Environment I	3
SWG 502 Human Behavior in the Social Environment II	3
SWG 510 Foundation Practice I	3
SWG 511 Foundation Practice II*	3
SWG 519 Research Methods in Social Work	3
SWG 531 Social Policy and Services I	3
SWG 533 Diversity and Oppression in Social Work Context	3

SWG 580 Community and Organizational Change	3
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* Only students who successfully pass the waiver exam for SWG 510 Foundation Practice I are allowed to take the waiver exam for SWG 511 Foundation Practice II.

Comprehensive Examinations. ASU requires a comprehensive examination for graduation in all professional master's programs that do not have a thesis requirement. All Social Work students must pass a written comprehensive examination, administered by the school, before graduation.

Academic Standing and Curriculum Sequencing. In order to remain in good academic standing, the student must maintain an overall GPA of 3.00 at the end of each semester. Most courses in the program are sequential; successful completion of the prior course in the sequence is required to enroll in the following course. Students may not enroll in any second-year required courses until all foundation courses have been successfully completed.

Tucson Component. The School of Social Work offers the full foundation year (30 semester hours of credit) and some concentration-year course work in Tucson. Students may be required to commute to Tempe during both semesters of their concentration year. Courses are scheduled, however, so that the minimum of travel time is required of students. For information about or application to the Tucson component, call 520/884-5507.

Part-Time Program. A limited number of students are admitted each year to a planned part-time program. Students interested in this option must specifically apply to the part-time program. A maximum of one year of field work may be completed at the agency where the student is employed.

Financial Assistance. Recent federal reductions in support of human services and educational programs have severely limited the resources available for stipends. Therefore, it is important that applicants have a sound financial plan to cover expenses for the duration of the degree program.

Financial assistance information is available from Student Financial Assistance Office, Student Services Building, 480/965-3355.

DOCTOR OF PHILOSOPHY

The program seeks to prepare future social work scholars who are cognizant of the importance of practice-oriented and evaluative research in applied agency and community settings, who are involved in the development and application of theories in social work practice, and who plan to enhance social work knowledge through its communication and translation in the classroom and field settings.

The program introduces students to the complex range of roles and responsibilities of faculty leadership, to the challenging expectations of critical thinking and creativity in research and teaching, and to the multiple ways of integrating the tripartite demands of research, teaching, and service in the social work profession.

The Social Work faculty advocate for and support the human potential in the distinct experiences and perspectives of the Southwest region. The cultural and economic diversity of the Southwest makes it possible for faculty and students to engage in many issues in their community-based research and practice. Social Work graduates play key roles in creatively and ethically integrating their professional

applied activities with local, state, tribal, and regional interests in the realm of social welfare.

Admission. Admission decisions are made in odd-numbered years. Applicants must hold an M.S.W. degree from an accredited school of social work, preferably have a minimum of two years of post-M.S.W. professional social work paid employment, and apply to both the ASU Graduate College and the School of Social Work.

Admission to the Ph.D. program requires completion of all admission requirements and procedures set forth by the Graduate College and test scores from the Graduate Record Examination (GRE) (verbal, quantitative, and analytical). Applications are accepted up to March 1 preceding the fall semester to which the applicant is seeking admission. Students are admitted only in the fall semesters of odd-numbered years.

Application Procedure. The following should be submitted to

ADMISSIONS OFFICE
GRADUATE COLLEGE
ARIZONA STATE UNIVERSITY
PO BOX 871003
TEMPE AZ 85287-1003

1. the application for admission to the Graduate College;
2. two official transcripts from each institution the applicant has attended previously; and
3. test scores from the GRE.

The following should be submitted to

ACADEMIC SERVICES
SCHOOL OF SOCIAL WORK
ARIZONA STATE UNIVERSITY
PO BOX 871802
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1. application to the Ph.D. program in Social Work;
2. completed essay questions; and
3. four letters of reference that must use the reference letter forms provided by the School of Social Work.

Program of Study. Students must demonstrate scholarly competencies in several broad areas identified during the mentoring and advising process. These areas must include: micro/macro theories and perspectives on critical issues in social work and social welfare (24 semester hours), quantitative/qualitative research methodologies (12 semester hours), and professoriate training and mentoring in research, teaching, and service. The program requires a minimum of 36 semester hours beyond the M.S.W. degree and 84 semester hours beyond the baccalaureate degree. Because students must achieve competency requirements, they may need to take additional course work to achieve these competencies.

The program emphasizes enhancement of scholarship through:

1. applied social work research in diverse community settings and populations of the Southwest;
2. teaching, from syllabus development to classroom teaching across the professional continuum;
3. participation in collegial decision making; and

4. participation in field education and community services.

Students are expected to participate fully in research, teaching, and field liaison activities during their course of studies.

Advisement. The individualized plan for becoming a social work scholar and for learning associated faculty roles is developed by students and their faculty advisors over time.

Residency. Students should expect to complete the equivalent of four semesters of course work. The minimum residency requirement for the Ph.D. program is 18 semester hours in courses relating to the program of study, exclusive of dissertation. The residency must be completed in two consecutive semesters, not including summer sessions.

Foreign Language Requirements. None.

Comprehensive Examinations. Upon completion of course work and the substantive paper, but before beginning dissertation research, the student is given a written examination covering research, theory, and methods in the substantive area. If the student should fail one or more components of 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. Approval of the reexamination must be obtained from the supervisory committee and the dean of the Graduate College.

Dissertation Requirements. Each candidate must register for a minimum of 24 semester hours of credit for research and dissertation. The final copy of the dissertation must be received by the supervisory committee and the dean of the Graduate College at least three weeks before the degree conferral date.

Final Examinations. The final oral examination in defense of the dissertation is scheduled and conducted by the student's dissertation committee. A candidate must pass the final examination within five years after completing the comprehensive examination.

SPECIAL PROGRAMS

Tucson Component. The School of Social Work offers a part-time, cohort driven M.S.W. Program in Tucson in conjunction with the College of Extended Education. See "Tucson Component," page 286, for more information.

RESEARCH ACTIVITY

The School of Social Work offers excellent opportunities for empirical research on social, community, and individual problems and issues. Computer facilities and research support are available to faculty and students. Research is carried out in diverse community settings in conjunction with social agencies, as well as with public and private institutions. The faculty and students are engaged in a number of projects of local, regional, and national significance.

The areas of study for typical faculty research in any given year might include such topics as child abuse, adoption, foster care, reconstituted families, minority aging, chemical dependency, mental health, social welfare planning, social service agency administration, and community practice.

SOCIAL WORK (SWG)

SWG 501 Human Behavior in the Social Environment I. (3) F

Analyzes theories of personality and life-span development from methodological, ecological, and systems perspectives up to adolescence.

SWG 502 Human Behavior in the Social Environment II. (3) S

Life span development from middle childhood to maturity. Prerequisite: SWG 501.

SWG 510 Foundation Practice I. (3) F

Basic social work methods with an emphasis on the problem-solving process as it pertains to individuals, families, and small groups. Prerequisite: Social Work major.

SWG 511 Foundation Practice II. (3) S

Theory and methods of direct practice with groups and selected practice models. Lecture, lab. Prerequisite: SWG 510.

SWG 519 Research Methods in Social Work. (3) S

Conceptual foundations and methods of nomothetic research in social work. Includes problem identification, hypothesis formulation, measurement, sampling, and experimental design. Prerequisites: Social Work major; an approved course in statistics.

SWG 531 Social Policy and Services I. (3) F

Conceptual, analytical, and historical perspectives on the social welfare institution. Emphasis on poverty and inequality. Principles of policy analysis.

SWG 533 Diversity and Oppression in a Social Work Context. (3) F, S

Explores issues of social inequality related to disability, ethnicity, gender, race, and sexual orientation. Emphasis on populations of the Southwest.

SWG 541 Field Practicum I. (3) F, S

With SWG 542, two consecutive semesters (480 hours) of supervised social work practice in an approved placement. Pre- or corequisite: SWG 510.

SWG 542 Field Practicum II. (3) F, S

See SWG 541. Pre- or corequisite: SWG 511.

SWG 580 Community and Organizational Change. (3) F, S

Examines communities and human service organizations as social systems. Introduces strategies for initiating planned change.

SWG 605 Substance Abuse. (3) N

Psychological and sociocultural determinants of substance abuse. Overview of social policies and treatment approaches. Prerequisite: SWG 502 or instructor approval.

SWG 606 Assessment of Mental Disorders. (3) F

Theories and concepts of mental health and illness. Attention to classification systems and nomenclature used in assessing mental disorders. Prerequisite: SWG 502.

SWG 611 Social Work with Families. (3) F

Theory, concepts, and skills for working with diverse family populations. Emphasis on a systems and integrative approach. Prerequisites: SWG 511, 542.

SWG 612 Social Work with Groups. (3) N

Practice applications of knowledge and skill to social work with groups.

SWG 613 Social Work with Individuals. (3) S

Treatment of prevalent disorders encountered by social workers, selected from the following: anxiety disorders, personality disorders, depression, and schizophrenia. Lecture, seminar. Prerequisite: SWG 611.

SWG 614 Social Work with Families in Transition. (3) S

Analyzes the psychosocial dynamics of families disrupted by divorce, separation, or death of a parent. Offers differential social work interventions. Prerequisite: SWG 611.

SWG 616 Social Work with Chemically Dependent Families. (3) S

The dynamics of the chemically dependent family are examined and clinical approaches for intervening in the family system and sub-systems are presented. Prerequisite: SWG 611.

SWG 617 Social Work Practice with Children and Adolescents. (3) S

Theory, research, intervention that focus on children and adolescents. Prerequisite: SWG 611.

SWG 618 Family Violence. (3) S

Theory, research, intervention, and prevention strategies relevant to child maltreatment, partner abuse, and elder abuse. Prerequisite: SWG 611.

SWG 619 Practice-Oriented Research. (3) F

Accelerated course in application of scholarly and scientific principles to field practice, problem formulation, interventional procedures, and impact assessment. Prerequisite: SWG 519.

SWG 621 Integrative Seminar. (3) S

Explores the fit between theoretical frameworks and practice with clients. Requires presentation of empirical studies with clients. Prerequisite: SWG 611. Pre- or corequisite: SWG 613 or 614 or 616 or 617 or 618.

SWG 622 Community Research in Social Work. (3) N

Application of research design techniques to assessing need and measuring efficiency and effectiveness of community-wide programs. Prerequisite: SWG 519. Corequisite: SWG 680.

SWG 623 Agency and Community-Based Research in Social Work. (3) S

Research design techniques to data collection in human service agencies and communities. Statistical analysis for program evaluation and needs assessment. Prerequisites: SWG 519, 541, 542. Corequisite: SWG 680.

SWG 632 Social Policy and Services II. (3) S

Development of advanced knowledge and skills in social welfare policy analysis, policy formulation, and advocacy and intervention for policy change. Prerequisite: SWG 531.

SWG 641 Advanced Practicum: Direct Practice I. (3) F, S

With SWG 642, two consecutive semesters (480 hours) of supervised social work practice in an approved placement related to the student's career goal. Prerequisites: SWG 541, 542. Pre- or corequisite: SWG 611.

SWG 642 Advanced Practicum: Direct Practice II. (3) F, S

See SWG 641. Prerequisites: SWG 541, 542, 611. Pre- or corequisite: SWG 614 or 616 or 617 or 618.

SWG 643 Advanced Practicum: Planning, Social Work Administration, and Community Practice I. (3) F, S

With SWG 644, two consecutive semesters (480 hours) in social work practice in an approved placement related to the student's career goal. Prerequisites: SWG 541, 542. Pre- or corequisite: SWG 680.

SWG 644 Advanced Practicum: Planning, Social Work Administration, and Community Practice II. (3) F, S

See SWG 643. Prerequisite: SWG 643. Pre- or corequisite: SWG 681 or 682.

SWG 680 Program Planning in Social Services. (3) S

The social services planning process includes needs assessment, goals and objectives, program design, budgeting, management information systems, and program evaluation. Prerequisites: SWG 681, 682. Corequisite: SWG 623.

SWG 681 Social Work Administration. (3) F

Administrative skill building and theory application within human service nonprofit social work settings. Prerequisite: SWG 580.

SWG 682 Community Participation Strategies. (3) F

Course reviews strategies to involve citizens and the consumers of social and human services in community decision making systems. Participation is viewed as means to facilitate the empowerment of oppressed peoples. Prerequisite: SWG 580.

SWG 683 Developing Grants and Fund Raising. (3) N

Identification of potential funding sources, technical and interpersonal/political aspects of proposal development and fund raising. Prerequisite: SWG 580 or instructor approval.

SWG 720 Philosophy of Science Issues in Social Work. (3) F

Critical examination of social science, social work practice and policy in terms of philosophical assumptions and varying frames of reference.

SWG 721 Empirical Social Work Practice. (3) S

Application of scientific principles to problem formulation, assessment, and intervention procedures with an emphasis on the direct use of scientific tools in the conduct and evaluation of practice at all levels.

SWG 730 Families Across the Life-Span. (3) F

Policy and practice analysis of issues which affect families with a focus on the development of interventive strategies.

SWG 731 Social Welfare Policy Analysis and Development. (3) F

Methods of policy analysis, critique of social welfare policies against proposed models, and case studies of policy development emphasizing southwestern populations. Prerequisite: SWG 730.

SWG 732 Social Work Administration in a Systems Context. (3) F
Case studies of social work administration from initial conceptualization of policy through implementation at national, state, and local levels.

SWG 740 Community Research in Social Work. (3) F
Substantive, value, and methodological issues in community-based research as applied to social work topics.

SWG 741 Integrative Research Seminar. (3) F
Integration of theory, research methods, and statistics in community social work topics of specific interest to students.

Omnibus Graduate Courses: See page 51 for omnibus graduate courses that may be offered.

Sociology

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Chair

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PROFESSORS

BOLIN, COBAS, GORDON, HACKETT, HARDERT, KULIS,
LANER, NAGASAWA, PETERSON, SNOW,
THOMAS, WEITZ

ASSOCIATE PROFESSORS

BENIN, BLAIR, HARLAN, JACOBSON, KEITH,
MILLER-LOESSI, SULLIVAN

ASSISTANT PROFESSORS

AGADJANIAN, QIAN, RHEA

LECTURERS

FINE, PADILLA

INSTRUCTOR

WILLIAMS

The faculty in the Department of Sociology offer graduate programs leading to the M.A. and Ph.D. degrees in Sociology.

MASTER OF ARTS

This degree program provides advanced training for those preparing for teaching, research, or applied careers in sociology, and may be taken either as a terminal program or as a step toward eventual fulfillment of requirements for the Ph.D. A detailed description of the graduate program (including opportunities in teaching and research assistantships) may be obtained from the department chair.

Admission. Admission to the program is determined by the following criteria: Graduate Record Examination (GRE) scores (verbal, quantitative, and analytical), three letters of

appraisal from persons familiar with the applicant's academic background, valid transcripts of the student's academic record, and a biographical narrative provided by the applicant. Application deadline is February 15.

Program of Study. A master's degree in Sociology requires the successful completion of a minimum of 30 semester hours, including a 12-hour core curriculum, six hours of theory (SOC 585 and 586), and six hours of research methods (SOC 500 and 505), two hours of Sociology as a Profession (SOC 503, 504), with the balance to be drawn from substantive courses and six hours earned through the M.A. thesis (SOC 599).

Foreign Language Requirements. None.

Thesis Requirements. A thesis is required.

Final Examinations. A final oral examination in defense of the thesis is required. This oral examination also tests the student's comprehension of the area of sociology exemplified by the thesis.

DOCTOR OF PHILOSOPHY

This degree provides advanced training in theory, research methodology, and substantive fields to prepare sociologists for teaching and research with special emphasis on urbanism, urbanization, and related issues. A detailed description of this program (including opportunities in teaching and research assistantships) may be obtained from the department chair.

See "Doctor of Philosophy," page 101, for general requirements.

Admission. Admission to the program is determined by the following criteria: GRE scores (verbal, quantitative, and analytical), three letters of appraisal from persons familiar with the applicant's academic background, valid transcripts of the student's academic record, and a biographical narrative provided by each applicant. Applicants should have an M.A. or its equivalent in Sociology or a related field. Application deadline is February 15.

Program of Study. The Ph.D. requires 54 semester hours beyond the master's degree. Three hours each of theory, methods, and statistics are required, and 24 hours are earned through dissertation and research. The remaining 21 hours are in substantive courses reflecting the student's specialization. First-year Ph.D. students are required to take Sociology as a Profession (503, 504). A minimum of 30 semester hours of the approved Ph.D. program, exclusive of dissertation and research hours, must be completed after admission to the Ph.D. at ASU.

Foreign Language Requirements. None.

Comprehensive Examinations. Written comprehensive examinations focusing on two areas chosen by the student, and an oral defense of the dissertation proposal are required. After passing the comprehensive examinations and obtaining a formal approval of the dissertation proposal, the student is eligible to apply for candidacy.

Dissertation Requirements. A dissertation based on original work demonstrating creativity in research and scholarly proficiency in the subject area is required.

Final Examinations. A final oral examination in defense of the dissertation is required.

RESEARCH ACTIVITY

The Department of Sociology is committed to teaching and research in the following six areas reflecting faculty expertise. Recent research is listed under each area heading.

Demography/Urban Ecology. Family and household demography; Hispanic fertility; demographic determinants of adoptions; growth of Sunbelt retirement communities; mass media formats and urban life.

Family. Courtship; dating violence; dual earner families; families with handicapped children; kinship; family structure; marital stability; adolescence; parent-child bonds in later life; religious ethnic intermarriage; support networks of the poor.

Medical. Social psychological effects of AIDS; AIDS and high risk behavior; stigmatization of illness; alternative health care practitioners; technology and public health; medicalization in the media; mortality/morbidity of parents with handicapped children; stress and well-being.

Political. Nation-state expansion, authority, and expenditures; world polity/culture; comparative historical analyses; large-scale change and religious/political movements; the university and the state; race riots; environmental and nuclear power issues.

Race/Ethnicity. Comparative historical analyses of ethnic/race relations; Mexican female immigrants; Cubans and minority traders; Asian American issues; Mexican Americans; public policy; minority housing; ethnicity and health.

Stratification. Incorporation of women and minorities into academia; affirmative action issues; women and work; sexual harassment; work and personality; organizations; black student collegiate success; educational environments; learning and academic success; rise of the university; sexual minorities.

Research Facilities. Research facilities in the department consist of a survey research laboratory, small groups research laboratory, computer terminals and linkages to mainframe and the supercomputer, computational laboratory, and Gould Memorial Research Archive. The survey research laboratory conducts campus and community surveys. Among the topics studied are transportation, citizen attitudes, recreation, judicial evaluation, occupational destinations of graduate students, academic advisement, student,

staff and faculty attitudes, student living arrangements, changing sex roles, and student activism and political involvement.

SOCIOLOGY (SOC)

SOC 501 Practicum in Survey Research. (3) F, S

A research practicum in survey field work, analysis, and reporting in the Phoenix Area Study. Prerequisite: SOC 391 or equivalent.

SOC 502 Practicum in Survey Research. (3) F, S

Continuation of SOC 501. Prerequisite: SOC 501.

SOC 503 Sociology as a Profession I. (1) F

Becoming and working as a sociologist, including how to write a vita, choose a thesis topic, or find dissertation data. Prerequisite: graduate Sociology major.

SOC 504 Sociology as a Profession II. (1) S

Becoming and working as a sociologist, including how to write a vita, choose a thesis topic, or find dissertation data. Prerequisite: graduate Sociology major.

SOC 505 Applied Regression Analysis. (3) F, SS

Multiple linear regression topics relevant to sociological data analysis. Computer applications. Prerequisites: SOC 390 (or equivalent); a proficiency examination.

SOC 507 Social Statistics IIIA: Categorical Data Analysis. (3) F

Logistic regression and related topics relevant to categorical data analysis in sociology. Computer applications. Prerequisite: SOC 505 or instructor approval.

SOC 508 Social Statistics IIIB: Structural Equation Analysis. (3) S

Structural equation models are taught using LISREL and other computer packages. Topics include multiple group analyses and ordinal endogenous variable models. Prerequisite: SOC 505 or instructor approval.

SOC 509 Social Statistics IIIC: Event History Analysis. (3) F, S

Proportional hazards models and other methods for analyzing longitudinal data and establishing hazard rates of events for exploratory variables. Prerequisite: SOC 505 or equivalent.

SOC 515 Studies of the Family. (3) S

Current developments in the study of marriage and the family. Prerequisite: instructor approval.

SOC 585 Development of Sociology. (3) F

Major sociological theorists, including Durkheim, Weber, Marx, Parsons, Merton, Dahrendorf, Homans, and Mead. Prerequisite: instructor approval.

SOC 586 Contemporary Sociological Theory. (3) S

Analysis of major theories, including structural-functional, conflict, social exchange, symbolic interaction, and role theory. Prerequisite: instructor approval.

SOC 587 Contemporary Issues in Sociology. (3) S

Philosophy of social science. Contemporary issues in sociological theory and methods. Prerequisite: instructor approval.

SOC 588 Methodological Issues in Sociology. (3) S

Basic methodological issues in the application of scientific methods to the study of human social life. Emphasis on limited number of major works, with contrasting approaches to issues.

Omnibus Graduate Courses: See page 51 for omnibus graduate courses that may be offered.

Spanish

See "Languages and Literatures," page 231.