

Graduate Programs and Courses

All graduate degree programs and certificate programs are organized alphabetically by the name of the major or certificate with only a few exceptions. For example, French, German, and Spanish are found under "Languages and Literatures," page 247.

Accountancy

Certificate Program

ASU West offers a postbaccalaureate certificate in Accountancy. For information, see the *ASU West Catalog*, call 602/543-4567, or access www.west.asu.edu on the Web.

Accountancy and Information Systems

Master's Program

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PROFESSORS

J.R. BOATSMAN, BOYD, GOUL, JOHNSON, KAPLAN,
PANY, PEI, PHILIPPAKIS, RECKERS, ROY, SCHULTZ,
SMITH, STEINBART, VINZE, WYNDELTS

ASSOCIATE PROFESSORS

CHRISTIAN, GOLEN, GUPTA, HWANG, KEIM, KULKARNI,
MOECKEL, O'DELL, O'LEARY, REGIER,
ST. LOUIS, WHITECOTTON

ASSISTANT PROFESSORS

BHATTACHERJEE, CHEN, CHENOWETH, COMPRIX,
DAVID, DOWLING, IYER, O'DONNELL, ROBINSON,
SANTANAM, SHAO, WEISS

SENIOR LECTURERS

MacCRACKEN, SHREDNICK

LECTURERS

BALOGH, J.L. BOATSMAN, GEIGER, HAYES, TAYLOR

The faculty in the School of Accountancy and Information Management, College of Business, offer specialized professional programs leading to the Master of Accountancy and Information Systems (M.A.I.S.), Master of Science in Information Management (see "Information Management," page 182), and Master of Taxation (see "Taxation," page 322) degrees.

The faculty participate in offering the program leading to the Master of Business Administration (see "Master of Business Administration," page 137) and Ph.D. in Business Administration (see "Doctor of Philosophy," page 137) degrees.

MASTER OF ACCOUNTANCY AND INFORMATION SYSTEMS

The M.A.I.S. degree provides specialized preparation for careers in professional accounting in accounting and computer information systems/management, corporate accounting/finance, and management consulting.

Admission. Applicants must submit scores from the Graduate Management Admissions Test (GMAT) exam. All applicants are also required to submit the supplemental application materials required from the school. International applicants whose native language is not English must submit scores from the Test of English as a Foreign Language (TOEFL) and Test of Spoken English (TSE) exams. Preference in admission is given to those with degrees in accounting and business, although other exceptional candidates are considered. A complete advising guide and application packet may be obtained from the school's Web site.

Prerequisites. Applicants must complete the program prerequisites. Refer to the School of Accountancy and Information Management Web site for a current listing of required course prerequisites for the program.

Program of Study. The program of study consists of a minimum of 30 semester hours and is continually updated. A representative program might include the following courses:

ACC 533	Application Solutions in the Connected Economy	3
ACC 541	Strategic Innovations in Information and Cost Management.....	3
ACC 582	Information Security of Interorganizational Systems	3
ACC 585	Performance Measurement of Emerging Business Models.....	3
ACC 586	Shareholder Value Creation and Financial Statement Analysis	3
ACC 587	Business Process Integrity Controls.....	3
ACC 591	Seminar: Electronic Commerce	3
CIS 505	Object-Oriented Modeling and Programming	3
CIS 506	Business Database Systems	3
CIS 512	Intelligent Decision Systems and Knowledge Management	3

Visit the school's Web site for a current program of study.

Course Load. Students are limited to 12 hours per trimester.

Foreign Language Requirements. None.

Thesis Requirements. None.

Final Examinations. A final comprehensive, written examination is required of all candidates.

RESEARCH ACTIVITY

For current information about research activity, access the School of Accountancy and Information Systems Web site at www.cob.asu.edu/acct and see “Publications and Working Papers.”

ACCOUNTANCY (ACC)

ACC 502 Financial Accounting. (3)

once a year

Financial accounting concepts and procedures for external reporting. Prerequisite: M.B.A. degree program student.

ACC 503 Managerial Accounting. (3)

once a year

Managerial accounting concepts and procedures for internal reporting. Prerequisite: M.B.A. degree program student.

ACC 511 Taxes and Business Strategy. (3)

once a year

Economic implications of selected management decisions involving application of federal income tax laws. Recognition of tax hazards and tax savings. Prerequisite: ACC 502 (or its equivalent).

ACC 515 Professional Practice Seminar. (3)

once a year

History, structure, environment, regulation, and emerging issues of the accounting profession.

ACC 521 Tax Research. (3)

once a year

Tax research source materials and techniques. Application to business and investment decisions. Prerequisite: ACC 430.

ACC 533 Application Solutions in the Connected Economy. (3)

not regularly offered

Analysis of software solutions and evaluation methods. Emphasis on current topics such as enterprise modeling, ERP software, and inter-organizational solutions. Prerequisite: M.S. in Information Management degree program student or M.A.I.S. degree program student.

ACC 541 Strategic Innovations in Information and Cost Management. (3)

once a year

Strategic cost management emphasizing contemporary topics, including activity-based costing and strategic uses of information technology systems. Cooperative learning, lecture. Prerequisite: ACC 503 or M.S. in Information Management degree program student or M.A.I.S. degree program student.

ACC 567 Financial Models in Accounting Systems. (3)

once a year

Development and application of financial models by accountants. Analysis of decision support systems as financial modeling environments. Prerequisite: ACC 330.

ACC 571 Taxation of Corporations and Shareholders. (3)

once a year

Tax aspects of the formation, operation, reorganization, and liquidation of corporations and the impact on shareholders. Pre- or corequisite: ACC 521.

ACC 573 Taxation of Pass-Through Entities. (3)

once a year

Tax aspects of the definition, formation, operation, liquidation, and termination of a partnership. Tax planning is emphasized. Pre- or corequisite: ACC 521.

ACC 575 Family Tax Planning and Wealth Transfer Taxation. (3)

once a year

Tax treatment of wealth transfers at death and during life time, with emphasis on tax planning. Pre- or corequisite: ACC 521.

ACC 577 Taxation of Real Estate Transactions. (3)

once a year

Income tax aspects of acquisition, operation, and disposal of real estate; syndications; installment sales; exchanges; dealer-investor issues; alternative financing; and planning. Prerequisite: ACC 521 or instructor approval.

ACC 582 Information Security of Interorganizational Systems. (3)

not regularly offered

Function and responsibility of the information security officer. Advanced topics in security methods and technology. Prerequisite: M.S. in Information Management degree program student or M.A.I.S. degree program student.

ACC 585 Performance Measurement of Emerging Business Models. (3)

once a year

Application of quantitative techniques to accounting problems. Prerequisite: ACC 503 or M.S. in Information Management degree program student or M.A.I.S. degree program student.

ACC 586 Shareholder Value Creation and Financial Statement Analysis. (3)

not regularly offered

Develop skills necessary to exploit financial reporting information in a business environment and appreciation of reporting issues faced by management.

ACC 587 Business Process Integrity Controls. (3)

once a year

Design and evaluation of computer-based accounting information system. Development of computer-based business models for planning and control. Prerequisite: M.A.I.S. degree program student.

ACC 591 Seminar on Selected ACC Topics. (1–12)

once a year

Possible topics:

- (a) Computer Security. (3)
- (b) Data Warehouse and Data Mining. (3)
- (c) Electronic Commerce. (3)
- (d) Enterprise Modeling. (3)

Omnibus Graduate Courses. See page 50 for omnibus graduate courses that may be offered.

COMPUTER INFORMATION SYSTEMS (CIS)

CIS 502 Management Information and Decision Support Systems. (3)

once a year

Fundamentals of computer-based management information and decision support systems. Prerequisite: M.B.A. degree program student.

CIS 505 Object-Oriented Modeling and Programming. (3)

once a year

Object-oriented modeling of business information systems, abstract data types and object-oriented programming using a visual language. Prerequisite: M.S. in Information Management degree program student or M.A.I.S. degree program student.

CIS 506 Business Database Systems. (3)

once a year

Hierarchical, network, relational, and other recent data models for database systems. Processing issues such as concurrency control, query optimization, and distributed processing. Prerequisite: M.S. in Information Management degree program student or M.A.I.S. degree program student.

CIS 512 Intelligent Decision Systems and Knowledge Management. (3)

once a year

Definition, description, construction, and evaluation of computer-based decision systems. Prerequisite: M.S. in Information Management degree program student or M.A.I.S. degree program student.

CIS 515 Management Information Systems. (3)

not regularly offered

Systems theory concepts applied to the collection, retention, and dissemination of information for management decision making. Prerequisite: M.S. in Information Management degree program student or M.A.I.S. degree program student.

CIS 520 Systems Design and Evaluation. (3)

not regularly offered

Methodologies of systems analysis and design. Issues include project management, interface, organizational requirements, constraints, documentation, implementation, control, and performance evaluation. Prerequisite: M.S. in Information Management degree program student or M.A.I.S. degree program student.

CIS 530 Information Systems Development. (3)

once a year

Object-oriented and interprocess communication and control concepts for information systems; applications based on languages such as C++ and platforms such as networked UNIX. Prerequisite: M.S. in Information Management degree program student or M.A.I.S. degree program student.

CIS 535 Distributed Information Systems. (3)*once a year*

Distributed systems and their impact on information systems in business. Prerequisite: M.S. in Information Management degree program student or M.A.I.S. degree program student.

CIS 591 Seminar on Selected CIS Topics. (1–12)*once a year*

Possible topics:

- (a) Computer Security
- (b) Computing Architectures
- (c) Data Warehouse and Data Mining
- (d) Electronic Commerce
- (e) Enterprise Modeling

Prerequisite: M.S. in Information Management degree program student or M.A.I.S. degree program student.

CIS 593 Applied Project. (1–12)*not regularly offered*

Omnibus Graduate Courses. See page 50 for omnibus graduate courses that may be offered.

Aerospace Engineering

Master's and Doctoral Programs

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PROFESSORS

BOYER, CHATTOPADHYAY, LAANANEN, LIU, MIGNOLET,
REED, SARIC, WIE

ASSOCIATE PROFESSORS

KOURIS, LEE, RANKIN, WELLS

The faculty in the Department of Mechanical and Aerospace Engineering offer graduate programs leading to the M.S., Master of Science in Engineering, and Ph.D. degrees in Aerospace Engineering. A number of areas of study may be pursued, including aerodynamics, design, dynamics and control, propulsion, and structures. The faculty also offer graduate degree programs in Mechanical Engineering. All of the department's graduate programs stress a sound foundation leading to a specialized area of study.

The application deadline for admission in the fall semester is April 15. Applications received after that date and before November 15 are considered for admission in the spring semester.

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 100, for general requirements.

MASTER OF SCIENCE IN ENGINEERING

See "Master of Science in Engineering," page 200, 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 aerospace engineering. See "Doctor of Philosophy," page 103, 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 prepared to continue in the doctoral program and to detect deficiencies in the student'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 Aerospace 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.

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.

Computer Resources and Facilities

Aerospace 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. These machines are available for use by engineering faculty and students for classroom and research work.

The ASU Computing Commons is equipped with three IBM RS/6000-590s, one MASPAR, several DEC VAX 5000s, 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 via dial-in lines. The university also operates microcomputer sites with more than 400 IBM and Apple Macintosh systems.

COURSES

For courses, see "Mechanical and Aerospace Engineering (MAE)," page 265.

Agribusiness

Master's Program

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PROFESSORS

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MARQUARDT, SEPERICH, SHULTZ, THOR

ASSOCIATE PROFESSORS

GREEN, MILLER, RACCACH, RICHARDS, WHYSONG

ASSISTANT PROFESSORS

BURKINK, MANFREDO, PATTERSON,
SCHMITZ, STANTON

MASTER OF SCIENCE

The Morrison School of Agribusiness and Resource Management (MSABR), at ASU East, offers the M.S. degree in Agribusiness with a choice of two concentrations: (1) agribusiness management and marketing and (2) food quality assurance. In general, this degree is designed to prepare students from a variety of backgrounds with a set of critical and analytical business skills while recognizing the unique demands of the agribusiness and resource management sectors. Graduates are well prepared for successful administrative or managerial careers with either government or private-sector organizations in either field. Students are able to select either a research-oriented program, which leads to the completion of a supervised thesis, or a program consisting of course work only (nonthesis option). The nonthesis option allows students to develop an area of specialization and apply these skills to a real-world agribusiness problem through an integrative, capstone course experience. Both the thesis and nonthesis options require the completion of a common set of core courses and successful completion of an MSABR standard comprehensive exam following the first year of course work.

Admission. Applicants to the program are expected to meet the minimum requirements for admission to the Graduate College. In addition, scores from the Graduate Record Examination, Miller Analogies Test, or Graduate Management Admission Test are required. Applications must include a vita and statement of purpose; letters of recommendation are suggested. The statement of purpose must offer evidence of the applicant's basic skills in economics, accounting, statistics, and computer use, as well as some experience or knowledge in an area related to agribusiness. Applicants not meeting this last requirement may be considered for admission with deficiencies. The application deadline for admission in the fall semester is April 15. Applications received after that date and before November 15 are considered for admission in the spring semester. Applicants are strongly encouraged to apply by mid-February to increase their chances for official university funding.

Thesis Option. Students interested in pursuing a research-related career, or an in-depth study of a particular agribusiness issue to improve employment prospects, may choose the thesis option. These students are advised to begin discussions with faculty members early in their studies so that course work and potential employment can be geared toward supporting thesis research. Six of the 36 semester hours in the program are dedicated to the research time required to complete a thesis.

Nonthesis Option. The nonthesis M.S. degree in Agribusiness option provides an opportunity for students who wish to pursue a professional career that is not specifically research-oriented to obtain a rigorous and comprehensive graduate degree. The nonthesis option allows for the selection of six semester hours of electives to be taken in a specific area of emphasis. In lieu of a thesis, a nonthesis option student completes a case-oriented capstone course, which allows the student an opportunity to pursue a course-based project that integrates all of the core business skills acquired during the course work sequence.

Program of Study. All M.S. candidates must complete a minimum of 36 hours of approved graduate-level course work, excluding courses taken to address deficiencies. Of these 36 hours, 21 must be taken to satisfy core requirements in basic business, statistics, and computer proficiency. For students selecting the nonthesis option, fulfilling the requirements for an area of emphasis consists of the successful completion of six hours of elective courses from within that area chosen from graduate agribusiness courses. The specific courses are determined by the student and his or her academic advisor. Thesis students are required to complete three semester hours of research and three hours of writing in addition to six hours of general 500-level agribusiness electives.

It is suggested that students take a coherent sequence of courses such as those indicated below, but considerable flexibility is possible based on individual backgrounds and interests.

Thesis and Nonthesis M.S. in Agribusiness

Semester I

AGB 560	Advanced Agribusiness Management Systems.....	3
AGB 570	Managerial Economics for Agribusiness	3
	Total	6

Semester II

AGB 528	Advanced Agribusiness Marketing	3
AGB 532	Advanced Agribusiness Finance	3
AGB 561	Agribusiness Research Methods	3
	Total	9

Semester III

Nonthesis Option		
500-level AGB	emphasis electives.....	9
	Total	9

Thesis Option

AGB 511	Advanced Agribusiness Management.....	3
500-level AGB	electives.....	6
	Total	9

Semester IV

Nonthesis Option

AGB 511 Advanced Agribusiness Management	3
500-level AGB emphasis or other electives	6
Total	9

Thesis Option

AGB 592 Research	6
AGB 599 Thesis	3
Total	9

Total hours in program.....36

Cooperative Degree Program. The Morrison School of Agribusiness and Resource Management and the American Graduate School of International Management (Thunderbird) have a cooperative agreement for students interested in both agribusiness and international management. Thunderbird is an internationally recognized private graduate school, located in the Phoenix metropolitan area, offering course work in international studies, modern languages, and world business. This agreement enables students of ASU to take up to nine semester hours of course work at Thunderbird. To participate, the ASU student must be enrolled full-time (nine semester hours) and may only take three semester hours per semester at Thunderbird. The goal of this agreement is to enhance the educational opportunities available to qualified students of both institutions while making optimal use of the resources and facilities of both institutions.

Foreign Language Requirements. None.

Peace Corps' Master's International Program. MSABR has an agreement with the United States Peace Corps that makes combining graduate studies with Peace Corps service even more appealing. Participants can receive up to six hours of credit for their independent field work while in Peace Corps service. Graduate course work precedes departure to foreign countries. Interested individuals make separate application to ASU and the Peace Corps, and prepare plans of study with their faculty committees regarding studies in the field.

RESEARCH ACTIVITY

The faculty of agribusiness are engaged in a number of research projects of global, national, regional or state, importance. Scholarship in service to community is the hallmark of a state supported university and continues to be in the Morrison School of Agribusiness and Resource Management.

A few examples of this scholarship are "The National Food and Agriculture Policy Project;" a project involved with "Retail Contracting and Growers' Prices in Fresh Fruit;" investigations in "Emerging Markets of the Balkans and Black Sea Region;" as well as "Curriculum for a Bachelor of Science Degree in Food Management."

AGRIBUSINESS (AGB)

AGB 410 Agribusiness Management II. (3)

spring
Principles of human resource management in agribusiness firms. Prerequisite: AGB 310.

AGB 411 Agricultural Cooperatives. (3)

spring
Organization, operation, and management of agricultural cooperatives.

AGB 414 Agribusiness Analysis. (3)

fall and spring
Analysis of agribusiness firm decisions in the ecological, economic, social, and political environments. Special emphasis on ethical issues surrounding food production and consumption.
General Studies: L

AGB 420 Food Marketing. (3)

spring
Food processing, packaging, distribution, market research, new food research and development, and social implications. Prerequisite: AGB 320.

AGB 422 Consumer Behavior. (3)

fall
Application of behavioral concepts in analyzing consumer food purchases and their implications for marketing strategies. Prerequisite: completion of Agribusiness core (or its equivalent).

AGB 424 Sales and Merchandising in Agribusiness. (3)

summer
Principles and techniques of selling and merchandising in the agricultural and food industries.

AGB 425 Agricultural Marketing Channels. (3)

fall
Operational stages of agricultural commodities in normal distribution systems and implementation of marketing strategies. Prerequisite: AGB 320.

AGB 429 Marketing Research. (3)

fall
Examines the marketing research process and its role in facilitating agribusiness decisions. Emphasizes problem identification, survey design, and data analysis. Prerequisite: completion of Agribusiness core (or its equivalent).

AGB 431 Intermediate Agribusiness Financial Management. (3)

spring
Comprehensive treatment of topics in financial management of agribusiness: capital structure, dividend policy, asset valuation, mergers and acquisitions, risk management. Prerequisites: AGB 332, 333.

AGB 433 Intermediate Agribusiness Financial Markets. (3)

spring
Role and function of agribusiness in U.S. financial system. Topics include rural banking, farm credit system, monetary policy, and federal reserve. Prerequisite: completion of Agribusiness core (or its equivalent).

AGB 434 Agricultural Risk Management and Insurance. (3)

fall
Strategies to manage agricultural price and business risk: derivatives, insurance, self-insurance, and public policy. Prerequisite: completion of Agribusiness core (or its equivalent).

AGB 436 Entrepreneurship and Financial Management of E-Commerce. (3)

fall
Uses lectures, case studies, and business plans to highlight challenges of starting and running a small business. Lecture, seminar, case studies, computer labs.

AGB 440 Food Safety. (3)

spring
Control, prevention, and prediction of microbial and chemical food-borne diseases. Prerequisite: AGB 442 or instructor approval.

AGB 441 Food Chemistry. (3)

spring
Biochemical and chemical interactions that occur in raw and processed foods. Prerequisites: CHM 115, 231.

AGB 442 Food and Industrial Microbiology. (4)

not regularly offered
Food- and industrial-related microorganisms; deterioration and preservation of industrial commodities. Lecture, lab. Prerequisite: microbiology course with lecture and lab.

AGB 443 Food and Industrial Fermentations. (3)

spring
Management, manipulation, and metabolic activities of industrial microbial cultures and their processes. Prerequisite: AGB 442 or instructor approval.

AGB 445 Food Retailing. (3)*fall*

Food retail management. Discusses trends, problems, and functions of food retail managers within various retail institutions. Lecture, case studies.

AGB 450 International Agricultural Development. (3)*fall*

Transition of developing countries from subsistence to modern agriculture. Emphasis placed on implications for U.S. agribusiness working abroad.

*General Studies: G***AGB 452 International Agricultural Policy. (3)***fall*

Use of international trade theory to analyze the effects of government policies, trade agreements, and exchange rates on agribusiness. Prerequisite: ECN 112.

AGB 454 International Trade. (3)*spring*

International practices in trading of agribusiness, technology, and resource products and services.

AGB 455 Resource Management. (3)*spring*

Explores differences between societal and individual valuations of natural resources and considers public policy versus market-based solutions to environmental concerns. Prerequisite: ECN 112.

*General Studies: SB***AGB 456 World Agricultural Resources. (3)***fall*

World production and consumption of agricultural products, international relationships, and agencies concerned with world agricultural development problems.

*General Studies: G***AGB 457 Resource Policy and Sustainability. (3)***fall*

Considers the evolution of policy design, focusing on how resource and environmental concerns have affected agricultural development and trade policies. Prerequisite: ECN 112.

AGB 458 Bioremediation. (3)*spring*

Technical-regulatory and policy issues emanating from minetailing and animal waste. Lecture, case studies.

AGB 460 Agribusiness Management Systems. (4)*spring*

Development and use of decision support systems for agribusiness management and marketing. Lecture, lab.

AGB 463 Electronic Commerce Applications. (3)*fall*

Overview of electronic commerce technology with introduction to basics of design, control, operation, organization, and emerging issues. Pre- or corequisite: AGB 460 (or its equivalent).

AGB 466 Integrated Pest Control. (2)*fall and spring*

Management of pests affecting golf turf and landscape plants. Structural Pest Control Board sprayer certification preparation offered during the semester. Lecture, lab.

AGB 470 Comparative Nutrition. (3)*not regularly offered*

Effects of nutrition on animal systems and metabolic functions. Prerequisite: CHM 231.

AGB 471 Diseases of Domestic Animals. (3)*spring*

Discussion of animal welfare, mechanisms of disease development, causes and classification of diseases, disease resistance, and common zoonoses. Prerequisite: BIO 181.

AGB 473 Animal Physiology I. (3)*not regularly offered*

Control and function of the nervous, muscular, cardiovascular, respiratory, and renal systems of domestic animals. Prerequisites: BIO 181; CHM 113.

AGB 479 Veterinary Practices. (3)*fall and spring*

Observation of and participation in veterinary medicine and surgery supervised by local veterinarians. Prerequisite: advanced preveterinary student.

AGB 480 Agribusiness Policy and Government Regulations. (3)*spring*

Development and implementation of government food, drug, pesticide, and farm policies and regulations that affect the management of agribusiness.

AGB 484 Internship. (1–12)*fall and spring***AGB 490 Recent Advances in Agribusiness. (1)***fall and spring*

Reports and discussions of current topics and problems associated with agribusiness. May be repeated for credit.

AGB 500 Research Methods. (1–12)*not regularly offered***AGB 501 Master's Thesis Preparation. (1)***fall and spring*

Step-by-step guidelines to major elements of a master's thesis along with practical guidelines for conducting research.

AGB 511 Advanced Agribusiness Management. (3)*spring*

Analysis of organization behavior, change, and resource requirements within agribusiness systems.

AGB 512 Food Industry Management. (3)*spring*

Operations and management of food-processing factories, food distribution centers, and retail food-handling firms.

AGB 513 Advanced Cooperatives. (3)*fall*

Advanced study of cooperatives and other nongovernmental organizations (NGO) focusing on management and proposal preparation for international agencies.

AGB 514 Advanced Agribusiness Analysis I. (3)*spring*

Vertical integration and differentiation in food and agricultural industries. Prerequisite: AGB 528.

AGB 515 Agribusiness Coordination. (3)*spring*

Organizational alternatives for agribusiness with emphasis on cooperatives and trading companies. Prerequisite: AGB 528.

AGB 528 Advanced Agribusiness Marketing. (3)*fall*

Theory and analysis of marketing farm commodities, risks, and the effect of future trading on cash prices.

AGB 529 Advanced Agribusiness Marketing Channels. (3)*spring*

Analysis of agribusiness market channel systems. Formulation of marketing strategies.

AGB 532 Advanced Agribusiness Finance. (3)*fall*

Financial management of agribusiness firms; agribusiness financial analysis, investment analysis, agricultural risk management, and introduction to agricultural financial intermediaries. Prerequisites: both computer literacy and a finance course or only instructor approval.

AGB 535 Commodity Analysis. (3)*fall*

Analysis of commodity markets.

AGB 536 Small Business Finance, Entrepreneurship, and E-Commerce. (3)*fall*

Uses lectures, case studies, and business plans to highlight challenges of starting and running a small business. Lecture, seminar, case studies, computer labs.

AGB 540 Advanced Food Science. (3)*not regularly offered*

Chemical and physical nature of processed foods. Emphasis on food product development.

AGB 550 International Agricultural Development. (3)*fall*

Transition of developing countries from subsistence to modern agriculture. Emphasis placed on implications for U.S. agribusiness working abroad.

AGB 551 Agribusiness in Developing Countries. (3)*spring*

Factors influencing successful development of agribusiness enterprises in developing countries, including poverty, access to capital and technology, and trade opportunities.

AGB 552 International Agricultural Policy. (3)*fall*

Use of international trade theory to analyze the effects of government policies, trade agreements, and exchange rates on agribusiness.

AGB 554 Advanced International Trade. (3)*fall*

Advanced international practices in trading of agribusiness, technology, and resource products and services.

AGB 557 Resource Policy and Sustainability. (3)*fall*

Considers the evolution of policy design, focusing on how resource and environmental concerns have affected agricultural development and trade policies.

AGB 558 Advanced Bioremediation. (3)*spring*

Management and policy issues related to bioremediation of minetailing and animal waste and replacement of chemical control with biological methods. Lecture, case studies.

AGB 560 Advanced Agribusiness Management Systems. (3)*not regularly offered*

Development and use of decision support systems for agribusiness management decision making.

AGB 561 Agribusiness Research Methods. (3)*fall*

Use of model building, hypothesis testing, and empirical analysis in solving agribusiness problems.

AGB 570 Managerial Economics for Agribusiness. (3)*fall*

Concepts in micro- and macroeconomics applied to agribusiness management environments: price formation, market structure, information economics, fiscal and monetary policy. Prerequisites: introductory micro- and macroeconomics.

AGB 580 Practicum. (1-12)*not regularly offered***AGB 581 Advanced Agribusiness Policy. (3)***fall*

Policy-making history, structure, and process.

AGB 583 Field Work. (1-12)*not regularly offered***AGB 584 Internship. (1-12)***not regularly offered***AGB 587 Resource Policy and Sustainability. (3)***fall*

Considers the evolution of policy design, focusing on how resource and environmental concerns have affected agricultural development and trade policies.

AGB 590 Reading and Conference. (1-12)*not regularly offered***AGB 591 Seminar. (1-12)***not regularly offered***AGB 592 Research. (1-12)***not regularly offered***AGB 593 Applied Project. (1-12)***not regularly offered***AGB 594 Conference and Workshop. (1-12)***not regularly offered***AGB 595 Continuing Registration. (1)***not regularly offered***AGB 598 Special Topics. (1-4)***not regularly offered***AGB 599 Thesis. (1-12)***not regularly offered***AGB 600 Research Methods. (1-12)***not regularly offered***AGB 690 Reading and Conference. (1-12)***not regularly offered*

Omnibus Graduate Courses. See page 50 for omnibus graduate courses that may be offered.

Anthropology

Master's and Doctoral Programs

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TURNER

PROFESSORS

ALVAREZ, BAHR, BRANDT, CARR, CHANCE, CLARK, COWGILL, EDER, HUDAK, JOHANSON, KINTIGH, KOSS-CHIOINO, MARTIN, MARZKE, MERBS, NASH, B. NELSON, M. NELSON, REDMAN, SPIELMANN, STARK, WILLIAMS

ASSOCIATE PROFESSORS

BARTON, FALCONER, HEGMON, KIMBEL, RICE, WELSH

ASSISTANT PROFESSORS

BAKER, HAENN, JONSSON, REED, STEADMAN

SENIOR LECTURER

WINKELMAN

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

Admission. In addition to the general requirements for admission to the Graduate College, the Department of Anthropology requires applicants to provide a statement of their interests and professional goals and three letters of recommendation. Applicants who received their B.A. during the past ten years must also submit scores on the Graduate Record Examination. Undergraduate course work in anthropology is not a prerequisite for admission to the M.A. program. Admission to the Ph.D. program normally presumes an M.A. in Anthropology; students may be admitted without such a background on the condition that they acquire a knowledge of general anthropology in a manner to be specified at the time of admission.

Program of Study. Special training programs designed to terminate with a master's degree are possible at the discretion of the student and faculty advisors. For example, the concentrations in linguistics, museum studies, medical anthropology, and bioarchaeology are at the master's level. The primary purpose and scope of the graduate program in anthropology, however, is intended to lead to the Ph.D. degree.

The doctoral program is divided into three phases. The first consists of 24 semester hours of course work and readings, usually within a subdiscipline and closely allied areas, followed by six semester hours for the M.A. thesis (or publishable paper). The faculty may require additional hours of course work or other preparation for entering students who are unfamiliar with the concepts of general anthropology at a level equivalent to that of the Arizona State undergraduate anthropology core. Mastery of the phase I course material is

demonstrated by successful completion of a written qualifying examination in social-cultural anthropology or, in physical anthropology, bioarchaeology, and archaeology, by successful completion of a sequence of core courses.

Admission to phase II of the doctoral program is granted to students on the basis of performance in phase I, the quality of M.A. research, prior course work, faculty recommendations, and other relevant information. The second phase consists of 30 semester hours of course work, reading in anthropology and related fields, and directed research designed to prepare the student for the dissertation project. Proficiency in one foreign language or quantitative methods may be required by the supervisory committee. The second phase is completed when the following have been met: (1) passing a written comprehensive examination, and (2) passing the oral defense of the dissertation proposal. The successful student is then advanced to candidacy.

The final phase consists of 24 semester hours of research and dissertation.

Certificate in Museum Studies. The certificate is awarded to nondegree or graduate students who are accepted into the certificate program and who complete 12 hours of required course work and a six-semester hour internship at an approved museum. The certificate may be taken independently or in conjunction with the M.A. degree in Anthropology with a concentration in museum studies.

MASTER OF ARTS

Concentrations are available at the master's level in archaeology, bioarchaeology, linguistics, medical anthropology, museum studies, physical anthropology, and social-cultural anthropology.

The new medical anthropology concentration emphasizes biocultural perspectives on the study of health and illness behavior. The faculty has a range of teaching and research activities that span biological, physical, ecological, socio-cultural, and applied areas of medical anthropology. The program combines theoretical approaches with an applied problem-solving focus to prepare students for careers both in academia and in health care delivery and public health.

See "Master's Degrees," page 100, for general requirements. A concurrent M.A. degree in Anthropology and M.S. degree in Justice Studies is also available. See "Concurrent M.A. Anthropology/M.S. Justice Studies.," page 244.

DOCTOR OF PHILOSOPHY

Concentrations are available at the doctoral level in archaeology, physical anthropology, and social-cultural anthropology.

For more information on the Ph.D. degree, see "Doctor of Philosophy," page 103.



Old Main, renovated in 2000, houses the Alumni Association. -Tim Trumble photo

ANTHROPOLOGY (ASB)**ASB 400 Cultural Factors in International Business. (3)***spring*

Anthropological perspectives on international business relations; applied principles of cross-cultural communication and management; regional approaches to culture and business.

*General Studies: G***ASB 411 Kinship and Social Organization. (3)***spring*

Meanings and uses of concepts referring to kinship, consanguinity, affinity, descent, alliance, and residence in the context of a survey of the varieties of social groups, marriage, rules, and kinship terminological systems. Prerequisite: 6 hours in anthropology or instructor approval.

ASB 412 History of Anthropology. (3)*fall*

Historical treatment of the development of the culture concept and its expression in the chief theoretical trends in anthropology between 1860 and 1950. Prerequisite: ASB 102 or instructor approval.

*General Studies: L/SB***ASB 416 Economic Anthropology. (3)***fall*

Economic behavior and the economy in preindustrial societies; description and classification of exchange systems; relations between production, exchange systems, and other societal subsystems. Prerequisite: ASB 102 or instructor approval.

*General Studies: L/SB***ASB 417 Political Anthropology. (3)***once a year*

Comparative examination of the forms and processes of political organization and activity in primitive, peasant, and complex societies. Prerequisite: ASB 102 or instructor approval.

ASB 462 Medical Anthropology: Culture and Health. (3)*fall*

Role of culture in health, illness, and curing; health status, provider relations, and indigenous healing practices in United States ethnic groups. Lecture, discussion.

*General Studies: C***ASB 466 Peoples and Cultures of Africa. (3)***fall and spring*

Survey of African peoples and their cultures, external contact, and changes. Meets non-Western requirement. Lecture, discussion. Cross-listed as AFS 466. Credit is allowed for only AFS 466 or ASB 466.

*General Studies: SB, G, H***ASB 471 Introduction to Museums. (3)***fall*

History, philosophy, and current status of museums. Exploration of collecting, preservation, exhibition, education, and research activities in different types of museums. Prerequisites: both ASB 102 and ASM 101 or only instructor approval.

*General Studies: L***ASB 480 Introduction to Linguistics. (3)***fall*

Descriptive and historical linguistics. Survey of theories of human language, emphasizing synchronic linguistics.

*General Studies: SB***ASB 481 Language and Culture. (3)***spring*

Application of linguistic theories and findings to nonlinguistic aspects of culture; language change; psycholinguistics. Prerequisite: ASB 102 or instructor approval.

*General Studies: SB***ASB 483 Sociolinguistics and the Ethnography of Communication. (3)***not regularly offered*

Relationships between linguistic and social categories; functional analysis of language use, maintenance, and diversity; interaction between verbal and nonverbal communication. Prerequisites: both ASB 480 and ENG 213 (or FLA 400) or only instructor approval.

*General Studies: SB***ASB 485 U.S.-Mexico Border in Comparative Perspective. (3)***spring in odd years*

Explores the multicultural and social dimensions of communities along the U.S.-Mexico border, emphasizing social organization, migration, culture, and frontier ideology. Prerequisite: 6 hours in anthropology or instructor approval.

ASB 501 Applied Medical Anthropology. (3)*fall*

Overview of anthropology's applications in medicine and its adaptations to U.S. ethnic populations. Requires research project in medical setting. Lecture, seminar. Prerequisite: graduate standing or instructor approval.

ASB 502 Health of Ethnic Minorities. (3)*spring*

Prevalence of illness, risk factors, health ecology, and medical and indigenous treatments. Lecture, seminar. Prerequisite: graduate standing or instructor approval.

ASB 503 Advanced Medical Anthropology. (3)*fall*

Theory in medical anthropology and cross-cultural studies that illustrate particular theories. Lecture, seminar. Prerequisite: graduate standing or instructor approval.

ASB 504 Ethnic Relations. (3)*fall*

Structural processes of intergroup relations, methods for investigating psychocultural dimensions of ethnicity with focus upon U.S. ethnic groups. Lecture, seminar. Prerequisite: graduate standing or instructor approval.

ASB 505 Culture and Psychiatry. (3)*fall*

Psychiatry as a cultural phenomenon and indigenous definitions and treatments of mental disorders across cultures. Lecture, seminar. Prerequisite: graduate standing or instructor approval.

ASB 506 Gender, Emotions, and Culture. (3)*spring*

Relationships among gender and emotion across cultures. Lecture, seminar. Prerequisite: graduate standing or instructor approval.

ASB 529 Culture and Political Economy. (3)*not regularly offered*

Origin and spread of Western capitalism and its impact on non-Western societies. Utilizes ethnographic and historical case studies. Prerequisite: graduate standing.

ASB 530 Ecological Anthropology. (3)*once a year*

Relations among the population dynamics, social organization, culture, and environment of human populations, with special emphasis on hunter-gatherers and extensive agriculturalists.

ASB 532 Graduate Field Anthropology. (2-8)*spring*

Independent research on a specific anthropological problem to be selected by the student in consultation with the staff. May be repeated for credit. Prerequisites: ASM 338 (or its equivalent); instructor approval.

ASB 536 Ethnohistory of Mesoamerica. (3)*not regularly offered*

Indigenous societies of southern Mexico and Guatemala at Spanish contact and their postconquest transformation. Emphasis on the Aztec Empire. Prerequisite: graduate standing.

ASB 537 Topics in Mesoamerican Archaeology. (3)*not regularly offered*

Changing organization of pre-Columbian civilizations in Mesoamerica is explored through interpretive issues, such as regional analysis, chiefdoms, urbanism, and exchange. Prerequisite: instructor approval.

ASB 540 Method and Theory of Sociocultural Anthropology and Archaeology. (3)*fall*

Basic issues concerning concepts of social and ethnic groups, cultural and sociological theory, and the nature of anthropological research. Prerequisite: instructor approval.

ASB 541 Method and Theory of Social and Cultural Anthropology. (3)*spring*

Continuation of ASB 540. Prerequisite: ASB 540 or instructor approval.

ASB 542 Method and Theory of Archaeology I. (3)*spring*

Models of human evolution, culture change, and interpretation of hunter-gatherer and tribal societies, ceramic, lithic, and faunal materials. Prerequisite: instructor approval.

ASB 543 Method and Theory of Archaeology II. (3)*fall*

Covers concepts of social complexity along with economy, demography, and social dynamics, followed by archaeological research design. Prerequisite: instructor approval.

ASB 544 Settlement Patterns. (3)*not regularly offered*

Spatial arrangement of residences, activity sites, and communities over landscape. Emphasis on natural and cultural factors influencing settlement patterns. Prerequisite: instructor approval.

ASB 546 Pleistocene Prehistory. (3)*fall*

Development of society and culture in the Old World during the Pleistocene epoch, emphasizing technological change through time and the relationship of people to their environment. Prerequisite: ASB 361 (or its equivalent).

ASB 547 Issues in Old World Domestication Economies. (3)*spring*

Archaeological evidence for transitions in Old World subsistence economies from hunting and gathering to dependence on domesticated plants and animals. Prerequisite: ASB 362 (or its equivalent).

ASB 550 Economic Archaeology. (3)*not regularly offered*

Prehistoric economies in hunter-gatherer, tribal, and complex societies. Covers subsistence strategies, craft production and specialization, and exchange. Prerequisite: instructor approval.

ASB 551 Prehistoric Diet. (3)*not regularly offered*

Critical review of techniques for recovering dietary information and theoretical models concerned with explaining diet and nutrition. Prerequisite: instructor approval.

ASB 555 Complex Societies. (3)*spring*

Examines structural variations in hierarchically organized societies, along with origins, dynamics, and collapse. Seminar.

ASB 559 Archaeology and the Ideational Realm. (3)*not regularly offered*

"Postprocessual" and other views concerning relevance of mental phenomena for understanding sociocultural change. Various approaches to inferring prehistoric meanings.

ASB 563 Hunter-Gatherer Adaptations. (3)*not regularly offered*

Evolution of prehistoric hunter-gatherer societies in the Old and New Worlds from the most ancient times through protohistoric chiefdoms. Prerequisite: instructor approval.

ASB 567 Southwestern Archaeology. (3)*spring*

Broad coverage of Southwestern cultural developments focusing on current debates and rigorous use of archaeological data in making cultural inferences.

ASB 568 Intrasite Research Strategies. (3)*fall*

Research issues within a single site context. Topics include quantitative spatial analysis, site definition, sampling, distributional analysis, and substantive interpretation.

ASB 571 Museum Principles. (3)*fall*

History, philosophy, and current status of museums. Exploration of collecting, preservation, exhibition, education, and research activities in different types of museums. Prerequisites: both ASB 102 and ASM 101 or only instructor approval.

ASB 572 Museum Collection Management. (3)*spring*

Principles and practices of acquisition, documentation, care, and use of museum collections; registration, cataloging, and preservation methods; legal and ethical issues. Prerequisite: ASB 571 or instructor approval.

ASB 573 Museum Administration. (3)*spring*

Formal organization and management of museums, governance, personnel matters, fund raising and grantsmanship, legal and ethical issues. Prerequisite: ASB 571 or instructor approval.

ASB 574 Exhibition Planning and Design. (3)*spring*

Exhibition philosophies and development; processes of planning, designing, staging, installing, evaluating, and disassembling temporary and long-term exhibits. Prerequisites: both ASB 571 and 572 or only instructor approval.

ASB 575 Computers and Museums. (3)*fall*

Basics of museum computer application; hardware and software; fundamentals of database management; issues of research, collections management, and administration.

ASB 576 Museum Interpretation. (3)*fall*

Processes of planning, implementing, documenting, and evaluating educational programs in museums for varied audiences—children, adults, and special interest groups. Lecture, discussion. Prerequisite: ASB 571.

ASB 577 Principles of Conservation. (3)*spring*

Preservation of museum objects: nature of materials, environmental controls, and causes of degradation; recognizing problems, damage, and solutions; proper care of objects. Prerequisites: both ASB 571 and 572 or only instructor approval.

ASB 579 Critical Issues in Museum Studies. (3)*fall*

Current debates of museum practice from an anthropological perspective. Addresses issues of collection, presentation, authenticity, and authority. Seminar. Prerequisite: ASB 571 or instructor approval.

ASB 591 Seminar. (1–12)*not regularly offered*

Selected topics in archaeology, linguistics, and social-cultural anthropology. Possible topics:

- (a) Archaeological Ceramics. (3)
- (b) Archaeology of North America. (3)
- (c) Cultural Anthropology. (3)
- (d) Culture and Personality. (3)
- (e) Evolution and Culture. (3)
- (f) Historical Archaeology. (3)
- (g) Interdepartmental Seminar. (3)
- (h) Language and Culture. (3)
- (i) Linguistics. (3)
- (j) Museum Studies. (3)
- (k) Problems in Southwestern Archaeology. (3)
- (l) Problems in Southwestern Ethnology. (3)
- (m) Social Anthropology. (3)

Omnibus Graduate Courses. See page 50 for omnibus graduate courses that may be offered.

ANTHROPOLOGY (ASM)**ASM 435 Archaeological Pollen Analysis. (3)***fall*

Theory, methodology, and practice of pollen analytic techniques. Compares uses in botany, geology, and archaeology. 2 hours lecture, 3 hours lab, possible field trips. Prerequisite: instructor approval.

ASM 452 Dental Anthropology. (4)*fall*

Human and primate dental morphology, growth, evolution, and genetics. Within- and between-group variation. Dental pathology and behavioral-cultural-dietary factors. 3 hours lecture, 3 hours lab. Prerequisite: instructor approval.

*General Studies: SG***ASM 454 Comparative Primate Anatomy. (4)***spring*

Functional anatomy of the cranial, dental, and locomotor apparatus of primates, including humans, emphasizing the relation of morphology to behavior and environment. 3 hours lecture, 3 hours lab, dissections, demonstrations. Prerequisite: instructor approval.

ASM 455 Primate Behavior Laboratory. (3)*not regularly offered*

Instruction and practice in methods of observation and analysis of primate behavior. Discussion of the relationship between class work on captive animals and field techniques for studying free-ranging groups. Directed readings, 6 hours lab. Prerequisites: ASM 343; instructor approval.

*General Studies: L***ASM 465 Quantification and Analysis for Anthropologists. (3)***spring*

Statistical, quantitative, and geometric strategies for envisioning and exploring archaeological, physical anthropological, bioarchaeological, and sociocultural data. Univariate and multivariate methods. Prerequisites: introductory statistical course; instructor approval.

ASM 507 Anthropological Study of Disease. (3)*once a year*

In-depth introduction to the study of disease processes from an anthropological perspective. Lecture, seminar. Prerequisite: graduate standing or instructor approval.

ASM 548 Geoarchaeology. (3)*fall*

Geologic context relevant to archaeological research. Topics include sediments, deposition environments, soils, anthropogenic and biogenic deposits, and quaternary chronology. Prerequisite: instructor approval.

ASM 555 Advanced Human Osteology. (3)*not regularly offered*

Laboratory and field techniques in dealing with the human skeleton. Emphasis on preparation, identification, radiography, sectioning, microscopy, and data processing. 1 hour lecture, 6 hours lab. Prerequisite: ASM 341 or instructor approval.

ASM 565 Quantitative Archaeology. (3)*spring*

Formal methods of structuring, codifying, and analyzing data for archaeological problems. Designing research to yield data amenable to productive analysis.

ASM 566 Advanced Topics in Quantitative Archaeology. (3)*fall*

Archaeological issues associated with quantitative analysis, e.g., Bayesian and Monte Carlo approaches, simulation, diversity. May be repeated for credit. Prerequisite: ASM 565 or instructor approval.

ASM 573 Lithic Analysis. (3)*not regularly offered*

Analysis and interpretation of chipped stone artifacts. Focus on both techniques and underlying concepts and their application to real collections. Prerequisite: instructor approval.

ASM 591 Seminar. (1–12)*not regularly offered*

Selected topics in archaeology and physical anthropology. Possible topics:

- (a) Bioarchaeology. (3)
- (b) Evolution and Culture. (3)
- (c) Interdepartmental Seminar. (3)
- (d) Physical Anthropology. (3)
- (e) Primates and Behavior. (3)

Omnibus Graduate Courses. See page 50 for omnibus graduate courses that may be offered.

Architecture

Master's Program**Ron McCoy***Director***(AED 162) 480/965-3536****arch.grad@asu.edu****www.asu.edu/caed/architecture****REGENTS' PROFESSOR**

COOK

PROFESSORS

HOFFMAN, McCOY, MEUNIER, OZEL, ROTONDI,
SCHEATZLE, UNDERHILL, UNDERWOOD

ASSOCIATE PROFESSORS

BRYAN, ELLIN, HARTMAN, KROLOFF, KUPPER, LOOPE,
VAN DUZER, ZYGAS

ASSISTANT PROFESSORS

CAICCO, HAHN, HEJDUK, LERUM, MURFF, PETRUCCI,
SOROKA, SPELLMAN

The faculty in the School of Architecture offer a professional program leading to the Master of Architecture degree and a research-based postprofessional graduate program leading to the M.S. degree in Building Design. See "Master of Science in Building Design," page 118, for information on this degree program.

The faculty in the school also participate in offering a Ph.D. in Environmental Design and Planning. See "Environmental Design and Planning," page 207, for information on this degree program.

MASTER OF ARCHITECTURE

The Master of Architecture is the accredited professional degree program at ASU. There are two typical programs of study available: (1) a two-year program for applicants who have completed the four-year Bachelor of Science in Design (with a major in Architectural Studies) at ASU or an equivalent degree from another school that offers an accredited professional degree in architecture, and (2) a three-plus-year program for applicants with an undergraduate degree in a discipline or field other than architecture. Both programs promote broad areas of knowledge, professional skill, and a social awareness that the architect must command if architecture is to enhance contemporary life and remain an enduring and valid expression of society.

The program represents an attempt to develop the knowledge and skills necessary for graduates to achieve future leadership roles in the professional practice of architecture and related environmental design fields.

It is the intention of the faculty that the programs also

1. ensure a basic level of educational experience sufficient to enter the practice of architecture after successfully completing state licensing requirements and examination,

2. encourage the student to develop proficiencies in specific areas compatible with individual interests and university instructional capabilities,
3. provide a breadth of understanding that will encourage and motivate the student to continue learning throughout a professional career, and
4. develop opportunities that combine instruction and research directed toward adding value to the built environment.

Elective foci currently offered in the program include energy-conscious design, computer applications, urban design, architectural history and theory, and architectural administration and management.

In the first year of the two-year program, graduate design studio projects focus on advanced comprehensive problems that require integration of the full range of knowledge and skills from students' undergraduate education. In the second year, students select design studios and undertake final design projects that complement their areas of interest. Courses in technology, history and theory, and architectural management are structured alongside the studio sequence.

The three-plus-year program begins with an intensive 10-week summer session introducing architecture and design fundamentals and continues with a preparatory year of architectural history, technology, and design. The final two years are similar to the two-year program described above. Students with no work experience in architecture must also complete a summer internship between the first and second years.

Application Requirements. An applicant to the M.Arch. program must hold a baccalaureate or graduate degree from a college or university recognized by ASU and must meet the minimum GPA requirements as established by the Graduate College.

In addition, all applicants are required to submit for review a design portfolio, GRE scores (except for international students), a statement of intent, and letters of reference. Applicants are accepted on a space-available basis only. Students may be admitted to the two-year program *with deficiencies* if their previous course work is not equivalent to the ASU undergraduate requirements and standards.

Students intending to apply for admission to the professional program in architecture at the *graduate level* should write to the graduate program coordinator well in advance of the application deadline.

International applicants whose native language is not English must submit a TOEFL score of 550 or above. International students should write the Graduate Admissions Office at least one year before the date they plan to begin study.

Application Procedures. Applicants must submit separate application materials to the Graduate College and the School of Architecture.

School of Architecture. In addition to the Graduate College admission requirements, applicants must file all of the following admission materials with

MASTER OF ARCHITECTURE ADMISSIONS
COMMITTEE
SCHOOL OF ARCHITECTURE
ARIZONA STATE UNIVERSITY
PO BOX 871605
TEMPE AZ 85287-1605

1. *Statement of Intent.* A personal narrative (maximum 600 words or two pages typed) indicating the applicant's interest, previous academic and practical background, and personal and professional educational objectives must be submitted.
2. *Letters of Recommendation.* A minimum of three letters of recommendation in support of the applicant must be mailed directly to the Graduate Admissions Committee, School of Architecture. The references should be from professionals or educators familiar with the applicant's experience and capability for graduate work.
3. *Portfolio.* Candidates applying for the two-year Master of Architecture program are required to submit a portfolio. The portfolio must be no larger than 8.5" x 11" (image size). The admissions committee is interested in the quality of work submitted in the portfolio, and applicants are advised not to lavish expense on special or unusual packaging. Slides, original drawings, and loose (unbound) materials should not be submitted. The portfolio should include at least five projects with a range of complexity and with concise, explanatory statements for each project. Include the dates of execution; course, professor, or firm; objective or program summary; and most importantly, a brief self-analysis of the results. When any work is not completely original, the relevant sources must be given. When work is of a team nature, the applicant's role and contribution to the project should be clearly indicated. Applicants who have professional experience and wish to submit examples of professional work may do so. Of particular interest are projects in which the applicant has played a principal role in design. The portfolio is returned after final admission procedures, provided the applicant encloses a self-addressed return mailer with sufficient prepaid postage or if the applicant appears in person to claim the materials within one year of submission. Unclaimed portfolios are retained for one year only. The School of Architecture assumes no liability for materials lost or damaged during shipment or handling.
4. *Creative Work.* Candidates applying for the three-plus-year Master of Architecture program must also provide a portfolio of work as described in paragraph three above. It is recognized that candidates to this program may not have work related to architecture. Therefore, the portfolio should include other forms of creative work such as drawings, designs, paintings, photography, writing, craft, and construction. The work presented may be from vocational, avocational, or academic sources.

Because of space limitations, not all qualified applicants can be accommodated and the admission process is necessarily selective.

Students should indicate for which program of study they are applying. Those with a four-year degree equivalent to the B.S.D. in Architectural Studies should apply for the two-year program. Those with an undergraduate degree not in architecture should apply for the three-plus-year program. Students who are uncertain about which program suits them should write to the graduate program coordinator for determination of appropriate application. Applicants are required to write their names in a clear and consistent manner on all materials submitted, preferably in the “family name, first name” format (e.g. Smith, John).

Students with a previous professional degree in architecture (five or six years) who wish to pursue advanced study in climate responsive architecture, building energy performance, computer-aided design, energy simulation and analysis, and facilities development and management should apply to the Master of Science in Building Design program. See “Master of Science in Building Design,” page 118.

Application Deadline. Priority consideration is given to completed applications received on or before January 15. Students are not admitted to the two-year Master of Architecture program at any time other than the beginning of the fall semester. Students are not admitted to the three-plus-year Master of Architecture program at any time other than the beginning of the first summer session.

Personal Interview. A personal interview is not required. However, a candidate wishing to visit the school is welcome and should make arrangements by contacting the Graduate Programs Coordinator in the School of Architecture.

Requirements for the Two-Year Program. The two-year graduate program requires a minimum of 56 semester hours of approved courses and electives and a comprehensive examination. For most students, this program involves an average of 14 semester hours per semester. An internship may be offered as an elective to be taken in the summer before the final year of study. The internship is an honors program individually arranged and approved by the Master of Architecture Committee.

Students who can adequately demonstrate competence through experience or previous academic course work for any of the specific requirements outlined below are encouraged to petition the graduate advisor for a course substitution.

Typical Program of Study

First Year

Fall	
ADE 521 Advanced Architectural Studio I.....	5
APH 505 Foundation Theory Seminar.....	3
ATE 553 Building Systems III.....	3
ATE 563 Building Structures III.....	3
Total	14
Spring	
ADE 522 Advanced Architectural Studio II.....	5
APH 515 Current Issues and Topics.....	3
ATE 556 Building Development.....	3
Professional elective*.....	3
Total	14

Second Year

Fall	
AAD 551 Architectural Management I.....	3

ADE 621 Advanced Architectural Studio III.....	5
ANP 681 Project Development.....	3
Professional elective*.....	3
Total	14
Spring	
AAD 552 Architectural Management II.....	3
ADE 622 Advanced Architectural Studio IV.....	5
Approved elective.....	3
Professional elective*.....	3
Total	14
Master of Architecture total	56

* At least one professional elective must be a CAD course or be taken in the area of computers, if the student can demonstrate CAD skills.

Requirements for the Three-Plus-Year Program. The three-plus-year graduate program requires a minimum of 99 semester hours of approved courses and electives and a comprehensive examination. For most students, this program involves 12 semester hours in the first summer and 14–15 semester hours in each of the subsequent six semesters. A summer internship is required after the first full year of study. A second internship may be offered as an elective to be taken in the summer before the final year of study. The second internship is an honors program individually arranged and approved by the Master of Architecture Committee.

Students who can adequately demonstrate competence through experience or previous academic course work for any of the specific requirements outlined below are encouraged to petition the graduate advisor for a course substitution.

Typical Program of Study

First Year

Summer	
ADE 510 Foundation Architectural Studio.....	6
APH 200 Introduction to Architecture <i>HU, G</i>	3
APH 509 Foundation Seminar.....	3
Total	12
Fall	
ADE 511 Core Architectural Studio I.....	6
APH 313 History of Western Architecture <i>I L, HU</i>	3
ATE 353 Architectural Construction.....	3
ATE 451 Building Systems I.....	3
Total	15
Spring	
ADE 512 Core Architectural Studio II.....	6
APH 314 History of Western Architecture <i>II L, HU</i>	3
ATE 361 Building Structures I.....	3
ATE 452 Building Systems II.....	3
Total	15
Summer	
ARP 584 Clinical Internship.....	1
Total	1

Second Year

Fall	
ADE 521 Advanced Architectural Studio I.....	5
APH 505 Foundation Theory Seminar.....	3
ATE 462 Building Structures II.....	3

ATE 553 Building Systems III	3
Total	14
Spring	
ADE 522 Advanced Architectural Studio II	5
APH 515 Current Issues and Topics	3
ATE 556 Building Development	3
Professional elective*	3
Total	14
Third Year	
Fall	
AAD 551 Architectural Management I	3
ADE 621 Advanced Architectural Studio III	5
ANP 681 Project Development	3
ATE 563 Building Structures III	3
Total	14
Spring	
AAD 552 Architectural Management II	3
ADE 622 Advanced Architectural Studio IV	5
Approved elective	3
Professional elective*	3
Total	14
Total hours in program	99

* At least one professional elective must be a CAD course or be taken in the area of computers, if the student can demonstrate CAD skills.

Comprehensive Examinations. The faculty require that all students pass an oral comprehensive examination based, in part, on a defense of their final design project in ADE 622. Each student is required to undertake an independent design project in ADE 622, based on an approved proposal completed the previous semester in ANP 681. Examiners typically include members of the Architecture faculty and may include distinguished practitioners not on the faculty.

M.Arch./M.B.A. Concurrent Degree Program. A Master of Architecture/Master of Business Administration concurrent degree program is offered through cooperative arrangement between the faculty of the College of Business and the College of Architecture and Environmental Design. Students may obtain both degrees in approximately three years of study by concurrently meeting the requirements for each degree program. Separate applications are required by the respective units.

This program requires a minimum of 88 semester hours for those in the two-year M. Arch program. Once admitted, in consultation with their respective advisors, students develop programs of study that meet degree requirements of both programs and their particular interests. Students interested in this offering should request further information from the School of Architecture graduate advisor.

MASTER OF SCIENCE IN BUILDING DESIGN

The faculty in the School of Architecture offer a graduate program leading to the M.S. degree in Building Design. Concentrations are available in computer-aided design, energy performance and climate-responsive architecture, and facilities development and management. The program provides advanced study at the postprofessional level for architects, and at the specialist level for nonarchitects who have a degree in a related area such as engineering, busi-

ness, computer science, and the physical and environmental sciences. The purpose of the program is the development of knowledge useful to the arts and sciences of building design and the integration of that knowledge in the design process. Within this context, the program emphasizes (1) the ecological importance of energy-conscious design and construction, as well as the high social value placed on buildings in which natural forces and systems are utilized rather than suppressed, and (2) the development of research, information systems, and management processes suited to the planning and design of complex buildings in urban settings.

The faculty in the school also participate in offering the Ph.D. in Environmental Design and Planning. See "Environmental Design and Planning," page 207, for information on the Ph.D. degree program.

Applicants considered for admission to the program must hold a baccalaureate or graduate degree from a college or university recognized by ASU and meet the minimum GPA requirements for admission as established by the Graduate College.

It is preferred that applicants have at least one year of professional employment or comparable field/research experience in building design in addition to their academic experiences. Applicants are accepted on a space-availability basis, and must specify an area of research concentration upon application. International applicants whose native language is not English must submit a Test of English as a Foreign Language score of 550 or higher. International students should write the Graduate Admissions Office at least one year prior to the date they plan to begin study.

Application Procedures. Applicants must submit separate application materials to the Graduate College and the School of Architecture.

Application Deadline. Priority consideration is given to completed applications received on or before February 15. All fellowships and scholarship allocations for entering students are normally made from applicants in this group. Applications for admission received after February 15 can be considered only for remaining vacancies and "alternate" placement.

School of Architecture. In addition to the Graduate College admission requirements, applicants must file all of the following admission materials with

ACADEMIC ADVISOR,
MASTER OF SCIENCE IN BUILDING DESIGN
SCHOOL OF ARCHITECTURE
ARIZONA STATE UNIVERSITY
PO BOX 871605
TEMPE, AZ 85287-1605

Applicants are encouraged to ascertain that all materials have been received by contacting an advisor at 480/965-3536.

Statement of Intent. A personal narrative (maximum 600 words or two pages typed) indicating the applicant's interest, previous academic and practical background, and personal and professional educational objectives must be submitted.

Letters of Recommendation. A minimum of three letters of recommendation in support of the applicant must be mailed directly to the Graduate Admissions Committee, School of

Architecture. The references should be from professionals or educators familiar with the applicant's experience and capability for graduate work.

Portfolio. Applicants must submit a folio documenting projects, papers, creative endeavors, and, if appropriate, work experience (maximum size 9" x 12").

The portfolio is returned after final admission procedures, *provided* the applicant encloses a self-addressed return mailer with sufficient prepaid postage, or if the applicant appears in person to claim the materials within one year of submission. Unclaimed portfolios are retained for only one year. The School of Architecture assumes no liability for lost or damaged materials. Students must have their name clearly visible on all parts of application, portfolio, statement of intent, etc.

Research/Teaching Statement. Students wishing to be considered for teaching or research assistantships should include an additional statement outlining areas in which they feel competent to serve as a teaching or research assistant. International students who wish to be considered for a teaching assistantship and whose native language is not English are required to pass the Test of Spoken English administered by the American English and Culture Program at ASU.

Program of Study. The program requires a minimum of 30 semester hours of approved course work at the advanced level, including six hours of thesis credit.

The M.S. degree in Building Design is based on concepts of research and decision-making emphasized by the College of Architecture and Environmental Design.

Students admitted to the program are required to take a research methods core, certain courses in their area of concentration, additional elective course work as approved and directed by the supervisory committee, and write and defend a thesis. While the minimum requirement is 30 semester hours, most students require at least four semesters of course work and work on their thesis to successfully complete this degree program.

The concentrations include the following: design knowledge and computing, energy performance and climate-responsive architecture, and facilities development and management.

Computer-Aided Design Concentration

Research/thesis.....	12
Area of concentration requirements.....	12
Approved electives.....	6
<hr/>	
Minimum total	30

The *design knowledge and computing* concentration focuses on investigations of computer-aided design methods and techniques and their application to problem-solving issues in the built environment. The goal of the program is to provide a fundamental understanding of computer-aided design methods and to explore critically the application and potential of these techniques in practice. Topics studied include computer graphics, geometric modeling, design databases, interactive graphic environments for design, comprehensive computer-aided design systems, databases for facilities planning, and computer applications in urban design and building construction. The computer-aided design requirements (12 semester hours) consist of ANP 530 Computer Graphics in Architecture, ANP 561 Architectural Information Processing Systems, ANP 563 Methods in

Architectural Design Computation, and ANP 590 RC: Computer Programming and Architecture.

Energy Performance and Climate-Responsive Architecture Concentration

Research/thesis.....	10
Area of concentration requirements.....	15
Approved electives.....	5
<hr/>	
Minimum total	30

The energy performance and climate-responsive architecture concentration is concerned with the relationships among climate and site, thermal and visual comfort, and energy demand and consumption. Courses in this concentration establish a basic core of knowledge on the principles of the natural energies available at the building boundary due to climate and site; thermal and optical behavior of building materials and components; passive and low-energy architectural systems for heating, cooling, and lighting; and appropriate integration with mechanical systems. Additional courses are available to support advanced study and research in a variety of related specialties.

Examples of the areas of advanced study that are available are climate-responsive architecture and analysis of building energy performance. In climate-responsive architecture, a student applies the principles of "bioclimatic" building design in a studio setting to maximize the use of renewable energy resources in particular locations and building programs. In analysis of building energy performance, a student applies physical and economic analysis, computer simulation, and/or measurement as tools in determining component or whole-building performance relative to energy, climate, and cost-efficiency. The student is concerned with climate responsive, low-energy building design through resource-efficient building concepts, materials, components, and systems such as daylighting, passive solar heating, passive cooling, and earth sheltering.

Most students address these problems with an emphasis on either a design-oriented approach in a studio setting or with an emphasis on an analysis-oriented approach through the application of the most current building energy simulation and analysis tools. Some students want to combine these approaches in their thesis problem. The energy performance and climate responsive architecture requirements include APH 511 Energy Environment Theory, ATE 521 Building Environmental Science, ATE 550 Passive Cooling and Heating I, ATE 551 Passive Cooling and Heating II, and ATE 582 Environmental Control Systems.

Facilities, Development, and Management Concentration

Research/thesis.....	12
Area of concentration requirements.....	6
Approved electives.....	12
<hr/>	
Minimum total	30

The *facilities development and management* concentration is concerned with the decision-making processes in building development and design firm management. The goal of the program is the advancement of knowledge about the interactions between design and managerial processes. This concentration addresses the following topics: spatial decision models, building development processes and financing, market structure and strategy, pricing and cost control, design automation and group decision-making,

architectural programming and post-occupancy evaluation, and professional ethics. The program benefits from ties to various professional groups and other academic units concerned with business and facilities management. The facilities development and management requirements (six semester hours) consist of AAD 552 Architectural Management II and AAD 555 Architect as Developer.

Foreign Language Requirements. None.

Thesis Requirements. A thesis is required. Each candidate devotes research effort of six semester hours of thesis/research credit in preparation of a thesis. The thesis must conform to school policies and meet Graduate College format requirements.

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

RESEARCH ACTIVITY

Renata Hejduk, is an architectural historian/theorist who works on the Continental and American post-World War II avant-garde in architecture and urbanism. Her focus is on the 1960s and 70s. Her upcoming book is coedited with Jim Williamson and is entitled *The Structure of Faith: The Continuity of Religious Imagination in Modern and Contemporary Architecture*.

Professor Dan Hoffman's research takes the form of design projects focusing on the tectonic implications of sustainable building strategies. Current projects include the development of a housing prototype for the Navajo using small diameter logs and a camp for children and adults of special needs in the Arizona forests.

David Scheatzle's recent research activity includes a demonstration of residential comfort control using radiant cool ceiling panels. His research paper was published in the transactions of the American Society of Heating, Refrigerating and Air Conditioning Engineers, February, 2000: "Monitoring and evaluating a year round radiant/convective system."

Ellen Soroka is finishing a book on Carlo Scarpa to be published in 2001 and is engaged in research that focuses on the interrelationship of contemporary building and conservation at an urban and architectural level.

Leslie Van Duzer (in collaboration with Kent Kleinman) is completing a building monograph entitled "Notes on Almost Nothing: Mies van der Rohe's Haus Lange and Haus Esters."

Paul Zygas' current research interest is focused on the Baroque architecture in the Grand Duchy of Lithuania from 1600 to 1750.

ARCHITECTURE COURSES

Courses offered by the faculty of the School of Architecture are categorized in the instructional areas described below.

Architectural Administration and Management (AAD). AAD courses investigate the organization and managerial aspects of contemporary architectural practice. These studies examine the overall processes relative to management coordination, administration procedures, ethics, legal constraints, and the financial controls and measures of contemporary architectural practice.

Architectural Design and Technology Studios (ADE). ADE encourages synthesis of the knowledge and understanding the student has gained from previous and parallel course work, and from other sources, toward the comprehensive design of architectural projects. The laboratories integrate the needs, limitations, and determinants of design problems while applying analytical methods and technical skills in seeking and comparing alternative solutions for assigned problems.

Environmental Analysis and Programming (ANP). ANP develops capabilities to analyze and program environmental and human factors as preconditions for architectural design. These studies are concerned with the existing and emerging methods used by the profession to evaluate and analyze. A variety of courses on computer utilization is included in this area.

Architectural Philosophy and History (APH). APH develops an understanding of architecture as both a determinant and a consequence of humankind's culture, technology, needs, and behavior in the past and present. These studies are concerned with the rationale for the methods and results of design and construction.

Architecture Professional Studies (ARP). ARP provides students with residency and off-campus opportunities and educational experience in group and individual studies relative to specific student interests and faculty expertise.

The program also offers several opportunities to study abroad. In addition, various required and optional field trips are undertaken in course work. (Supplemental fees are assessed for these offerings.)

Architectural Technology (ATE). ATE develops knowledge of the technical determinants, resources, and processes of architecture. These studies are concerned primarily with the science and technology of design and construction, including materials, structural systems, construction systems, environmental control systems, active and passive solar systems, and acoustics and lighting.

ARCHITECTURAL ADMINISTRATION AND MANAGEMENT (AAD)

AAD 551 Architectural Management I. (3)

fall

Design delivery, coordination of construction documents, cost estimating, bidding and negotiations, construction observation, and post construction services. Case studies. Lecture, discussion. Prerequisite: graduate-level standing. Corequisite: ADE 621.

AAD 552 Architectural Management II. (3)

spring

Organizational, human performance, and market influences on architecture firms and projects. Readings, case studies, and analysis of managerial problems and solutions. Lecture, discussion. Prerequisites: AAD 551; ADE 621.

AAD 555 Architect as Developer. (3)

once a year

Development building, real estate, construction funding, land acquisition, and the sources for capital. Prerequisite: instructor approval.

AAD 599 Thesis. (1-12)

not regularly offered

Fee.

AAD 681 Professional Seminar: Capstone. (3)

spring

Examination of ethical, political, social, economic, ecological, and cultural issues confronting the practice of architecture. Readings and case studies. Seminar. Prerequisite: AAD 552. Corequisite: ADE 622.

Omnibus Graduate Courses. See page 50 for omnibus graduate courses that may be offered.

ARCHITECTURAL DESIGN AND TECHNOLOGY STUDIOS (ADE)

ADE 510 Foundation Architectural Studio. (6)

summer

Fundamentals of architectural design, methodology, visualization, and representation. Lecture, studio, field trips. Fee. Prerequisite: admission to Master of Architecture degree program.

ADE 511 Core Architectural Studio I. (6)

fall

Application of design fundamentals in architectural problems, including construction, technology, programmatic and environmental determinants. Lecture, studio, field trips. Fee. Prerequisites: APH 200, 509. Prerequisite with a grade of "C" or higher: ADE 510.

ADE 512 Core Architectural Studio II. (6)

spring

Application of architectural design fundamentals to increasingly complex problems, including specific sites and activities. Lecture, studio, field trips. Fee. Prerequisite with a grade of "C" or higher: ADE 511.

ADE 521 Advanced Architectural Studio I. (5)

fall

Design problems emphasizing theory, aesthetics, and tectonics as influences on architectural form. Lecture, studio, field trips. Fee. Prerequisite: admission to Master of Architecture degree program.

ADE 522 Advanced Architectural Studio II. (5)

spring

Design problems emphasizing the comprehensive integration of building systems and technologies as influences on architectural form. Lecture, studio, field trips. Fee. Prerequisite with a grade of "C" or higher: ADE 521.

ADE 621 Advanced Architectural Studio III. (5)

fall

Design problems emphasizing the urban context, planning issues, and urban design theory as influences on architectural form. Lecture, studio, field trips. Fee. Prerequisite: instructor approval. Prerequisite with a grade of "C" or higher: ADE 522. Corequisite: AAD 551.

ADE 622 Advanced Architectural Studio IV. (5)

spring

Individual, student-initiated project reflecting a culminating synthesis of architectural ideas. Studio. Fee. Prerequisites with a grade of "C" or higher: ADE 621; ANP 681.

ADE 631 Building Systems Simulation Studio. (5)

fall

Design of energy-efficient medium and large commercial complexes; synthesis to optimize performance using new and advanced algorithms. Lecture, lab, studio. Prerequisites: ATE 521, 550, 551, 582.

ADE 661 Bioclimatic Design Studio. (6)

once a year

Sustainable architectural and site synthesis at a variety of scales emphasizing bioclimatic criteria and the use of passive and low-energy systems. Prerequisite: professional degree or instructor approval. Corequisite: ATE 558.

Omnibus Graduate Courses. See page 50 for omnibus graduate courses that may be offered.

ENVIRONMENTAL ANALYSIS AND PROGRAMMING (ANP)

ANP 500 Research Methods. (1–12)

not regularly offered

Fee.

ANP 530 Computer Graphics in Architecture. (3)

once a year

Fundamentals of computer graphics programming in architecture, including graphics hardware, device-independent packages, 2- and 3-dimensional transformations, and data structures. 2 hours lecture, 3 hours lab. Prerequisite: ANP 475 or instructor approval.

ANP 561 Architectural Information Processing Systems. (3)

once a year

Applications of information processing systems to architectural problems. Analysis of computing tools with respect to assumptions and theories. Lecture, lab. Prerequisites: graduate standing; instructor approval.

ANP 563 Methods in Architectural Design Computation. (3)

spring

Concepts and models for research in computer-aided architectural design with an emphasis on computational methods and a system framework. Discussion, lab. Prerequisite: ANP 500 or instructor approval.

ANP 590 RC: Computer Programming and Architecture. (1–12)

not regularly offered

ANP 598 Special Topics. (1–4)

not regularly offered

Possible topics:

(a) Computer-Aided Design Methods

ANP 599 Thesis. (1–12)

not regularly offered

Fee.

ANP 681 Project Development. (3)

fall

Definition and elaboration of major ideas for implementation in ADE 622 in relation to contemporary theory and practice. Seminar. Prerequisite: ADE 522.

Omnibus Graduate Courses. See page 50 for omnibus graduate courses that may be offered.

ARCHITECTURAL PHILOSOPHY AND HISTORY (APH)

APH 505 Foundation Theory Seminar. (3)

fall

Foundation of conceptual architectural inquiry, stressing the reciprocal and interdependent relationship between design and theory. Lecture, seminar. Corequisite: ADE 521.

APH 509 Foundation Seminar. (3)

summer

Historical, technical, theoretical, environmental, and professional issues in architecture. Lecture, seminar, field trips. Prerequisite: ADE 510.

APH 511 Energy Environment Theory. (3)

fall

Solar and other energy sources in designed and natural environments; architectural, urban, and regional implications of strategies using other renewable resources.

APH 515 Current Issues and Topics. (3)

spring

Critical examination of current architectural issues, topics, and discourse. Prerequisite: APH 505.

APH 581 Contemporary Urban Design. (3)

spring

Exploration of the contemporary city and urban design issues related to contemporary cities. Seminar, lecture, discussion. Prerequisite: APH 505.

APH 681 Architectural Theory. (3)

spring

Examination of architectural theory. Emphasis on application of theory to practice. Seminar. Prerequisite: instructor approval.

APH 682 Architectural Criticism. (3)

fall

Examination of architectural criticism, emphasizing specific methods of criticism and their application for aesthetic judgment. Seminar. Prerequisite: instructor approval.

APH 683 Critical Regionalism. (3)

not regularly offered

Critical inquiry in cultural grounding the definition of place in architectural theory and practice. Lecture, field studies. Prerequisite: APH 446 or 447.

Omnibus Graduate Courses. See page 50 for omnibus graduate courses that may be offered.

ARCHITECTURE PROFESSIONAL STUDIES (ARP)

ARP 584 Clinical Internship. (1)

summer

Structured practical experience following a contract or plan, supervised by faculty and practitioners.

ARP 684 Professional Internship. (2–6)*spring*

Field experience in an architectural firm specializing in an area directly related to the student's advanced study. Integration of theory and state-of-the-art practices. Credit/no credit. Prerequisite: instructor approval.

Omnibus Graduate Courses. See page 50 for omnibus graduate courses that may be offered.

ARCHITECTURAL TECHNOLOGY (ATE)**ATE 521 Building Environmental Science. (3)***fall*

Scientific principles relating to comfort and environmental control. Heat and moisture transfer. Solar/natural energies for heating, cooling, and lighting. Lecture, lab. Prerequisite: MAT 290 (or its equivalent).

ATE 530 Daylighting Design. (3)*spring*

Daylight analysis, availability, design sky measurements, modeling and simulation. Integration with passive heating, cooling, building design, and energy considerations. Lecture, lab.

ATE 550 Passive Cooling and Heating I. (3)*spring*

Theory, analysis, and application of passive and low-energy systems for thermal comfort in buildings emphasizing heating. Prerequisite: ATE 521.

ATE 551 Passive Cooling and Heating II. (3)*fall*

Theory, analysis, and application of passive and low-energy heating systems for thermal comfort in buildings emphasizing cooling. Prerequisite: ATE 550.

ATE 552 Energy Parameters in Buildings. (3)*not regularly offered*

Advanced modeling. Transient and multidimensional analysis of thermal and daylight performance using variable weather data. Prerequisite: ATE 551 or instructor approval.

ATE 553 Building Systems III. (3)*fall*

Design and integration of building systems, including mechanical, electrical, plumbing, security, communications, fire protection, and transportation. Prerequisite: admission to upper division or instructor approval.

ATE 554 Building Energy Efficiency. (3)*spring*

Impact of building design on energy performance. Climate responsiveness, operations dynamics, and subsystems integration in thermal comfort and efficiency. Prerequisite: ATE 452.

ATE 556 Building Development. (3)*spring*

Comprehensive design development through the understanding and integration of building materials and systems. Lecture, seminar. Prerequisites: ATE 462, 553; CAD proficiency. Corequisite: ADE 522.

ATE 557 Construction Documents. (3)*spring*

Production of architectural working drawings; legal status, organization, layout, site survey plans, sections, elevations, details, schedules, and coordination. Lecture, lab. Prerequisite: admission to upper division.

ATE 558 Bioclimatic Parameters. (3)*spring*

Theory, analysis, and application of energy-related parameters of site, climate, human comfort, and building program for design synthesis.

ATE 560 Building Energy Analysis. (3)*fall*

Computer simulation of building thermal behavior. Software review. Detailed study of selected simulation models using case study projects. Lab. Prerequisites: ANP 475 (or 477); ATE 582.

ATE 561 Energy Analysis Techniques. (3)*fall*

Mathematical models of building envelope and comfort conditioning systems as bases for optimization techniques. Prerequisite: ATE 560.

ATE 562 Experimental Evaluation. (3)*once a year*

Instrumentation, measurement and computational techniques for analysis of building components, and assessment of thermal and luminous performance. Fee. Prerequisite: ATE 521.

ATE 563 Building Structures III. (3)*fall*

Analysis, design, and detailing of steel buildings and frames. Lateral analysis of small rigid and braced frame systems. Lecture, lab. Prerequisite: ATE 462 (or its equivalent).

ATE 564 Advanced Structures: Concrete. (3)*once a year*

Analysis, design, and detailing of concrete systems, considering continuity, multistory frames and shear walls, and lateral analysis. Computer application. Prerequisite: ATE 563 or instructor approval.

ATE 565 Advanced Structures: High Rise. (3)*once a year*

Developments in high-rise construction. Effects of wind and seismic forces. Preliminary analysis, design, and detailing considering code requirements. Lecture, lab. Prerequisite: ATE 563 or instructor approval.

ATE 582 Environmental Control Systems. (3)*once a year*

Heating, ventilation, and air-conditioning systems. Loads, psychometrics, refrigeration cycle, air/water distribution, controls, energy performance standards, and utility rates. 2 hours lecture, 3 hours lab, field trips. Prerequisite: ATE 451 or 521.

ATE 599 Thesis. (1–12)*not regularly offered*

Fee.

Omnibus Graduate Courses. See page 50 for omnibus graduate courses that may be offered.

Art**Master's and Doctoral Programs****Julie F. Codell***Director***(ART 102) 480/965-3468****michele.fugiel@asu.edu****herbergercollege.asu.edu/art****REGENTS' PROFESSOR**

WEISER

PROFESSORS

ALQUIST, BATES, BRITTON, CODELL, ECKERT, ERICKSON, FAHLMAN, GASOWSKI, GILLINGWATER, KAIDA, KLETT, MAGENTA, MAXWELL, MEISSINGER, OTIS, PILE, PIMENTEL, RISSEEUW, SCHMIDT, SHARER, STOKROCKI, SWEENEY, WHITE, YOUNG

ASSOCIATE PROFESSORS

COCKE, COLLINS, DUNCAN, GULLY, HAJICEK, JENKINS, MARC, PESSLER, PITTSLEY, SCHLEIF, SCHOEBEL, SCHUTTE, SEGURA, SERWINT, UMBERGER, VERSTEGEN, WOLFTHAL

ASSISTANT PROFESSORS

BROWN, McIVER

The faculty in the School of Art offer a program with a major in Art leading to the M.A. degree with concentrations in art education and art history.

Students admitted to the Master of Education degree program with a major in Secondary Education may also elect art as the subject matter field.

The Ph.D. degree in Curriculum and Instruction is offered with a concentration in art education through the College of

Education and in the History and Theory of Art in collaboration with the University of Arizona.

MASTER OF ARTS

Art Education

Admission. An applicant must have a bachelor's degree from an accredited college or university with a major of not less than 45 semester hours of art, including 12 hours of art history and six hours of art education. Additional hours may be required by the school.

An applicant must have a GPA of at least 3.00 in undergraduate course work during the junior and senior years. Applicants who do not meet these requirements must submit scores from the Miller Analogies Test or the Graduate Record Examination. Applicants should submit a formal art education research paper for review.

Program of Study. The degree program requires a minimum of 30 semester hours of credit in art education, including 18 hours of core courses, six hours of special topics on research related to integrating the teaching of studio art, art history, and criticism or aesthetics, and six hours of research and thesis.

To meet the core requirements, students must take the following core courses:

ARE 510 Art Education Colloquium.....	3
ARE 520 Issues in Teaching Inquiry in Art	3
ARE 525 Research on Teaching Art History	3
ARE 530 Issues in Teaching Studio Art.....	3
ARE 535 Research on Teaching Studio Art.....	3
ARE 540 Teaching Art in Cultural Contexts	3

Before the end of the first semester of course work (six or more semester hours), a program of study must be submitted to the Graduate College. Additional program requirements are indicated in the *M.A. in Art Education Guidelines*.

Qualifying Research Paper. A qualifying research paper must be submitted at the end of the semester in which the student completes the first 15 hours of course work. This paper must be judged satisfactory by the art education faculty before the start of the following semester, or the student is put on probation. During the semester following the qualifying research paper review, the student on probation may not enroll in more than nine semester hours of course work (these may not be thesis hours). To continue in the program, the student must submit a satisfactory research paper before the end of that semester.

Thesis Requirements. A written thesis is required.

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

Art History

Admission. An applicant must have a bachelor's degree with an undergraduate major or minor in art history, or at least four upper-division art history courses, in which an average GPA of 3.00 was maintained. Graduate Record Examination (aptitude test) scores must be submitted in support of the application, along with three letters of recommendation. Applicants should submit one formal research paper for review and a one-page statement of intent indicat-

ing their objectives for graduate study. The application deadline is January 15.

Program of Study. The degree program requires 33 semester hours of credit including a minimum of 21 hours in art history, with at least 12 of these earned in 500-level seminars. At least one course must be taken in each of the four core areas: non-Western, ancient/medieval, renaissance/baroque, and modern. Satisfactory completion of ARS 501 Methodologies and Art History is required during the first semester of residence. The remaining hours include ARS 599 Thesis, approved electives, and other courses specified by the faculty.

For more information, a student should request a copy of the *M.A. in Art History Guidelines* from the School of Art.

Foreign Language Requirements. Demonstration of a reading knowledge of one foreign language (French, German, or with faculty approval, another language appropriate to the field of study) is required. Depending upon the student's chosen area of study, reading knowledge of an additional language may be required.

Qualifying Research Paper. In order for the student to continue graduate study, a qualifying research paper, submitted in the semester in which 15 hours will be completed, must be judged satisfactory by the faculty.

Thesis Requirements. A written thesis is required.

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

MASTER OF FINE ARTS

Art

The Master of Fine Arts degree in Art requires a minimum of 60 semester hours of graduate work beyond the bachelor's degree. The objective of this degree is to provide advanced study in one or more of the following concentrations: ceramics, drawing, fibers, intermedia, metals, painting, photographic studies, photography, printmaking, sculpture, or wood.

Admission. A bachelor's degree from a college or university recognized by ASU is required. All students applying for the M.F.A. degree must submit to the chair of the Graduate Studio Committee a portfolio of 20 slides of their work with a return envelope and postage. Three letters of recommendation and a statement of intent pertaining to the student's educational objectives are also required. Because each area of specialization may have unique requirements, students are advised to contact the School of Art for additional information.

Selection Procedures. Faculty review committees appointed by the Graduate Studio Committee make the recommendations for admission. All aspects of the application are evaluated with the purpose of selecting for the available openings those students who have the most reasonable prospect for success in the proposed programs of study. The application deadline is January 15 for the following fall semester. Each student whose application is complete by the deadline date should be advised of admission status within six weeks of the deadline.

Review Sequence

All students are reviewed after completing 15 semester hours of graduate studio work. A progress review may be called at any time during the course of the graduate program. Following the review (after 15 semester hours), the student must form a supervisory committee to direct the program through the completion of the M.F.A. exhibition and final oral examination. For more information, a student should request a copy of the *M.F.A. Guidelines* from the School of Art.

Program of Study. A total of 60 semester hours of graduate credit subject to committee approval is required, including:

1. 27–32 graduate studio hours in the major area(s) of concentration;
2. nine hours of graduate-level art history;
3. nine hours of graduate work outside the area of concentration. These hours may be taken in art auxiliary, art education, art history, or outside the school or college. At least three hours are recommended in a studio discipline; and
4. 10–15 hours of ART 680 Practicum, resulting in an M.F.A. Exhibition.

Credit Before Admission. Subject to the recommendation of the review committee, students with a completed M.A. degree in Studio Art may have up to 24 hours (exclusive of thesis or project) applied to the M.F.A. program. In other cases, a maximum of 12 semester hours of transfer credit may be applied to the degree program. However, only nine hours of nondegree graduate credit taken before admission at ASU or another institution may be used to fill degree requirements (see “Credit Completed Before Admission,” page 101).

Foreign Language Requirements. None.

Final Examination. An oral defense of the M.F.A. exhibition (ART 680) is required.

Time Limit. The total program and all requirements for the degree, including transferred course work, must be completed within seven calendar years.

DOCTOR OF PHILOSOPHY—Ph.D.

Faculty in the School of Art offer programs leading to doctoral degrees in art education and art history. Additional information about graduate programs and forms for graduate study are available online at www.asu.edu/graduate or from graduate admissions.

ART EDUCATION

Ph.D. in Curriculum and Instruction

A Ph.D. degree in Curriculum and Instruction with a concentration in art education is available through the College of Education. For more information, see “Curriculum and Instruction,” page 174.

Admissions. In addition to meeting the Graduate College admission requirements, each applicant must provide the following: a letter of intent including career goals and reasons for seeking the interdisciplinary Ph.D. in Curriculum and Instruction; GRE scores; a sample of scholarly written

work; and three letters of recommendation. One year of full-time K–12 teaching experience is strongly recommended.

Program of Study. The degree requires 90 to 93 semester hours beyond the bachelor’s degree. Course work is divided into four core areas: core requirements, professional focus, cognate study, and dissertation/individual research. A foreign language is not required.

Program Committee. A chair and at least two other members oversee early advising and the preparation of the initial program of study. A five-member committee is required for the administration and evaluation of the comprehensive examination. Three of these members must be from the interdisciplinary committee, two of whom must have expertise in the student’s area of concentration.

Dissertation Committee. After passing the comprehensive examination, a dissertation committee is formed with the approval of the dean of the Graduate College. Members of the program committee may continue to serve as members of the dissertation committee or the members of the committee may change. The dissertation committee chair must be a faculty member designated eligible to serve in this capacity by the interdisciplinary committee and the dean of the Graduate College.

HISTORY AND THEORY OF ART

Ph.D. in History and Theory of Art

The Arizona Ph.D. in the History and Theory of Art is a collaborative program between Arizona State University and the University of Arizona, directed by a Ph.D. steering and academic committee with members from both universities. The emphasis is on interdisciplinary methodologies and electronic technologies to prepare students for museum and teaching careers. See “Doctor of Philosophy,” page 103, for general requirements.

Admissions. Applicants must submit an application form, fee, GRE scores, official transcripts, and other materials to the Graduate College Admissions Office. The following materials must be sent to the graduate advisor, art history: a statement of intent regarding graduate study, a scholarly research paper, requests for assistantships and tuition waivers, and three academic letters of recommendation (to be sent directly by referees). The postmark deadline is January 15 for complete admission applications for enrollment in the following fall semester.

Students with a B.A. fulfilling the requirements for acceptance into the M.A. program may seek admission directly into the Ph.D. program. Other applicants may hold an M.A. in Art History or another discipline approved by the Ph.D. steering committee. Students lacking in sufficient background in art history are required to make up these credits before courses may be counted toward the Ph.D.

Program of Study. The Ph.D. requires 54 semester hours beyond the M.A., including six semester hours of Ph.D. core classes, 12 semester hours in the major area of emphasis, six semester hours in the minor area, six semester hours in interdisciplinary courses outside of art history, and a written dissertation (24 semester hours). Students need to complete the requirements for the M.A. in Art with a concentration in art history before advancing to the Ph.D. program.

Foreign Language. A reading knowledge of at least two foreign languages is required. A third language may be necessary, depending on the field of study.

Ph.D. Committee. A three- to five-member comprehensive examination and dissertation committee directs the student's subsequent work. The committee consists of two art history faculty members in the student's major area and one in the minor area or related discipline. One member must be from the University of Arizona.

Comprehensive Examinations. A written examination is required upon completion of course work. The subsequent oral examination, within six months of passing the written examination, addresses the dissertation proposal.

Admission to Candidacy. A student advances to candidacy upon completion of the written and oral examinations.

ART AUXILIARY (ARA)

ARA 460 Gallery Exhibitions. (3)

fall and spring

Practical experience in all phases of department gallery operations and preparation of gallery publications. May be repeated for credit. Prerequisite: instructor approval.

ARA 488 Understanding Art. (3)

fall and spring

Understanding art as an emergent cultural phenomenon with an emphasis on a critical examination of conceptual issues in art. Writing required. Prerequisites: both ARS 101 and 102 or only instructor approval.

General Studies: L/HU

Omnibus Graduate Courses. See page 50 for omnibus graduate courses that may be offered.

ART EDUCATION (ARE)

ARE 440 Disciplines of Art Education. (3)

once a year

Explorations in art education's disciplines, history, and people's art-making development at diverse age levels and abilities. Lecture, discussion. Prerequisites: a combination of ARS 101 and 102 and ART 113 and 115 or only instructor approval.

ARE 450 Teaching Inquiry in Art. (3)

fall and spring

Designing inquiry-based curriculum units built on developmental levels of art making and art understanding. Lecture, discussion. Prerequisites: ARS 101, 102.

ARE 470 Art Criticism: Aesthetics. (3)

fall

Traditions of aesthetics and art criticism; conceptual issues in contemporary art; education in the visual arts. Prerequisite: ARE 440 or instructor approval.

ARE 482 Teaching Art Processes. (3)

spring

Art traditions of the 20th century as a basis for studio and art history instruction. 2 hours lecture, 2 hours studio. Meets art postbaccalaureate certification requirement. Prerequisite: ARE 450.

ARE 486 Art Education: Strategies and Applications. (3)

fall

Implementation and evaluation of art instruction for K–12 population. Includes teaching of Saturday classes in the Children's Art Workshop. Meets art postbaccalaureate certification requirement. Prerequisite: ARE 482.

ARE 496 Methods and Assessment of Learning in Art. (3)

once a year

Individual or group research on the assessment of art learning incorporating theory and practice. Meets art postbaccalaureate certification requirement. Prerequisites: both ARE 470 and 486 or only instructor approval.

ARE 510 Art Education Colloquium. (3)

not regularly offered

Historical foundations of art education and faculty presentations regarding teaching and research related to the visual arts.

ARE 520 Issues in Teaching Inquiry in Art. (3)

once a year

Issues in teaching and learning through inquiry about artworks using print and electronic reproductions and information. Recommended to be taken before ARE 525.

ARE 525 Research on Teaching Art History. (3)

once a year

Review of empirical and historical research, research methods, learning theory, and assessment of learning in art history. Pilot studies on the effects of instruction upon learning. Recommended to be taken after ARE 520.

ARE 530 Issues in Teaching Studio Art. (3)

once a year

Critical examination of issues concerning teaching multicultural art to different populations of students. Historical and philosophical foundations reviewed. Recommended to be taken before ARE 535. Lecture, discussion.

ARE 535 Research on Teaching Studio Art. (3)

once a year

Review of empirical and historical research methods, learning theory, and assessment of learning in studio art, including developmental studies and their limitations. Pilot studies on the effects of instruction upon learning. Recommended to be taken after ARE 530.

ARE 540 Teaching Art in Cultural Contexts. (3)

once a year

Relationship of multicultural perspectives to teaching/learning art criticism, aesthetics, studio art, and art history.

ARE 610 Issues and Trends in Art Education. (3)

not regularly offered

Doctoral-level investigation of historical and contemporary issues related to teaching and research in art education.

ARE 611 Curriculum Development in Art Education. (3)

not regularly offered

Doctoral-level inquiry into the philosophical, psychological, and sociological foundations of curriculum development.

Omnibus Graduate Courses. See page 50 for omnibus graduate courses that may be offered.

ART HISTORY (ARS)

ARS 400 History of Printmaking. (3)

once a year

History of the print as an art form and its relation to other modes and forms of artistic expression. Prerequisites: both ARS 101 and 102 or only instructor approval.

General Studies: HU, H

ARS 410 Early Christian and Byzantine Art. (3)

once a year

Art and architecture of the early church and the Byzantine Empire from the 4th to the 15th century. Prerequisites: both ARS 101 and 102 or only instructor approval.

General Studies: HU

ARS 458 Critical Theories in the Visual Arts. (3)

not regularly offered

Examines current critical theories through their application to all visual arts. May include new historicism, Marxism, deconstruction, post-structuralism, semiotics, Lacanian psychoanalysis, feminism, post-modernism. Lecture, discussion, student presentations. Prerequisites: both ARS 101 and 102 or only instructor approval.

General Studies: HU

ARS 469 Mexican Art. (3)

once a year

Art of Mexico and related Central American cultures from the prehistoric to the contemporary schools. Meets non-Western art history requirement. Prerequisites: both ARS 101 and 102 or only instructor approval.

General Studies: HU, H

ARS 473 Art of Japan. (3)*once a year*

Japanese art from the Jōmon period to the present. Meets non-Western art history requirement. Prerequisites: both ARS 101 and 102 or only instructor approval.

*General Studies: HU***ARS 485 Women in the Visual Arts. (3)***spring*

Historical study of art by women in various media; related social, political, educational issues; representation of women in art. Lecture, discussion. Prerequisites: both ARS 101 and 102 or only instructor approval.

*General Studies: L***ARS 501 Methodologies and Art History. (3)***fall*

History of the discipline and an exploration of various methodologies, critical theory, and bibliographies used by art historians. Seminar.

ARS 502 Critical Studies in Egyptian Art. (3)*not regularly offered*

Egyptian art from pre-Dynastic to New Kingdom periods. Focus on aesthetic, philosophical, and cultural contexts. Research paper and readings required.

ARS 504 Critical Approaches to Greek Art. (3)*once a year*

Art and architecture of Aegean civilizations (Cycladic, Minoan, Mycenaean) and of Greece to end of Hellenistic period. Research paper and readings required.

ARS 506 Critical Studies in Roman Art. (3)*once a year*

Art and architecture of Etruria, the Roman Republic, and the Roman Empire. Research paper and/or supplemental readings required.

ARS 514 Critical Approaches to Romanesque Art. (3)*not regularly offered*

Sculpture, painting, architecture, and the minor arts in western Europe, ca. 1030–1200, considered within religious, economic, and social contexts. Research paper required.

ARS 516 Critical Approaches to Gothic Art. (3)*not regularly offered*

Architecture, sculpture, painting, and the minor arts in western Europe, ca. 1150–1350, considered within religious, social, and economic contexts. Research paper required.

ARS 517 Critical Approaches to Late Gothic Art. (3)*not regularly offered*

Art of the late-Gothic style, ca. 1350–1525, considered within religious, social, economic, and political contexts. Research or reading project required.

ARS 522 Sixteenth-Century Italian Art. (3)*once a year*

Critical study of painting, sculpture, and architecture in 16th-century Italy in its religious and historical context.

ARS 528 Eighteenth-Century Art in Europe. (3)*once a year*

Critical study of European art from the late Baroque to the early years of Neoclassicism.

ARS 530 Art of Spain and New Spain. (3)*once a year*

Critical study of architecture, painting, and sculpture from 1500 to 1800. Lecture, conference.

ARS 532 Art, Politics, and Patronage, 1770–1850. (3)*fall*

Critical analyses of political events in Europe. Issues of patronage, art as propaganda examined. Impact of war and revolution on visual arts.

ARS 534 Studies in Modern European Art, 1850–1914. (3)*once a year*

Critical study of visual arts using primary source material from mid-19th century to WWI within philosophical, socioeconomic, and economic contexts. Lecture, tutorial. Prerequisite: instructor approval.

ARS 542 Critical Issues in American Painting I. (3)*once a year*

Explores themes and social issues in American art with a critical study of American painting from the 18th century to 1850. Lecture, discussion. Prerequisites: ARS 101, 102.

ARS 543 Critical Issues in American Painting II. (3)*once a year*

Explores themes and social issues in American art with a critical study of American painting from 1850 to 1900. Lecture, lab. Prerequisite: instructor approval.

ARS 544 American Modernism and Realism, 1900–1945. (3)*once a year*

Critical study of the social, political, and artistic changes in American art during the first half of the 20th century. Prerequisites: both ARS 101 and 102 or only ARS 340.

ARS 562 Art of Ancient Mesoamerica. (3)*fall*

Critical study of art and architecture of Mexico and Maya areas before Spanish contact. Lecture, conference.

ARS 565 Native Art of North America. (3)*once a year*

Critical examination of Native American art within culture, prehistory to the present. Prerequisites: both ARS 101 and 102 or only instructor approval.

ARS 574 Studies in Japanese Art. (3)*once a year*

Critical examination of the nature and history of Japanese art, its rich heritage and its indebtedness to foreign sources. Lecture, discussion. Prerequisites: both ARS 101 and 102 or only instructor approval.

ARS 575 Approaches to Chinese Painting. (3)*fall*

Critical history of Chinese painting from Eastern Chou to 1911. Emphasis on masters, regional developments, and conceptual underpinnings. Lecture, discussion. Prerequisites: both ARS 101 and 102 or only instructor approval.

ARS 591 Seminar. (1–12)*once a year*

Graduate seminar. Problems or criticism in possible topics:

- (a) American Art. (3–6)
- (b) American Indian Art. (3–6)
- (c) Ancient Art. (3–6)
- (d) Baroque Art. (3–6)
- (e) Chinese Art. (3–6)
- (f) Critical Theories in the Visual Arts. (3–6)
- (g) Medieval Art. (3–6)
- (h) Modern Art. (3–6)
- (i) Native American Art. (3–6)
- (j) Photographic History. (3–6)
- (k) Pre-Columbian Art. (3–6)
- (l) Renaissance Art. (3–6)

Prerequisite: instructor approval.

ARS 599 Thesis. (1–12)*not regularly offered*

Omnibus Graduate Courses. See page 50 for omnibus graduate courses that may be offered.

ART (ART)**CERAMICS****ART 460 Ceramic Clay. (3)***spring*

Research into various clay body formulations, local natural materials, slip glazes, and engobes. Lecture, lab, studio. Fee. Prerequisites: both ART 360 and 364 or only instructor approval.

ART 463 Ceramic Glaze. (3)*fall*

Glaze calculation and formulation using various glaze colors and surfaces. Lecture, lab, studio. Fee. Prerequisite: ART 460 or instructor approval.

ART 466 Special Problems in Ceramics. (3)*fall, spring, summer*

Emphasis on personal expression within structure of seminars, critiques, and studio work. Professional methods of presentation/documentation of work. 6 hours a week. May be repeated for credit. Fee. Prerequisite: ART 364 or instructor approval.

ART 494 Special Topics. (1–4)*not regularly offered*

Possible topics:

- (a) Ceramics Printmaking
Fee.
- (b) Turning
Fee.
- (c) Vapor Glazes
Fee.

ART 594 Conference and Workshop. (1–12)*not regularly offered*

Possible topics:

- (a) Turning
Fee.

ART 598 Special Topics. (1–4)*not regularly offered*

Possible topics:

- (a) Ceramic Clay
Fee.
- (b) Ceramic Glaze
Fee.
- (c) Ceramics Printmaking
Fee.
- (d) Experimental Printmaking
Fee.
- (e) Special Problems in Ceramics
Fee.

DRAWING**ART 411 Advanced Drawing. (3)***fall and spring*

Visual and intellectual concepts through problem solving and independent study. Emphasis on the individual creative statement. 6 hours a week. May be repeated for credit. Prerequisites: ART 311; instructor approval.

ART 414 Advanced Life Drawing. (3)*fall and spring*

Various media and techniques on an advanced level. The human figure as an expressive vehicle in various contexts. 6 hours a week. May be repeated for credit. Fee. Prerequisite: ART 315 or instructor approval.

ART 415 Art Anatomy. (4)*not regularly offered*

Study of human anatomical structures as applied to the practice of figure-oriented art. 3 hours lecture, 5 hours studio a week. Fee. Prerequisite: ART 214.

ART 598 Special Topics. (1–4)*not regularly offered*

Possible topics:

- (a) Art Anatomy
Fee.
- (b) Life Drawing
Fee.

FIBERS**ART 476 Fibers: Multiple Harness Weaving. (3)***fall and spring*

Advanced loom techniques and computer pattern design. Emphasis on individual design and loom application. Fee. Prerequisite: ART 113 or 115 or 376 or instructor approval.

ART 477 Printed Textiles. (3)*once a year*

Techniques for screen printing on fabric exploring pattern as a compositional element. Various stencil methods including photographic processes. May be repeated for credit. Studio. Fee. Prerequisite: ART 377 or instructor approval.

ART 478 Advanced Surface Design. (3)*spring in odd years*

Emphasis on personal expression with advanced problems in stich resist, arashi shibori, transfers, indigo, vat and disperse dyes, and pigments. Studio. Prerequisites: both ART 377 and 477 or only instructor approval.

ART 494 Special Topics. (1–4)*not regularly offered*

Possible topics:

- (a) Fibers and Surface
Fee.
- (b) Print Textiles
Fee.

ART 598 Special Topics. (1–4)*not regularly offered*

Possible topics:

- (a) Fibers and Surface
Fee.
- (b) Print Textiles
Fee.
- (c) Printed Textiles
Fee.

INTERMEDIA**ART 439 Mixed Media. (3)***fall and spring*

Exploring visual effects by combining traditional and nontraditional methods, techniques, and concepts. 6 hours a week. May be repeated for credit. Studio. Prerequisites: a combination of ART 113 and 115 and 6 hours additional studio requirements or only instructor approval.

ART 440 New Media Concepts. (3)*fall and spring*

Continued experiments with new media and interdisciplinary concerns in art. 6 hours a week. May be repeated for credit. Fee. Prerequisite: ART 443. Corequisite: ART 441.

ART 441 Video Art. (1)*fall and spring*

Utilizing video and audio equipment essential to the production of broadcast quality video art. 2 hours a week. May be repeated for credit. Fee. Corequisite: ART 440.

ART 442 Folk/Outsider Art. (3)*fall*

Exploration of ideas, attitudes, and art of contemporary "self-taught," "visionary," and "outsider" artists. Research and studio practice. Lecture, studio. Prerequisites: both ART 113 and 115 or only instructor approval.

ART 443 Intermedia. (3)*fall and spring*

Experimental, conceptual, and interdisciplinary studio art with emphasis on new media and technologies. 6 hours a week. May be repeated once for credit. Prerequisites: both ART 113 and 115 or only instructor approval.

ART 449 Computer Animation and Video. (3)*fall and spring*

Integration of 3D fine arts animation with video and compositing. May be repeated for credit. Studio. Fee. Prerequisite: ART 348 or instructor approval.

ART 450 Computer Animation and Audio. (3)*fall and spring*

Integration of audio with 3D animation for fine arts applications. Includes compositing and effects. May be repeated for credit. Studio. Fee. Prerequisites: ART 449; instructor approval.

ART 530 Two-Dimensional and Three-Dimensional Computer Art. (3)*once a year*

Integration of 2D and 3D computer imaging for art. Emphasis on new directions for computer imaging which accounts for media characteristics. Studio.

ART 540 Advanced Computer Art. (3)*once a year*

Study of motion for 3D models, light sources, and surface effects. Assumes students have a comprehension of complex modeling, mapping, and lighting. Studio. Prerequisite: ART 346 or instructor approval.

ART 598 Special Topics. (1–4)*not regularly offered*

Possible topics:

- (a) Dimensional Animation
Fee.

METALS**ART 472 Advanced Jewelry. (3)***fall and spring*

Jewelry making with emphasis on developing personal statements and craftsmanship. 6 hours a week. May be repeated for credit. Fee. Prerequisites: ART 372; instructor approval.

ART 473 Advanced Metalworking. (3)*once a year*

Forging and forming techniques in individualized directions. 6 hours a week. May be repeated for credit. Fee. Prerequisites: ART 373; instructor approval.

ART 598 Special Topics. (1–4)*not regularly offered*

Possible topics:

- (a) Jewelry Metalworking
Fee.

PAINTING**ART 423 Advanced Painting. (3)***fall and spring*

Continuation of ART 324. 6 hours a week. May be repeated for credit. Prerequisite: ART 324.

ART 425 Advanced Figure Painting. (3)*fall and spring*

Continuation of ART 325. 6 hours a week. May be repeated for credit. Fee. Prerequisites: ART 315, 324, 325.

ART 427 Advanced Watermedia. (3)*fall and spring*

Continuation of ART 327. Advanced techniques, concepts, and methods with watercolor and other water-based media on paper. 6 hours a week. May be repeated for credit. Fee. Prerequisite: ART 327 or instructor approval.

ART 598 Special Topics. (1–4)*not regularly offered*

Possible topics:

- (a) Figure Painting
Fee.
- (b) Watercolor
Fee.

PHOTOGRAPHY**ART 401 Nonsilver Photography. (3)***fall and spring*

Recognition of the inherent characteristics of nonsilver processes and their use in communicating ideas. 6 hours a week. May be repeated for credit. Fee. Prerequisite: ART 304 or instructor approval.

ART 403 Senior Photographic Projects. (3)*fall and spring*

Technical and philosophical refinement of personal aesthetic with various photographic media. 6 hours a week. May be repeated for credit. Fee. Prerequisite: ART 304 or instructor approval.

ART 404 Portraiture Photography. (3)*fall and spring*

Photographing people. Critical discussions and slide lectures on issues in portraiture. 6 hours a week. May be repeated for credit. Fee. Prerequisite: ART 304 or instructor approval.

ART 405 Advanced Color Photography. (3)*fall and spring*

Intensive use of subtractive color process in photographic printing. 6 hours a week. May be repeated for credit. Fee. Prerequisite: ART 305 or instructor approval.

ART 406 Photo Techniques. (3)*fall and spring*

Camera and darkroom techniques with emphasis on creative control of the black and white print. 6 hours a week. Prerequisite: ART 301 or instructor approval.

ART 407 View Camera. (3)*fall and spring*

View camera and darkroom techniques. Studio, lab. Fee. Prerequisite: ART 301 or instructor approval.

ART 409 Photographic Exhibition. (3)*once a year*

Care of photographic prints, print presentation, and exhibition. Practical experience in gallery operations. 6 hours a week. May be repeated for credit. Prerequisite: ART 304 or instructor approval.

ART 498 Pro-Seminar. (1–7)*not regularly offered*

Possible topics:

- (a) Landscape Photography: Theory
Fee.

ART 598 Special Topics. (1–4)*not regularly offered*

Possible topics:

- (a) Advanced Color Photography
Fee.
- (b) Nonsilver Photography
Fee.
- (c) Portraiture Photography
Fee.
- (d) View Camera
Fee.

PRINTMAKING**ART 452 Advanced Lithography. (3)***fall and spring*

Continuation of ART 352. 6 hours a week. May be repeated for credit. Fee. Prerequisite: ART 352 or instructor approval.

ART 454 Advanced Screen Printing. (3)*once a year*

Continuation of ART 354. 6 hours a week. May be repeated for credit. Fee. Prerequisite: ART 354 or instructor approval.

ART 455 Advanced Photo Processes for Printmaking. (3)*once a year*

Continued study of photomechanical techniques and applications to printmaking or photographic processes. Fee. Prerequisite: ART 355 or instructor approval.

ART 456 Fine Printing and Bookmaking I. (3)*once a year*

Letterpress printing and typography as fine art. Study of history, alphabets, mechanics of hand typesetting, presswork, and various forms of printed matter. Fee. Prerequisite: instructor approval.

ART 457 Fine Printing and Bookmaking II. (3)*once a year*

Continuation of ART 456. Bookbinding, book design and printing, advanced typography, theory, and presswork. May be repeated for credit. Fee. Prerequisites: ART 456; instructor approval.

ART 458 Papermaking. (3)*fall and spring*

History, theory, demonstrations, sheet forming, collage treatments, and 3-dimensional approaches. 6 hours a week. May be repeated for credit. Fee. Prerequisite: instructor approval.

ART 459 Monoprinting. (3)*fall and spring*

Nonmultiple printed image using a variety of technical approaches. 6 hours a week. May be repeated for credit. Fee. Prerequisites: ART 311, 323 (or any 300-level printmaking class); instructor approval.

ART 494 Special Topics. (1–4)*not regularly offered*

Possible topics:

- (a) Experimental Paper
Fee.
- (b) Experimental Printmaking
Fee.
- (c) Relief Printmaking
Fee.

ART 551 Intaglio Projects. (3)*fall and spring*

Materials and methods of intaglio as a matrix for exploring various contemporary issues. Specifically structured to accommodate the graduate-level drawing student with no printmaking background. Studio. Fee.

ART 598 Special Topics. (1–4)*not regularly offered*

Possible topics:

- (a) Advanced Photo Process for Printmaking
Fee.
- (b) Experimental Paper
Fee.
- (c) Fine Printing and Bookmaking I
Fee.
- (d) Fine Printing and Bookmaking II
Fee.
- (e) Lithography
Fee.
- (f) Monoprinting
Fee.
- (g) Papermaking
Fee.
- (h) Photo Processes for Printmaking I
Fee.
- (i) Relief Printmaking
Fee.
- (j) Screen Printing
Fee.

SCULPTURE**ART 431 Special Problems in Sculpture. (3)***fall and spring*

Development of a personal approach to sculpture. Emphasis on form, individual problems, and related color technology. Professional practices and presentation. 6 hours a week. May be repeated for credit. Fee. Prerequisites: ART 332; instructor approval.

ART 432 Neon Sculpture. (3)*fall*

Techniques for creating neon in an art context. Glass tube bending and fabrication. Construction of artworks utilizing light-generating gases. 6 hours a week. May be repeated for credit. Fee. Prerequisite: instructor approval.

ART 433 Foundry Research Methods. (3)*fall and spring*

Research in foundry techniques. Studio. Pre- or corequisite: ART 333 or instructor approval.

ART 436 Architectural Sculpture. (3)*not regularly offered*

Sculptural concepts as related to architecture and other man-made environments. Scale drawing, models, and relief sculpture. 6 hours a week. May be repeated for credit. Fee. Prerequisite: ART 332 or instructor approval.

ART 437 Film Animation. (3)*fall*

Production of short 16mm films that feature articulated sculptural objects, models, dolls, puppets, and graphics through the use of single-frame filming techniques. 6 hours a week. May be repeated for credit. Fee. Prerequisite: instructor approval.

ART 438 Experimental Systems in Sculpture. (3)*spring*

Simple electrical and mechanical systems that can be utilized in the context of studio art and installations. Active production of studio artworks required. 6 hours a week. May be repeated for credit. Fee. Prerequisite: instructor approval.

ART 474 Advanced Wood. (3)*fall and spring*

Extended experience and advanced techniques in the use of wood to create functional works of art. 6 hours a week. May be repeated for credit. Fee. Prerequisites: ART 374; instructor approval.

ART 494 Special Topics. (1–4)*not regularly offered*

Possible topics:

- (a) Advanced Sculpture
Fee.
- (b) Carving
Fee.
- (c) Film: Post-Production
Fee.
- (d) Foundry Casting Methods
Fee.
- (e) Live Action Film
Fee.

ART 594 Conference and Workshop. (1–12)*not regularly offered*

Possible topics:

- (a) Carving
Fee.

ART 598 Special Topics. (1–4)*not regularly offered*

Possible topics:

- (a) Advanced Sculpture
Fee.
- (b) Architectural Sculpture
Fee.
- (c) Experimental Systems in Sculpture
Fee.
- (d) Film: Post-Production
Fee.
- (e) Foundry Casting Methods
Fee.
- (f) Live Action Film
Fee.
- (g) Neon Sculpture
Fee.
- (h) Special Problems in Sculpture
Fee.
- (i) Wood
Fee.

SPECIAL STUDIO ART**ART 582 Art Research. (1–12)***fall, spring, summer*

Independent study research using classroom facilities and supplies. Studio.

ART 621 Studio Problems. (3)*fall, spring, summer*

Advanced study. 6 hours a week each section. May be repeated for credit. Possible topics:

Possible topics:

- (a) Ceramics
Fee.
- (b) Drawing
- (c) Fiber Art
- (d) Jewelry Metalworking
Fee.
- (e) Metals
- (f) Painting
- (g) Photography
- (h) Printmaking
Fee.
- (i) Sculpture
- (j) Studio Art
- (k) Wood

Prerequisite: instructor approval.

ART 680 Practicum: M.F.A. Exhibition. (1–15)*fall, spring, summer*

Studio work in preparation for required M.F.A. exhibition. Public exhibit to be approved by the student's supervisory committee and accompanied by a final oral examination. Photographic documentation and written statement of problem. Prerequisite: approval of the student's supervisory committee.

ART 682 M.F.A. Exhibition Research. (1–12)*fall, spring, summer*

M.F.A. exhibition practicum using classroom facilities and supplies. Can be used in place of ART 680. Prerequisite: approval of the student's supervisory committee.

Omnibus Graduate Courses. See page 50 for omnibus graduate courses that may be offered.

Artist Diploma, Post-Bachelor's

See "Post-Bachelor's Artist Diploma," page 274.

Asian Languages and Civilizations— Chinese/Japanese

See “Languages and Literatures,” page 247.

Bioengineering

Master’s and Doctoral Programs

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PROFESSORS GUILBEAU, TOWE

ASSOCIATE PROFESSORS
GARCIA, HE, KIPKE, MASSIA, PIZZICONI,
SWEENEY, YAMAGUCHI

ASSISTANT PROFESSORS
MUTHUSWAMY, PANITCH, VERNON

The Bioengineering faculty within the Department of Bioengineering offer graduate programs leading to the M.S. and Ph.D. degrees in Bioengineering. Areas of study include biochemical engineering, bioelectrical engineering, biomechanical engineering, biosystems/biotransport engineering, bioinstrumentation, biomaterial engineering, and biocontrol engineering. Research topics include artificial organs, biocontrol systems, biomechanics, bioinstrumentation, biomaterials, biosystems engineering, biotechnology, cardiovascular engineering, cellular and tissue bioengineering, neural bioengineering, noninvasive imaging, and rehabilitation engineering.

The faculty also participate in offering the Tri-University Master of Engineering degree program. See “Master of Engineering,” page 195, for program description.

Graduate Record Examination. Graduate Record Examination scores are required from all students.

Transition Program. Students applying to the Bioengineering M.S. or Ph.D. degree programs may have an undergraduate B.S. degree in a major field other than Bioengineering. The qualifications of transition students are reviewed by the department graduate committee, and a special program of transition course work is designed for successful applicants. In general, transition students should have had, or be prepared to take, calculus through ordinary differential equations, inorganic chemistry, physics, and a number of undergraduate engineering courses in order to be prepared for graduate bioengineering courses. Other course work from the undergraduate program may be required depending upon the research topic selected by the student.

Transition students should contact the graduate coordinator to evaluate the undergraduate transcript.

MASTER OF SCIENCE

See “Master’s Degrees,” page 100, for general requirements.

Program of Study. All candidates pursuing a M.S. degree in Bioengineering are required to complete an approved program of study consisting of the minimum required semester hours, including research and thesis. Special course requirements for the different areas of study are established by the faculty and are available from the Department of Bioengineering. Part-time students must successfully complete a research seminar course for at least three semesters during the course of study. Candidates whose undergraduate degree was in a field other than bioengineering may be required to complete more than 30 semester hours of credit on the program of study.

Research Seminar Requirements. In addition to the course work and thesis requirements, all full-time master’s degree students must successfully complete a research seminar course during each semester of attendance.

Thesis Requirements. A written thesis is required.

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

Nonthesis Option

The nonthesis option within the M.S. degree program in Bioengineering is reserved for students who have full-time employment in industry and who intend to enroll in the M.S. degree program on a part-time basis, or for students who wish to continue their study of bioengineering past the baccalaureate level before seeking admission to a medical school.

Admission Requirements. Students seeking admission to the nonthesis option must request this option when applying for admission to the M.S. degree program. Students who are admitted to the thesis option are not allowed to subsequently transfer into the nonthesis option. Students admitted to the nonthesis option, however, may subsequently request approval to transfer into the thesis option. Additionally, the student must meet the following criteria to qualify for the nonthesis option: (1) be a full-time employee of a local industry and indicate at the time of application that he or she intends to pursue the M.S. degree on a part-time basis or (2) declare at the time of application that his or her career goal is to seek admission to a medical school.

Course Requirements. A total of 33 semester hours, including a bioengineering seminar and project, is required for graduation in the nonthesis option. The program of study for the nonthesis option requires the same set of core courses and seminar in bioengineering that is required of students in the thesis option. Instead of research and thesis hours, the student must complete six additional credits of course work selected from the catalog list of BME courses (the total course work requirement, including seminar, is 33 semester hours).

Project. Students admitted to the nonthesis option must also register for three semester hours of BME 593 Applied

Project. Students are required to complete an in-depth literature survey and/or research design in some aspect of bioengineering, resulting in a written report.

Defense of the Applied Project. The student is required to successfully defend the Applied Project in bioengineering before his or her graduate supervisory committee.

Financial Aid. Students admitted to the nonthesis option within the bioengineering master's degree program do not qualify for graduate research or teaching assistantships or other financial assistance available to thesis option master's degree students.

Admission to the Ph.D. Program. If the student wishes to subsequently enter the Ph.D. program after completing the requirements for the nonthesis option, the application procedure is the same as if the student was applying with a thesis-track M.S. degree.

DOCTOR OF PHILOSOPHY

The Ph.D. degree in Bioengineering is conferred upon evidence of excellence in research resulting in a scholarly dissertation that is a contribution to knowledge.

See "Doctor of Philosophy," page 103, for general requirements.

Program of Study. Upon admission of the applicant with regular or provisional status, a supervisory committee (program committee) is appointed. This committee is responsible for the guidance and direction of the student's graduate program of study. The program committee is composed of a minimum of three faculty members, including a chair. Generally, the student's graduate advisor serves as chair of the program committee. The program committee advises the student in developing a program of study and assumes primary responsibility in assessing the student's progress in the program.

Research Seminar Requirements. In addition to the course work and dissertation requirements, all full-time doctoral students must successfully complete a research seminar course during each semester of attendance.

Qualifying Examination. A qualifying exam is administered to test the student's mastery of basic engineering fundamentals. The examination is usually taken early in the student's program of study (after two semesters of residence at ASU, and no later than three semesters). A student must express in writing the intention to take the exam to the department graduate committee through the graduate coordinator.

Foreign Language Requirements. None.

Comprehensive Examinations. When the Ph.D. student has essentially completed the course work in the approved program of study, the student is given a written comprehensive examination covering the field of study. The written examination is followed by an oral examination.

Admission to Candidacy and Appointment of Dissertation Committee. After the student passes the comprehensive examinations, a dissertation committee composed of at least five faculty members is appointed. The dissertation committee meets to approve the student's dissertation prospectus. Generally, the prospectus should include a perti-

nent review of the literature, a statement of the proposed study, the hypothesis to be tested, a description of the research design, a discussion of the specific data to be collected, and a description of the means by which the data is to be analyzed. After the dissertation committee has approved the prospectus, the student applies to the Graduate College for admission to candidacy.

Dissertation Requirements. A dissertation based on original work demonstrating creativity in research and scholarly proficiency in the subject area is required. The dissertation is expected to reflect and contribute significantly to knowledge. It must clearly indicate mastery of research methods.

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

RESEARCH ACTIVITY

For current information about research activity, access the Department of Bioengineering Web site at www.eas.asu.edu/~bme.

BIOENGINEERING (BME)

BME 411 Biomedical Engineering I. (3)

once a year

Review of diagnostic and prosthetic methods using engineering methodology. Introduction to transport, metabolic, and autoregulatory processes in the human body. Prerequisite with a grade of "C" or higher: BME 334.

BME 412 Biomedical Engineering II. (3)

once a year

Review of electrophysiology and nerve pacing applications, introduction to biomechanics and joint/limb replacement technology, cardiovascular and pulmonary fluid mechanics, and the application of mathematical modeling. Prerequisite: instructor approval.

BME 415 Biomedical Transport Processes. (3)

once a year

Principles of momentum, heat, and mass transport with applications to medical and biological systems and medical device design. Prerequisites: MAT 274; PHY 131.

BME 416 Biomechanics. (3)

fall

Mechanical properties of bone, muscle, and soft tissue. Static and dynamic analysis of human movement tasks such as locomotion. Prerequisite with a grade of "C" or higher: BME 318.

BME 417 Biomedical Engineering Capstone Design I. (3)

fall

Technical, regulatory, economic, legal, social, and ethical aspects of medical device systems engineering design. Lecture, field trips. Prerequisite: ECE 300. Prerequisites with a grade of "C" or higher: BME 318, 334.

BME 419 Biocontrol Systems. (3)

fall

Application of linear and nonlinear control systems techniques toward analysis of neuromusculoskeletal, cardiovascular, thermal, and mass transfer systems of the body. Prerequisites: ECE 201; MAT 274.

BME 435 Physiology for Engineers. (4)

fall

Physiology of the nervous, muscular, cardiovascular, endocrine, renal, and respiratory systems. Emphasizes use of quantitative methods in understanding physiological systems. Lecture, lab. Prerequisites: a combination BIO 181 and CHM 116 and PHY 131 or only instructor approval.

BME 470 Microcomputer Applications in Bioengineering. (4)

spring

Use of microcomputers for real-time data collection, analysis, and control of experiments involving actual and simulated physiological systems. Lecture, lab. Prerequisites: ECE 100, 334. Prerequisite with a grade of "C" or higher: BME 435.

BME 511 Biomedical Engineering I. (3)*once a year*

Diagnostic and prosthetic methods using engineering methodology. Transport, metabolic, and autoregulatory processes in the body.

BME 512 Biomedical Engineering II. (3)*once a year*

Electrophysiology and nerve pacing applications, introduction to biomechanics and joint/limb replacement, technology, cardiovascular and pulmonary fluid mechanics, and mathematical modeling.

BME 513 Biomedical Instrumentation. (3)*fall*

Principles of medical instrumentation. Studies of medical diagnostic instruments and techniques for the measurement of physiologic variables in living systems.

BME 514 Advanced Biomedical Instrumentation. (3)*not regularly offered*

Principles of applied biophysical measurements using bioelectric and radiological approach. Prerequisites: ECE 334; MAT 274 (or its equivalent).

BME 515 Biomedical Transport Processes. (3)*not regularly offered*

Principles of momentum, heat, and mass transport with applications to medical and biological systems and medical device design. Prerequisite: instructor approval.

BME 516 Topics in Biomechanics. (3)*fall*

Mechanical properties of bone, muscle, and soft tissue. Static and dynamic analysis of human movement tasks, including in-depth project. Prerequisite: instructor approval.

BME 518 Introduction to Biomaterials. (3)*spring*

Topics include structure property relationships for synthetic and natural biomaterials, biocompatibility, and uses of materials to replace body parts. Prerequisite: ECE 350 (or its equivalent) or instructor approval.

BME 519 Topics in Biocontrol Systems. (3)*fall*

Linear and nonlinear control systems analysis of neuromusculoskeletal, cardiovascular, thermal, and mass transfer systems of the body, including in-depth project. Prerequisites: both ECE 201 and MAT 274 or only instructor approval.

BME 520 Bioelectric Phenomena. (3)*not regularly offered*

Study of the origin, propagation, and interactions of bioelectricity in living things; volume conductor problem, mathematical analysis of bioelectric interactions, and uses in medical diagnostics.

BME 521 Neuromuscular Control Systems. (3)*spring*

Overview of sensorimotor brain structures. Application of nonlinear, adaptive, optimal, and supervisory control theory to eye-head-hand coordination and locomotion.

BME 522 Biosensor Design and Application. (3)*once a year*

Theory and principles of biosensor design and application in medicine and biology. Principles of measurements with biosensors. Prerequisite: instructor approval.

BME 523 Physiological Instrumentation Lab. (1)*fall*

Laboratory experience with problems, concepts, and techniques of biomedical instrumentation in static and dynamic environments. Lab. Prerequisites: BME 435; ECE 334. Pre- or corequisite: BME 513.

BME 524 Fundamentals of Applied Neural Control. (3)*once a year*

Fundamental concepts of electrical stimulation and recording in the nervous system with the goal of functional control restoration. Pre- or corequisite: BME 435 or instructor approval.

BME 525 Surgical Techniques. (2)*spring*

Principles of surgical techniques, standard operative procedures, federal regulations, guidelines, and state-of-the-art methods. Lecture, lab.

BME 532 Prosthetic and Rehabilitation Engineering. (3)*once a year*

Analysis and critical assessment of design and control strategies for state-of-the-art medical devices used in rehabilitation engineering. Pre- or corequisite: BME 416 or 516 or EPE 610.

BME 533 Transport Processes I. (3)*fall*

Unified treatment of momentum, heat, and mass transfer from molecular theory, and continuum points of view. Continuum equations of microscopic and macroscopic systems and multicomponent and multiphase systems. Cross-listed as CHE 533. Credit is allowed for only BME 533 or CHE 533.

BME 534 Transport Processes II. (3)*spring*

Continuation of BME 533 or CHE 533, emphasizing mass transfer. Cross-listed as CHE 534. Credit is allowed for only BME 534 or CHE 534. Prerequisite: BME 533 or CHE 533.

BME 543 Thermodynamics of Chemical Systems. (3)*fall*

Classical and statistical thermodynamics of nonideal physicochemical systems and processes; prediction of optimum operating conditions. Cross-listed as CHE 543. Credit is allowed for only BME 543 or CHE 543.

BME 544 Chemical Reactor Engineering. (3)*spring*

Reaction rates, thermodynamics, and transport principles applied to the design and operation of chemical reactors. Cross-listed as CHE 544. Credit is allowed for only BME 544 or CHE 544. Prerequisite: BME 543 or CHE 543.

BME 551 Movement Biomechanics. (3)*spring*

Mechanics applied to the analysis and modeling of physiological movements. Computational modeling of muscles, tendons, joints, and the skeletal system with application to sports and rehabilitation. Prerequisite: BME 416 or 516 or instructor approval.

BME 566 Medical Imaging Instrumentation. (3)*not regularly offered*

Design and analysis of imaging systems and nuclear devices for medical diagnosis, therapy, and research. Laboratory experiments using diagnostic radiology, fluoroscopy, ultrasound, and CAT scanning. Lecture, lab. Prerequisite: instructor approval.

BME 568 Medical Imaging. (3)*not regularly offered*

CT, SPECT, PET, and MRI. 3-dimensional *in vivo* measurements. Instrument design, physiological modeling, clinical protocols, reconstruction algorithms, and quantitation issues. Prerequisite: instructor approval.

BME 593 Applied Project. (1–12)*not regularly offered*

Omnibus Graduate Courses. See page 50 for omnibus graduate courses that may be offered.

Biology

Master's and Doctoral Programs

James P. Collins*Chair***(LSC 226) 480/965-3571****ls.la.asu.edu/biology****REGENTS' PROFESSOR**

ALCOCK

PROFESSORS

CAPCO, CHANDLER, CHURCH, COLLINS, DOWLING, ELSER, FAETH, FISHER, GRIMM, HAZEL, HEDRICK, LAWSON, MAIENSCHIN, McGAUGHEY, MOORE, OHMART, PYNE, RUTOWSKI, SATTERLIE, A. SMITH, WALSBURG

ASSOCIATE PROFESSORS

CARROLL, DEVICHE, FEWELL, FOUQUETTE, GOLDSTEIN, HARRISON, G. SMITH

ASSISTANT PROFESSORS

DENARDO, FAGAN, HOFMANN, KINZIG, KUMAR,
LORSON, NEWFELD, ORCHINIK, RAWLS, STRICK

RESEARCH PROFESSORS

DAVIDSON, PEARSON

ASSISTANT RESEARCH PROFESSOR

WILSON-RAWLS

ACADEMIC PROFESSIONAL

DOUGLAS

The faculty in the Department of Biology offer programs leading to the M.S. and Ph.D. degrees in Biology. A concentration in ecology is available, among other areas of study.

The faculty collaborate with the Departments of Microbiology and Plant Biology in offering the program leading to the Master of Natural Science degree when one of the concentrations is biology (see "Natural Science," page 278).

Students admitted to the Master of Education degree program with a major in Secondary Education may also elect biology as the subject matter field.

These programs are designed to prepare students for careers in teaching and research in educational, medical, industrial, and governmental institutions.

Graduate Record Examination. Submission of scores on the verbal, quantitative, analytical, and advanced sections of the Graduate Record Examination is required for admission to the M.S. and Ph.D. degree programs.

Application Deadline. Completed college and departmental application materials should be received by December 15 for admission in the fall semester.

MASTER OF SCIENCE

The program of each student is prepared in consultation with the supervisory committee, consisting of a major professor and two additional faculty members. A minimum of 30 semester hours is required. The program must include six hours of thesis, one hour of seminar, and may include a maximum of eight additional hours in various special graduate courses such as research and reading and conference. A final oral examination covering the thesis and related subject matter is administered by the supervisory committee.

DOCTOR OF PHILOSOPHY

The Ph.D. program in the Department of Biology allows the student to acquire high research competency in one or more specialized areas while receiving a broad, solid grounding in biological sciences.

See "Doctor of Philosophy," page 103, for general requirements.

Program of Study. The program of study is planned by the student and the supervisory committee, consisting of a major professor and four additional faculty members. The program is tailored to the needs of the individual student.

Foreign Language Requirements. None are required by the department. However, each student's supervisory committee may specify a reading proficiency in one or more foreign languages if appropriate to the student's educational objectives.

Comprehensive Examinations. The comprehensive examination consists of a written and oral component. To advance to candidacy for the Ph.D., the student must successfully complete three graduate seminars in areas different from the major area of emphasis; one of these must be a two-semester-hour writing seminar completed by the end of the third semester (see topics outlines under "Research Activity"). The seminars include evaluation of synthetic writing skills. A synthetic, detailed research proposal must be completed by the fourth semester. The student must defend the proposal orally to the supervisory committee within three weeks after successful completion of the written research proposal.

Dissertation Requirements. A dissertation based on original research is required. (See "Doctoral Dissertations," page 102.)

Final Examinations. A final defense of the dissertation is required. (See "Open Dissertation Defenses," page 102.)

FACILITIES

The modern Life Science Center houses well-equipped research laboratories and teaching facilities. The W. M. Keck Bioimaging Laboratory includes a laser-equipped scanning confocal microscope and an LFO high resolution scanning electronic microscope. The Life Sciences Electron Microscopy Laboratory includes both scanning and transmission electron microscopes as well as a freeze-fracture unit. Housing of laboratory animals and maintenance of breeding colonies are provided by the Animal Research Center. Arizona fauna is well represented in departmental collections. Desert, montane, riparian, and lacustrine habitats are within driving distance; species diversity is high.

RESEARCH ACTIVITY

Research of faculty and graduate students includes a wide range of biological topics. Current research interests within the department include these topics.

Behavior. Reproductive behavior; sexual selection; communication; neural and hormonal mechanisms of behavior; behavioral ecology; behavioral genetics.

Biology Education. Student reasoning patterns and alternative conceptual frameworks; the nature of scientific reasoning; learning styles, instructional techniques, and issues in curriculum development.

Cell and Molecular Biology. Cytoskeleton assembly; localization of RNA in oocytes and embryos; regulation of exocytosis and endocytosis; cell-division; cell-cell interaction; recombinant DNA; gene mapping; regulation of gene expression in eukaryotes; mechanisms of interferon action; signal transduction; confocal and electron microscopy; cellular bases of vertebrate photoperiodic responses.

Computational, Statistical, and Mathematical Biology. Functional genomics; population and statistical genetics; genome computing; computational molecular evolution; population and community ecology, including extinction risk, spatial dynamics, and the evolution and assembly of communities; spatial modeling of species richness; environmental monitoring and assessment; environmental statistics.

Conservation Biology. Conservation genetics; fragmentation effects; extinction dynamics; patterns and consequences of rarity; design and operation of reserves; urban

ecology; conserving desert fishes and aquatic habitats; desert to rain-forest biodiversity; international dimensions; sustainable development.

Developmental Biology. Cell and organ differentiation; regulation; development of synapses; developmental genetics; control of oogenesis; in vitro fertilization; regulation of pattern formation; myogenesis; morphogens; intercellular signaling pathways.

Ecology. Life histories, dispersal, and foraging; plant-animal interactions; community structure; biogeography; physiological ecology; ecosystems structure and functioning; wildlife fisheries management. Research in terrestrial and aquatic desert habitats reflects the unique location of ASU, metapopulation dynamics.

Evolution. Population genetics, molecular evolution, systematics, speciation, evolution of behavior, morphological diversification.

Genetics. Molecular and developmental genetics; genetic regulatory mechanisms of cellular differentiation; behavioral genetics; variation in natural populations; molecular evolutionary genetics; functional genomics.

History and Philosophy of Biology. The nature of biological science and the way science changes; who does biology and why; what assumptions biologists make and how they influence the research done; questions about funding, institutions, and the social context for biology; history of ideas about the origin of life; how scientists decide what kinds of ideas are believable about nature and which ones are unbelievable; how the relationship between science and religion has changed over the centuries.

Neuroscience. Behavioral neuroendocrinology; invertebrate and vertebrate neurobiology; control of locomotion; actions of stress on the brain; mechanisms of hormone action in the brain; action of neuropeptides, neural basis of behavior; neuroanatomical correlates of behavior; hormonal control of neural plasticity.

Physiology. Membrane metabolism and function, thermal adaptation, regulation, and ion transport; tissue, epithelial, and cuticular function; comparative and reproductive endocrinology; neurophysiology; environmental physiology especially related to desert adaptations; parasites and reproduction; comparative biochemistry; the physiology of temperature; environmental regulation of gene expression; renal and respiratory physiology; energetics and physiology of flight.

BIOLOGY (BIO)

BIO 406 Computer Applications in Biology. (3)

fall

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 PLB 432. Credit is allowed for only BIO 406 or PLB 432. Prerequisites: both BIO 182 and MAT 117 (or 210) or only instructor approval.

General Studies: CS

BIO 410 Techniques in Wildlife Conservation Biology. (3)

fall

Field and analytical techniques used in evaluating population structure, viability and environmental impacts. Lecture, lab. Fee. Prerequisites: both BIO 317 and 320 or only instructor approval.

General Studies: L

BIO 411 Advanced Conservation Biology I. (3)

fall

Principles of conservation science, biology of threatened species, management principles that meet conservation goals, emphasizing North American ecosystems. Prerequisites: BIO 317, 320.

BIO 412 Advanced Conservation Biology II. (3)

spring

Global biodiversity patterns, processes, and conservation; global environmental change; sustainable use of natural resources; emphasizing international approaches to conservation biology. Prerequisites: BIO 317, 320.

BIO 415 Biometry. (4)

fall

Statistical methods applied to biological problems, design of experiments, estimation, significance, analysis of variance, regression, correlation, chi square, and bioassay; the use of computers. Does not satisfy laboratory requirements for the College of Liberal Arts and Sciences' General Studies program. 3 hours lecture, 3 hours lab. Prerequisite: MAT 210 (or its equivalent).

General Studies: CS

BIO 416 Professional Values in Science. (3)

once a year

Considers issues related to values in science such as collaboration, finances, legal issues, media, mentoring, ownership of ideas, scientific integrity. Discussion, student projects. Cross-listed as HPS 410. Credit is allowed for only BIO 416 or HPS 410.

General Studies: L

BIO 423 Population and Community Ecology. (3)

not regularly offered

Organization and dynamics of population and communities, emphasizing animals. Theoretical and empirical approaches. Prerequisite: BIO 320 or instructor approval.

BIO 424 Mathematical Models in Ecology. (4)

not regularly offered

Mathematical modeling of populations, communities, and ecosystems, including case studies and student-designed projects. 3 hours lecture, 3 hours lab. Prerequisites: BIO 320; any calculus course.

BIO 425 Animal Ecology. (3)

not regularly offered

Physiological and behavioral adaptations of individual animals to both abiotic and biotic environments. Prerequisite: BIO 320.

BIO 426 Limnology. (4)

not regularly offered

Structure and function of aquatic ecosystems, with emphasis on freshwater lakes and streams. 3 hours lecture, 3 hours lab or field trip. Fee. Prerequisite: BIO 320 or instructor approval.

General Studies: L

BIO 428 Biogeography. (3)

fall

Environmental and historical processes determining distributional patterns of animals and plants, emphasizing terrestrial life. Prerequisites: BIO 182 (or its equivalent); junior standing.

General Studies: L

BIO 435 Research Techniques in Animal Behavior. (3)

not regularly offered

Experimental and field studies of animal behavior; description and quantification of animal behavior and interpretation of behavior within an evolutionary framework. 1 hour lecture, 6 hours lab. Prerequisite: BIO 331.

General Studies: L

BIO 441 Cytogenetics. (3)

not regularly offered

Chromosomal basis of inheritance. Cross-listed as PLB 412. Credit is allowed for only BIO 441 or PLB 412. Prerequisite: BIO 340.

BIO 442 Cytogenetics Laboratory. (2)

not regularly offered

Microscopic analysis of meiosis, mitosis, and aberrant cell division. 6 hours lab. Cross-listed as PLB 413. Credit is allowed for only BIO 442 or PLB 413. Pre- or corequisite: BIO 441 or PLB 412.

BIO 446 Principles of Human Genetics. (3)

once a year

Molecular and cellular analysis of the human genome. Prerequisite: BIO 340.

General Studies: L

BIO 450 Advanced Developmental Biology. (3)*spring*

Current concepts and experimental methods involving differentiation and biosynthetic activities of cells and organisms, with examples from microorganisms, plants, and animals. Prerequisite: BIO 351.

BIO 453 Animal Histology. (4)*spring*

Microscopic study of animal tissues. 3 hours lecture, 3 hours lab. Fee. Prerequisite: BIO 182 or instructor approval.

BIO 454 Aquatic Insects. (3)*not regularly offered*

Systematics and ecology of aquatic insects. Prerequisite: BIO 386.

BIO 464 Photobiology. (3)*not regularly offered*

Principles underlying the effects of light on growth, development, and behavior of plants, animals, and microorganisms. Cross-listed as PLB 440. Credit is allowed for only BIO 464 or PLB 440. Prerequisites: CHM 231 (or 331); 12 hours in life sciences.

BIO 465 Neurophysiology. (3)*spring in even years*

Detailed treatment of cellular and organismal neurophysiology and nervous system function. Prerequisite: BIO 360.

BIO 466 Neurophysiology Laboratory. (2)*not regularly offered*

Intracellular and extracellular electrophysiological recording techniques, histological preparations, and dye-filling techniques. 6 hours lab. Pre- or corequisite: BIO 465.

BIO 470 Systematic Zoology. (4)*spring in odd years*

Philosophy, theory, practice of interpreting animal diversity, including species concepts speciation, nomenclature, and evolutionary and phylogenetic classification emphasizing phylogenetics. 3 hours lecture, 3 hours lab. Prerequisites: junior standing; 18 hours in life sciences.

*General Studies: L***BIO 471 Ornithology. (3)***spring in odd years*

Biology of birds. 2 hours lecture, 3 hours lab, weekend field trips. Fee. Prerequisite: BIO 370 or instructor approval.

BIO 472 Mammalogy. (4)*fall in odd years*

Classification, structure, habits, ecology, and distribution of mammals, emphasizing North American forms. 3 hours lecture, 3 hours lab or field trip, weekend field trips. Fee. Prerequisite: BIO 370 or instructor approval.

BIO 473 Ichthyology. (3)*spring in odd years*

Systematics and biology of recent and extinct fishes. 2 hours lecture, 3 hours lab or field trip, weekend field trips required. Fee. Prerequisites: both BIO 370 and 425 or only instructor approval.

BIO 474 Herpetology. (3)*spring in even years*

Systematics and biology of recent and extinct reptiles and amphibians. 2 hours lecture, 3 hours lab or field trip. Fee. Prerequisite: BIO 370.

BIO 480 Methods of Teaching Biology. (3)*spring*

Methods of instruction, experimentation, organization, and presentation of appropriate content in biology. Prerequisite: 20 hours in the biological sciences.

BIO 495 Undergraduate Thesis. (3)*fall, spring, summer*

Guided research culminating in the preparation of an undergraduate thesis based on supervised research done in this and previous semesters. Prerequisites: at least 3 hours of BIO 310 (or 499); formal conference with instructor; instructor and department chair approval.

BIO 502 Transmission Electron Microscopy. (3)*not regularly offered*

Theory, use, and methods of preparing biological materials for transmission electron microscopy. Lecture, lab. Materials fee. Prerequisite: instructor approval.

BIO 505 Scanning Electron Microscopy. (3)*not regularly offered*

Theory, use, and methods of preparing biological materials for scanning electron microscopy. 2 hours lecture, 3 hours lab. Materials fee. Prerequisite: instructor approval.

BIO 508 Scientific Data Presentation. (2)*spring*

Techniques necessary for presentation of scientific data used in journal publications, grant proposals, and visual presentations. Lecture, lab. Prerequisite: instructor approval.

BIO 520 Biology of the Desert. (2)*not regularly offered*

Factors affecting plant and animal life in the desert regions and adaptations of the organisms to these factors. Prerequisite: 10 hours in biological sciences or instructor approval.

BIO 522 Populations: Evolutionary Ecology. (3)*not regularly offered*

Principles of population biology and community ecology within an evolutionary framework. 2 hours lecture, 2 hours recitation. Prerequisites: BIO 320, 415 (or MAT 210), 545.

BIO 524 Ecosystems. (3)*not regularly offered*

Structure and function of terrestrial and aquatic ecosystems, with emphasis on productivity, energetics, biogeochemical cycling, and systems integration. Prerequisite: BIO 320 (or its equivalent).

BIO 526 Quantitative Ecology. (3)*not regularly offered*

Sampling strategies, spatial pattern analysis, species diversity, classification, and applications of multivariate techniques to ecology. 2 hours lecture, 3 hours lab. Prerequisites: BIO 415 (or its equivalent); a course in ecology.

BIO 529 Advanced Limnology. (3)*not regularly offered*

Recent literature, developments, methods, and limnological theory; field and lab application to some particular topic in limnology. Prerequisite: BIO 426.

BIO 543 Molecular Genetics. (3)*fall*

Nature and function of the gene; emphasis on the molecular basis of inheritance and gene expression in prokaryotes and eukaryotes. Prerequisites: BIO 340; a course in organic chemistry.

BIO 545 Populations: Evolutionary Genetics. (3)*not regularly offered*

Mathematical models in the description and analysis of the genetics of populations. Prerequisites: a combination of BIO 320 and 345 and 415 or only instructor approval.

BIO 547 Techniques in Evolutionary Genetics. (4)*not regularly offered*

Practical experience in modern techniques for the study of evolution. Lecture, lab. Prerequisites: BIO 340, 345; instructor approval.

BIO 550 Advanced Cell Biology. (3)*spring*

Applications of contemporary electron microscopic and biochemical/molecular techniques for studying eukaryotic cell functions. Mechanisms of intracellular protein trafficking. Prerequisites: BIO 353 (or 360 or its equivalent or PLB 360); CHM 231 (or 331 or its equivalent).

BIO 551 Biomembranes. (3)*not regularly offered*

Structure and function of biological membranes, emphasizing synthesis, fluidity, exocytosis, endocytosis, and cell responses to hormones and neurotransmitters. Prerequisites: BIO 353 (or its equivalent); CHM 231 (or 331 or its equivalent).

BIO 552 Developmental Genetics. (3)*spring*

Genetic approaches to the analysis of development during the life cycle of eukaryotic organisms, and the role of genes in the unfolding of the differentiated phenotype. Prerequisite: BIO 340.

BIO 560 Comparative Physiology. (3)*not regularly offered*

Analysis of function in invertebrates and vertebrates, emphasizing evolutionary trends in physiological systems. Prerequisite: BIO 360 (or its equivalent).

BIO 566 Environmental Physiology. (3)*not regularly offered*

Physiological responses and adaptations of animals to various aspects of the physical environment. Prerequisites: BIO 320, 360.

BIO 568 Mammalian Physiology. (3)*not regularly offered*

Detailed treatment of mammalian organ system functions emphasizing integrative mechanisms. Prerequisite: BIO 360 (or its equivalent).

BIO 569 Cellular Physiology. (3)*not regularly offered*

Emphasizes the molecular basis for cell structure and function. Prerequisites: BIO 360; a course in organic chemistry.

BIO 583 OTS: Fieldwork in Tropical Biology. (6–8)*spring and summer*

Intensive field-orientated classes with Organization for Tropical Studies (OTS) in Costa Rica with emphasis on research in ecology and systematics. Lecture, lab, fieldwork. Cross-listed as PLB 583. Credit is allowed for only BIO 583 or PLB 583. Prerequisites: graduate standing; a course in basic ecology.

BIO 584 Internship. (1–12)*fall and spring***BIO 591 Seminar. (1–12)***fall and spring*

May be repeated for credit. Possible topics:

- (a) Adaptations. (1–3)
- (b) Behavior. (1–3)
- (c) Cell Biology. (1–3)
- (d) Ecology. (1–3)
- (e) Evolution. (1–3)
- (f) Genetic Engineering. (1–3)
- (g) Genetics. (1–3)
- (h) Physiology. (1–3)

Omnibus Graduate Courses. See page 50 for omnibus graduate courses that may be offered.

MOLECULAR BIOSCIENCES/BIOTECHNOLOGY (MBB)**MBB 445 Techniques in Molecular Biology/Genetics. (2)***fall and spring*

Molecular genetic principles: plasmid construction, purification, and characterization; PCR; mutageneses; hybridization and sequence analysis; protein quantitation, immunologic detection, and electrophoresis. Cross-listed as MIC 445. Credit is allowed for only MBB 445 or MIC 445. Prerequisites: both BIO 340 and MIC 302 or only instructor approval.

MBB 446 Techniques in Molecular Biology/Genetics Lab. (2)*fall and spring*

Molecular genetic techniques; plasmid construction, purification, and characterization; PCR; mutageneses; hybridization and sequence analysis; protein quantitation; immunologic detection and electrophoresis. Cross-listed as MIC 446. Credit is allowed for only MBB 446 or MIC 446. Pre- or corequisite: MBB 445 or MIC 445.

MBB 484 Internship. (3)*not regularly offered***MBB 490 Capstone: Issues in Biotechnology. (2)***fall and spring*

Integration of science and humanities within problem-solving exercises dealing with intellectual property, ethics, regulatory issues, business practices, and commercialization. Prerequisite: Molecular Biosciences/Biotechnology major or instructor approval.

MBB 499 Individualized Instruction. (3)*not regularly offered*

Omnibus Graduate Courses. See page 50 for omnibus graduate courses that may be offered.

Building Design

See “Master of Science in Building Design,” page 118.

Business Administration

Master’s and Doctoral Programs**Department of Finance****Herbert M. Kaufman***Chair***(BAC 519) 480/965-3131****asufin@asu.edu****www.cob.asu.edu/fin****Department of Management****William H. Glick***Chair***(BA 323) 480/965-7586****asumgt@asu.edu****www.cob.asu.edu/mgt****Department of Marketing****Michael P. Mokwa***Chair***(BAC 400) 480/965-3621****asumkt@asu.edu****www.cob.asu.edu/mkt****Department of Supply Chain Management****Joseph R. Carter***Chair***(BA 318) 480/965-6044****asuscm@asu.edu****www.cob.asu.edu/scm****Finance**

Professors: Booth, Coles, Kaufman, Sushka;
Associate Professors: Cesta, Gallinger, Hertzell, Hoffmeister;
Assistant Professors: Griffin, Nardari, Perry

Management

Professors: Ashforth, Bohlander, Cardy, Dooley, Glick,
Gomez-Mejia, Hershauer, Hom, Kinicki, Kulik, Ostroff,
Penley, V. Smith-Daniels;
Associate Professors: Boyd, Brenenstuhel, Callarman, Choi,
Cook, Keats, Keller, Moorhead, Olivas, Roberson,
D. Smith-Daniels, Van Hook;
Assistant Professors: Blancero, Koka,
Lane, Rungtusanatham;
Senior Lecturer: Kreitner;
Lecturers: Davila, Sack

Marketing

Professors: Bitner, Brown, Hutt, Jackson, Kumar, Lastovicka,
Mokwa, L. Ostrom, Reingen, Schlacter, Ward;
Associate Professors: Blasko, Nowlis, Sinha,
Stephens, Walker;
Assistant Professors: A. Ostrom, Roundtree

Supply Chain Management

Professors: J. Carter, P. Carter, Ellram, Guntermann, Hendrick, Jennings, Kirkwood, Pearson, Smeltzer;
Associate Professors: Aranda, Bohlman, Brooks, Butler, Choi, Davis, Dundas, Keefer, Leonard, Lock, Lynch, Maltz, Murranka, Siferd, Verdini;
Assistant Professor: Amundson;
Senior Lecturer: Flynn

The faculty in the College of Business offer a Ph.D. degree in Business Administration and a Master of Business Administration (M.B.A.) degree offered in day (full-time), evening, and executive programs.

Other professional master's degrees offered through the College of Business are described in this catalog under their respective degree program headings.

ASU West also offers a Master of Business Administration (M.B.A.) degree. For more information about the ASU West program, see the *ASU West Catalog*, call 602/543-4567, or access www.west.asu.edu on the Web.

MASTER OF BUSINESS ADMINISTRATION

The central theme of the program is to build and strengthen capabilities in knowledge and analysis of the functional areas of business, basic skills, and managerial abilities. Knowledge involves textbook and case materials. Basic skills include computing, writing and critical thinking, presentation and speaking, team and group work, interpersonal relations, and time management. There is a strong team emphasis throughout the ASU curriculum.

The M.B.A. program is supported by each of the seven academic units within the College of Business.

Admission. See "Admission to the Graduate College," page 92. All students applying to graduate business administration programs (except those applying to the M.S. degree in Economics) are required to take the GMAT. The TOEFL is required of all international applicants whose native language is not English or who are not graduates of an institution located in the United States. The TSE is not required for admission to the ASU M.B.A. program. However, it may be required for a dual degree program. For more information on testing, call 609/771-7330 or write

EDUCATIONAL TESTING SERVICE
PO BOX CN 6103
PRINCETON NJ 08541-6103

Students applying to the M.B.A. program are required to have at least two years of full-time work experience and to submit a statement of personal objectives for the degree program addressing commitment, goals, qualifications, and reasons for interest in the program. Applicants are to provide letters of recommendation commenting on the student's motivation, commitment, achievements, work experience, and opportunity for success in the program. In addition to the above data, students are to communicate their interest for either the day, evening, or executive program.

Registration. Registration in courses numbered 502 and above is limited to students who have been admitted to a graduate degree program, have the approval of the M.B.A. program office, and have the prerequisites of calculus and computer literacy.

Structure of the M.B.A. Program. M.B.A. courses are open only to students admitted to the M.B.A. program.

Program Requirements. While there are no business course prerequisites, applicants must have computer proficiency and expertise in using a spreadsheet package, a word processing package, a presentation software package, an e-mail package, and an Internet browser. Potential students must also demonstrate strong quantitative ability. This is accomplished through an above average performance (65th percentile or above) on the GMAT quantitative section or a college math course in calculus or advanced statistics.

At least 48 hours are required to complete the evening and executive programs. The day program has additional requirements that vary by area of study. Students are admitted to the fall semester only and, generally, enter and graduate as a class in two years.

The core courses are designed to provide a foundation in business knowledge and skills and must be taken in the prescribed sequence.

Elective courses build upon the business core and focus on the further development of an area of study.

The College of Business does not accept credits earned while students are in nondegree status; moreover, graduate business courses are not open to nondegree students.

Foreign Language Requirements. None.

Thesis Requirements. None.

Comprehensive Examinations. All students must successfully complete the comprehensive requirement established by the College of Business and Graduate College for the M.B.A. degree. The comprehensive exam is integrated with MGT 589 Strategic Management. Students passing this course with a grade of "A" or "B" satisfy the comprehensive exam requirement.

Dual/Concurrent Degree Programs. See "Dual/Concurrent Degree Programs," page 62.

DOCTOR OF PHILOSOPHY

The Ph.D. degree in Business Administration prepares candidates for scholarly careers at leading educational institutions and for positions in business and government organizations where advanced research and analytical capabilities are required. Major emphasis is placed upon the development of expertise in a chosen subject area, a disciplined and inquiring mind, competence in research methodology, and skill in effectively communicating advanced business concepts.

Students are encouraged to work closely with the faculty from the beginning of their programs. A ratio of resident doctoral students to faculty of less than one to one ensures that faculty may serve effectively as mentors for doctoral students.

Admission. A completed application for admission to the Ph.D. in Business Administration degree program includes

1. application for admission to the Graduate College,
2. undergraduate and postgraduate transcripts,
3. Graduate Management Admission Test score or scores from the Graduate Record Examination,

4. applicant's letter of personal career objectives and rationale for pursuing the Ph.D. program,
5. three letters of recommendation,
6. Test of Spoken English score for applicants whose native language is not English, and
7. Test of English as a Foreign Language score for applicants whose native language is not English and who have not completed a degree from a U.S. college or university.

Admission is granted for fall semesters only. The deadline for receipt of all required application materials is February 1.

Areas of Concentration. The Ph.D. student may choose from among six areas of concentration: accountancy, finance, computer information systems, management, marketing, and supply chain management. The accountancy specialization area includes financial accounting, managerial accounting, tax policy, auditing, and information systems. Research activities in information management encompass areas of theory and application in computer information systems. Research interests of the finance faculty offering the finance concentration focus on corporate finance, investments, financial markets, and banking. The management concentration requires three core courses: organizational theory, organizational behavior, and research methodology. In addition to these core courses, students choose one of two specialty tracks: strategic management or human resource management. Research conducted by the marketing faculty offering the marketing concentration is focused in several areas: advertising, buyer behavior, distribution channels, services marketing, and other dimensions of marketing, including sales management, industrial marketing, and public-policy implications of marketing. The faculty in the Department of Supply Chain management offer the supply chain management concentration and are actively involved in the input-conversion-output process.

Program of Study. See "Doctor of Philosophy," page 103, for general requirements. The Ph.D. degree program requires mathematical competence through linear algebra and calculus and computer skills. The program of study includes graduate study in economics, behavioral sciences, and quantitative/statistical analysis. The advanced program is composed of an area of concentration and supporting course work that best prepares students for conducting scholarly work in their areas of interest.

Comprehensive Examinations. A written comprehensive examination, designed to ascertain the candidate's knowledge and orientation in the major field of study and fitness to proceed to the completion of a dissertation, is required at the end of course work. An additional written comprehensive examination on a candidate's supporting course work is a departmental option. An oral examination after completion of written examinations is also a departmental option.

Dissertation Requirements. The candidate must present an acceptable dissertation based on original investigation. The dissertation must represent a significant contribution to knowledge, be written in a scholarly manner, and demonstrate the ability of the candidate to do independent research of high quality.

Final Examinations. A final oral examination in defense of the dissertation is required. The examination covers the subject matter of the dissertation and the field most nearly corresponding with that of the dissertation.

Department of Finance

FINANCE (FIN)

FIN 502 Managerial Finance. (3)

once a year

Theory and practice of financial decision making, including risk analysis, valuation, capital budgeting, cost of capital, and working capital management. Prerequisites: ACC 502; ECN 502; QBA 502.

FIN 521 Investment Management. (3)

once a year

Valuation of equities, fixed incomes, and options/financial futures in an individual security and portfolio context; mathematical asset allocation approaches. Lecture, discussion. Prerequisite: FIN 502.

FIN 527 Derivative Financial Securities. (3)

once a year

Analysis of forwards, futures, and option contracts on bonds, commodities, equities, and foreign exchange. Design of speculative and hedging strategies. Lecture, discussion. Prerequisites: FIN 502, 521.

FIN 531 Capital Markets and Institutions. (3)

once a year

Recent theoretical and operational developments in economic sectors affecting capital markets and institutions. Lecture, discussion. Prerequisite: FIN 502.

FIN 551 Financial Statement Analysis. (3)

once a year

Analysis of corporations' financial statements to ascertain their financial strength and default risk. Emphasis on studying cash flows. Lecture, cases. Prerequisites: ACC 502; FIN 502.

FIN 556 International Financial Management. (3)

once a year

Behavior of real and nominal currency exchange rates, management of international investment portfolios, corporate exchange exposure, and hedging exchange risk. Lecture, discussion. Prerequisite: FIN 502.

FIN 561 Financial Management Cases. (3)

once a year

Case-oriented course in applications of finance theory to management issues. Acquisition, allocation, and management of funds within the business enterprise. Working capital management, capital budgeting, capital structure, and financial strategy. Lecture, discussion, presentation. Prerequisite: FIN 502.

FIN 581 Applied Corporate Finance. (3)

once a year

Applies theories in corporate finance. Market efficiency, capital structure, "principal-agent" theory, corporate control, dividend policy, and capital budgeting. Prerequisite: FIN 502.

FIN 781 Theory of Finance. (3)

once a year

Fundamental tools of financial economics; asset pricing, arbitrage, option pricing, capital structure, dividend policy, asymmetric information, and transaction-cost economics. Prerequisites: FIN 502, 521, 531.

FIN 791 Doctoral Seminar in Finance. (1-12)

once a year

Possible topics:

- (a) Financial Institutions and Markets. (3)
Economic and monetary theory applied to financial markets and institutions; implications of financial structure for market performance and efficiency.
- (b) Financial Management. (3)
Financial theory pertaining to capital structure, dividend policy, valuation, cost of capital, and capital budgeting.
- (c) Investments. (3)
Investments and market theory; efficient markets hypothesis; option and commodity markets.

Prerequisite: FIN 781.

Omnibus Graduate Courses. See page 50 for omnibus graduate courses that may be offered.

Department of Management

MASTER'S DEGREE PROGRAM

The faculty in the Department of Management participate in offering the High Technology M.B.A., Executive M.B.A., Evening M.B.A., and Day M.B.A. programs. These programs are administered by the College of Business. For more information see "College of Business," page 61. Areas of study offered to high technology, evening, and executive M.B.A. students include process management in high technology organizations; globalization and diversity management; entrepreneurship and small business development; and management consulting.

PH.D. DEGREE PROGRAM

The faculty in the department offer students the opportunity to obtain a Ph.D. degree in Business Administration with a concentration in management. The doctoral program places primary emphasis on the development of research competence and emphasizes teaching as a vehicle to academic professionalism. The mission of the program is to provide an environment that is conducive to the development of scholars who are prepared to assume the diverse responsibilities of positions at leading research universities. The goal is to prepare students for research careers in the academic community.

Doctoral students are encouraged to design an individually meaningful course of study within the larger context of the management field. Opportunities for doing this are available through course work, individual work with faculty members, and independent research and study. Students in the Ph.D. program select a series of Ph.D. course modules within the department and several supporting courses from other departments on campus. Students develop additional focus and expertise through collaboration on major papers with individual faculty members.

The faculty in the Department of Management cover the areas of human resource management, management science, operations management, organizational behavior, organizational theory, and strategic management. The faculty's research and teaching emphasizes high tech management, quality, process and project management, decision analysis, globalization, diversity, small business and entrepreneurship, change management, stress, job loss, organizational identity, corporate governance, and human resource management practices. The faculty has distinguished itself with research and publications in premier journals. The department ranks 12th internationally for its rate of publication in premier academic journals. The department also ranks sixth internationally in premier journal articles that impact practice in operations and management science.

Further information, links to courses, current faculty, and updates on the Department of Management areas of study for the M.B.A. programs can be found on the Web at www.cob.asu.edu/mgt.

General information on the M.B.A. programs can be found at www.cob.asu.edu/mba.

Further information, application procedures, links to current faculty, and updates on the Ph.D. program in Business with a concentration in management can be found at www.cob.asu.edu/mgt/degree/PhDMainPg.htm.

MANAGEMENT (MGT)

MGT 413 Compensation Management. (3)

fall and spring

Establishing base and incentive pay with job analysis, job evaluation, and wage surveys; performance appraisal; conformance to compensation laws. Prerequisites: MGT 311; professional program business student.

MGT 422 Training and Development. (3)

fall and spring

Learning theory, orientation and basic-level training, management development, resource materials and methods. Prerequisites: MGT 311; professional program business student.

MGT 423 Employee-Management Relations. (3)

fall and spring

Employment relationship in union/nonunion setting. Employee-management rights/responsibilities, complaint administration, negotiations, union structure, and mock government negotiations.

MGT 424 Employee Selection and Appraisal. (3)

fall and spring

Concepts and methods of personnel selection and performance appraisal. Includes job analysis, measurement, and legal issues. Emphasizes experiential exercises. Prerequisite: MGT 311.

MGT 433 Management Decision Analysis. (3)

fall and spring

Decision-making concepts and methods in the private and public sectors and their application to organizational problems. Understanding of individual and group decision making. Prerequisites: MGT 301; professional program business student.

MGT 434 Social Responsibility of Management. (3)

fall, spring, summer

Relationship of business to the social system and its environment. Criteria for appraising management decisions. Managers as change agents. Prerequisites: MGT 301; professional program business student.

MGT 440 Small Business and Entrepreneurship. (3)

fall, spring, summer

Opportunities, risks, and problems associated with small business development and operation.

MGT 445 Business Plan Development. (3)

fall and spring

Develops a complete strategic business plan emphasizing the planning process undertaken by successful small business owners and entrepreneurs. Lecture, discussion, experiential exercise. Prerequisite: MGT 440.

MGT 459 International Management. (3)

fall, spring, summer

Concepts and practices of multinational and foreign firms. Objectives, strategies, policies, and organizational structures for operating in various environments. Credit is allowed for only MGT 459 or IBS 494 ST: International Management or IBS 494 ST: Multinational Management. Prerequisite: IBS 300 or MGT 301.

MGT 463 Strategic Management. (3)

fall, spring, summer

Strategic formulation and administration of the total organization, including integrative analysis and strategic planning. To be taken last semester of senior year. Prerequisites: completion of 108 hours, including all other business administration core requirements; professional program business student.

General Studies: L

MGT 468 Management Systems. (3)

fall and spring

Systems theory and practice applied to organization process and research. Organizations seen as open systems interacting with changing environments. Prerequisite: MGT 301.

MGT 480 Team Management Skills. (3)

fall and spring

Cooperative education class teaching team skills in active listening, conflict resolution, decision making, effective meetings, norming, and team roles. Cooperative learning.

MGT 484 Internship. (3)

fall, spring, summer

Nonmajor elective credit only.

MGT 494 Special Topics. (1–4)*not regularly offered*

Current topics in management, primarily designed for business majors. See the *Schedule of Classes* for current offerings. Possible topics:

- (a) Applied International Management. (3)
- (b) Cultural Factors in International Business. (3)

Prerequisite: IBS 300 or MGT 301 or IBS 494 or MGT 459.

MGT 502 Organization Theory and Behavior. (3)*once a year*

Important concepts and applications in management, including communication, decision making, group dynamics, leadership, motivation, organization change, and organization design. Prerequisites: computer literacy; graduate degree program student.

MGT 522 Human Resource Activity and the Management of Diversity. (3)*once a year*

Applies general and human resource management principles to work effectively with a diverse spectrum of people. Discussion, exercises. Prerequisite: M.B.A. degree program student.

MGT 523 Managing People for Service Advantage. (3)*once a year*

Covers HRM practices that are conducive to building and maintaining internal customer equity and maximizing external customer service. Discussion, lecture, class exercises, cases. Prerequisite: M.B.A. degree program student.

MGT 559 International Management. (2–3)*once a year*

Studies international and cross-cultural influences on management processes and development of global leadership capabilities for experienced management professionals. Discussion, company analyses, case analyses, lecture, guest speakers. Prerequisite: M.B.A. degree program student.

MGT 561 Advanced Integrated Project. (2–3)*once a year*

Capstone project of the high-technology ASU M.B.A. Student teams develop business plans for new technology-based products. Online project. Prerequisite: M.B.A. degree program student.

MGT 570 Management Consulting. (3)*once a year*

Develops understanding of how internal and external consultants add value. Prerequisites: ability to use common business software, including Microsoft Office; familiarity with spreadsheets.

MGT 589 Strategic Management. (3–4)*spring*

Formulation of strategy and policy in the organization, emphasizing the integration of decisions in the functional areas. Prerequisite: M.B.A. degree program student.

MGT 591 Seminar. (1–12)*not regularly offered*

Possible topics:

- (a) Business Plan Competition. (3)
- (b) Entrepreneurship. (3)
- (c) Human Resource Activity and the Management of Diversity. (3)
- (d) Human Resource Management and Service Delivery. (3)
- (e) Human Resources and High-Technology Management. (3)
- (f) International Management. (3)
- (g) Management Consulting. (3)
- (h) Organizational Change and Business Process Consulting. (3)

MGT 593 Applied Projects. (3)*once a year*

Cross-functional teams initiate (possibly implement) organizational change within a local firm. Lecture, discussion, experiential learning. Pre- or corequisite: all core courses in the M.B.A. program.

MGT 598 Special Topics. (3)*not regularly offered*

Graduate special topics chosen from human resources, strategic management, and international management, including special topics in international management in Asia or Europe. Prerequisite: instructor approval.

MGT 791 Seminar: Doctoral Seminar in Management. (1–12)*once a year*

Short module seminars. Possible topics:

- (a) Causal Modeling. (1)
- (b) Change and Coping. (1)
- (c) Cognition: Micro and Macro Perspectives. (1)
- (d) Dysfunction in Workplace. (1)
- (e) Economic Theories of the Firm. (1)
- (f) Levels of Analysis. (1)
- (g) Motivation and Attitudes. (1)
- (h) Organizational Identity and Identification. (1)
- (i) Organizational Learning and Organizational Identity. (1)
- (j) Organizational Performance and Reward Systems. (1)
- (k) Organizational Strategy and Culture. (1)
- (l) Organizational Structure, Technology, and Information Systems. (1)
- (m) Organizational Withdrawal. (1)
- (n) Performance Appraisal. (1)
- (o) Power and Organizational Change. (1)
- (p) Selection. (1)
- (q) Strategy Overview. (1)
- (r) Teams, Groups, and Leadership. (1)
- (s) The Craft of Research. (1)

Omnibus Graduate Courses. See page 50 for omnibus graduate courses that may be offered.

QUANTITATIVE BUSINESS ANALYSIS (QBA)**Department of Management****QBA 505 Management Science. (3)***not regularly offered*

Quantitative approaches to decision making, including linear programming and simulation, with emphasis on business applications. Prerequisites: MAT 210; QBA 502.

QBA 508 Product and Service Innovation. (3)*fall and spring*

Develops strategies for innovation in products and services. Prerequisites: basic algebra; basic probability concepts; elementary knowledge of Windows.

QBA 550 Intermediate Decision Analysis. (3)*not regularly offered*

Quantitative decision analysis methods for business decision making under uncertainty, including decision diagrams, subjective probabilities, and preference assessment. Prerequisites: MAT 210; QBA 502.

QBA 591 Seminar. (1–12)*fall and spring*

Current topics in quantitative business analysis primarily designed for technology, evening, and executive M.B.A. students. Elective courses for these programs may include the following possible topics:

- (a) Decision Models. (3)
- (b) Decision Models for Consulting. (3)
- (c) Management Problem Solving. (3)
- (d) Strategic Decision Analysis. (3)

QBA 593 Applied Project. (1–12)*not regularly offered***QBA 599 Thesis. (1–12)***not regularly offered***QBA 791 Doctoral Seminars in Quantitative Business Analysis. (1–12)***not regularly offered*

The Department of Management has adopted a modular approach to Ph.D. education. Possible topics:

- (a) Chaos Theory. (1)
- (b) Risk Analysis. (1)
- (c) Strategic Decision Making. (1)
- (d) Systems Dynamics. (1)

Omnibus Graduate Courses. See page 50 for omnibus graduate courses that may be offered.

OPERATIONS MANAGEMENT (OPM)**OPM 450 Changing Business Processes. (3)***once a year*

Describes and analyzes business processes. Generates and evaluates alternatives. Creates improvement and implementation plans. Prerequisites: SCM 300; QBA 221.

General Studies: L

OPM 540 Quality and Productivity Management. (3)*not regularly offered*

Organizational factors influencing quality and productivity in the production of goods and services. Quality and productivity strategies, improvement programs, and measurement systems. Prerequisite: SCM 502 or instructor approval.

OPM 581 Management of Technology and Innovation. (3)*fall*

Technology life cycles, technology forecasting, new product development process, innovation teams, innovation best practices. Prerequisite: M.B.A. degree program student.

OPM 583 Project Management in Service Organizations. (2–3)*fall*

Project management planning, leadership, and control in service organizations. Discussion, lecture, class exercises, cases. Prerequisite: M.B.A. degree program student.

OPM 585 Facilities Design and Management of Technology. (3)*once a year*

Decisions regarding management of facilities and technology for manufacturing and service firms. Facilities location, layout, process design, and selection.

OPM 586 High-Technology Project Management. (2–3)*fall*

Project management processes for high-technology organizations, including planning, scheduling, team development, and control. Prerequisite: M.B.A. degree program student.

OPM 587 Project Management. (3)*once a year*

Planning, scheduling, and controlling of projects in R & D, manufacturing, construction, and services. Project selection, financial considerations, and resource management. Prerequisite: QBA 502.

OPM 588 Strategic Project Management. (2–3)*fall*

Overview of strategic project management processes, project planning and control, project portfolio management, resource allocation, management of strategic project partners. Discussion, lecture, class exercises, cases. Prerequisite: M.B.A. degree program student.

OPM 591 Seminar. (1–12)*once a year*

Possible topics:

- High-Performance Management Processes. (3)
- Management of Technology. (3)
- Manufacturing Management in High Technology. (3)
- Manufacturing Strategy. (3)
- New Product and Process Development. (3)
- Technology/Project Management. (3)

OPM 593 Applied Projects. (3)*once a year*

Cross-functional teams initiate (possibly implement) organizational change within a local firm. Lecture, discussion, experiential learning. Pre- or corequisite: all core courses in the M.B.A. program.

OPM 791 Doctoral Seminars in Operations and Production Management. (1–12)*not regularly offered*

Short module seminars. Possible topics:

- Management of Technology. (1)
- Manufacturing Strategy. (1)
- Operations Management. (1)
- Project Management. (1)

Omnibus Graduate Courses. See page 50 for omnibus graduate courses that may be offered.

Department of Marketing

MARKETING (MKT)

MKT 394 Special Topics. (1–4)*fall*

Possible topics:

- Global Markets. (3)
- Marketing and Selling. (3)

MKT 411 Sales Management. (3)*not regularly offered*

Applies management concepts to the administration of the sales operation. Prerequisite: MKT 302.

MKT 412 Promotion Management. (3)*once a year*

Integrates the promotional activities of the firm including advertising, personal selling, public relations, and sales promotion. Prerequisite: MKT 302.

MKT 424 Retail Management. (3)*once a year*

Role of retailing in marketing. Problems and functions of retail managers within various retail institutions. Prerequisite: MKT 300.

MKT 430 Marketing for Service Industries. (3)*once a year*

Concepts and strategies for addressing distinctive marketing problems and opportunities in service industries. Current issues and trends in the service sector. Prerequisites: MKT 300, professional program business student.

MKT 434 Industrial Marketing. (3)*once a year*

Strategies for marketing products and services to industrial, commercial, and governmental markets. Changing industry and market structures. Prerequisite: MKT 302 or instructor approval.

MKT 435 International Marketing. (3)*once a year*

Analyzes marketing strategies developed by international firms to enter foreign markets and to adapt to changing international environments. Prerequisites: MKT 302 (or instructor approval); professional program business student.

MKT 451 Marketing Research. (3)*fall and spring*

Integrated treatment of methods of market research and analysis of market factors affecting decisions in the organization. Prerequisites with a grade of "C" or higher: MKT 302; QBA 221.

MKT 460 Strategic Marketing. (3)*fall and spring*

Policy formulation and decision making by the marketing executive. Integrates marketing programs and considers contemporary marketing issues. Prerequisite: professional program business student. Prerequisites with a grade of "C" or higher: MKT 302, 304, 451.

*General Studies: L***MKT 494 Special Topics. (1–4)***fall, spring, summer*

Chosen from topics in the marketing and international marketing arenas to include seminars in international marketing in Europe and Asia. Possible topics:

- Applied International Marketing

MKT 499 Individualized Instruction. (1–3)*fall, spring, summer*

Topics of special interest chosen by students and agreed to by the departments to do independent studies with a professor acting as a guide.

MKT 502 Marketing Management. (3)*fall, spring, summer*

Managing the marketing function; market and environmental analysis; marketing planning, strategy, and control concepts. Development and management of marketing programs. Prerequisite: ECN 502.

MKT 524 Services Marketing. (3)*once a year*

Strategies for marketing services emphasizing the distinctive challenges and approaches that make marketing of services different from marketing manufactured goods. Prerequisite: MKT 502 (or its equivalent).

MKT 563 Marketing Strategy. (3)*not regularly offered*

Planning and control concepts and methods for developing and evaluating strategic policy from a marketing perspective. Prerequisite: MKT 502.

MKT 584 Internship. (3)*fall, spring, summer*

MKT 591 Seminar. (1–12)*once a year*

Offered in conjunction with the M.B.A. program (see M.B.A. program section). Possible topics:

- (a) Business-to-Business Marketing. (3)
- (b) Competitive Strategy for Services. (3)
- (c) Consumer Behavior and Market Strategy. (3)
- (d) Customer Satisfaction/Service Quality Measurement. (3)
- (e) International Marketing. (3)
- (f) Marketing in the Information Age. (3)
- (g) New Product and Service Development. (3)

Omnibus Graduate Courses. See page 50 for omnibus graduate courses that may be offered.

Department of Supply Chain Management

BUSINESS (BUS)

BUS 451 Business Research Methods. (3)*not regularly offered*

Methods of collecting information pertinent to business problem solving, including design, collection, analysis, interpretation, and presentation of primary and secondary data.

*General Studies: L***BUS 502 Managerial Communication. (1–3)***fall and spring*

Analysis of various business problems, situations, and development of appropriate communication strategies. Prerequisite: MGT 502.

BUS 504 Professional Report Writing. (3)*once a year*

Preparation and presentation of professional reports.

BUS 507 Business Research Methods. (3)*not regularly offered*

Techniques for gathering information for business decision making. Selection, design, and completion of a business-oriented research project.

BUS 591 Seminar. (3)*not regularly offered*

Selected managerial communication topics.

BUS 594 Study Conference or Workshop. (3)*not regularly offered***BUS 700 Research Methods. (3)***not regularly offered*

Omnibus Graduate Courses. See page 50 for omnibus graduate courses that may be offered.

LEGAL AND ETHICAL STUDIES (LES)

LES 411 Real Estate Law. (3)*once a year*

Legal and ethical aspects of land ownerships, interests, transfer, finance development, and regulations of the real estate industry.

LES 532 Negotiation Agreements. (3)*fall and spring*

Develops negotiation competencies to build partnerships and create lasting agreements with internal/external customers, suppliers, work teams, and external constituencies. Lecture and substantial student interaction through team exercises.

LES 579 Legal and Ethical Issues for Business. (3)*fall and spring*

Studies legal and ethical components of business decisions; self-regulation and social responsibility as strategies. Prerequisites: ACC 503; FIN 502; MGT 502; MKT 502.

Omnibus Graduate Courses. See page 50 for omnibus graduate courses that may be offered.

REAL ESTATE (REA)

REA 401 Real Estate Appraisal. (3)*once a year*

Factors affecting the value of real estate. Theory and practice of appraising and preparation of the appraisal report. Appraisal techniques. Prerequisites: REA 300; professional program business student.

REA 441 Real Estate Land Development. (3)*once a year*

Neighborhood and city growth. Municipal planning and zoning. Development of residential, commercial, industrial, and special purpose properties. Prerequisites: REA 300; professional program business student.

REA 456 Real Estate Investments. (3)*once a year*

Analyzes investment decisions for various property types. Cash flow and rate of return analysis. Prerequisites: FIN 300; professional program business student.

REA 461 Current Real Estate Topics. (3)*not regularly offered*

Discusses and analyzes current real estate topics of interest. Prerequisites: REA 300; professional program business student.

Omnibus Graduate Courses. See page 50 for omnibus graduate courses that may be offered.

SUPPLY CHAIN MANAGEMENT (SCM)

SCM 405 Urban Transportation. (3)*not regularly offered*

Economic, social, political, and business aspects of passenger transportation. Public policy and government aid to urban transportation development. Prerequisite: upper-division standing or instructor approval.

SCM 432 Materials Management. (3)*fall and spring*

Studies managing the productive flow of materials in organizations, including MRPII, JIT, quality, facility planning, and job design. Fee. Prerequisites: SCM 300; professional program business student majoring in Supply Chain Management.

SCM 440 Productivity and Quality Management. (3)*fall and spring*

Productivity concepts at the national, organizational, and individual levels. Quality management and its relationship to productivity in all organizations. Prerequisite: professional program business student majoring in Supply Chain Management.

SCM 455 Research and Negotiation. (3)*fall and spring*

Current philosophy, methods, and techniques used to conduct both strategic and operations supply chain management research and negotiation. Includes negotiation simulations. Prerequisite: professional program business student majoring in Supply Chain Management. Prerequisite with a grade of "C" or higher: SCM 355.

*General Studies: L***SCM 460 Carrier Management. (3)***not regularly offered*

Analyzes carrier economics, regulation, management, and rate-making practice; evaluates public policy issues related to carrier transportation. Prerequisite: upper-division standing or instructor approval.

SCM 463 Global Supply Chain Management. (3)*once a year*

Supply chain activities in international business with special emphasis on management of transportation, global sourcing, customs issues, and facility location in a global environment.

SCM 479 Supply Chain Strategy. (3)*fall and spring*

Synthesis of purchasing, production, transportation, and distribution systems to provide an integrated perspective of supply chain management. Prerequisite: professional program business student majoring in Supply Chain Management. Prerequisites with a grade of "C" or higher: SCM 345, 355, 432.

SCM 502 Operations and Supply Management. (3)*fall and spring*

Contemporary management issues, including environmental, project, and supply chain management; new product development; quality control; TQM. Prerequisite: M.B.A. degree program student.

SCM 532 Supply Chain Design and Development Strategies. (3)*fall*

Strategic orientation toward the design and development of the supply chain for purchasing, materials, and logistics systems.

SCM 541 Supply Chain Management and Control. (3)*spring*

Management and control of purchasing and logistics management systems. Total Quality Management to assess and assure customer satisfaction. Global strategies.

SCM 545 Supply Chain Continuous Improvement Strategies. (3)*spring*

Leading-edge strategies such as reengineering high-performance teams and expert systems for continuous improvement of the supply chain. Seminar.

SCM 591 Seminar. (1–12)*not regularly offered*

Possible topics:

- (a) Global Supply Chain Management. (3)
- (b) New Product Development. (3)
- (c) Quality and Productivity Management. (3)
- (d) Services Operations Management. (3)

SCM 791 Doctoral Seminar. (1–12)*once a year*

Possible topics:

- (a) Logistics, Transportation, and Physical Distribution Management. (3)
- (b) Purchasing and Materials Management. (3)

Omnibus Graduate Courses. See page 50 for omnibus graduate courses that may be offered.

Chemical Engineering

Master's and Doctoral Programs

Subhash Mahajan

Chair

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PROFESSORS

MAHAJAN, RAUPP, SATER

ASSOCIATE PROFESSORS

BEAUDOIN, BECKMAN, BURROWS, RIVERA, SIERKS

ASSISTANT PROFESSORS

ALLEN, DILLNER, RAZATOS

The faculty in the Department of Chemical and Materials Engineering offer graduate programs leading to the M.S., Master of Science in Engineering, and the Ph.D. degrees in Chemical Engineering. Areas of research emphasis include biotechnology and biomaterials, chemical therapies for neurodegenerative diseases, adhesion in biological and inorganic systems, electronic materials processing, environmentally-benign manufacturing, process design and operations, water and air purification, surface and reaction engineering, and photocatalysis. For students interested in the Bioengineering major, see "Bioengineering," page 130, for program description. Within the Engineering Science major, students may select materials science and engineering as the area of study (see "Engineering Science," page 201, for program description).

The faculty also participate in offering the interdisciplinary program leading to the Doctor of Philosophy degree with a major in Science and Engineering of Materials (see "Science and Engineering of Materials," page 307, for program description). A *Graduate Student Handbook*, detailing information on graduate studies in Chemical Engineering, is

available to admitted students. Students should contact the department.

The faculty also participate in offering the Tri-University Master of Engineering degree program. See "Master of Engineering," page 195, for program description.

Graduate Record Examination. Graduate Record Examination scores are required from all students.

MASTER OF SCIENCE

See "Master's Degrees," page 100, for general requirements.

Transition Program. Students applying for the program leading to a master's degree with a major in Chemical Engineering, or in the area of study of materials science and engineering under the Engineering Science major, may have an undergraduate B.S. degree in a major field other than chemical engineering or materials science. The qualifications of transition students are reviewed by the department graduate committee, and a special program is designed for successful applicants. In general, applicants should have had, or should be prepared to take, calculus through differential equations and physics. Transition students are expected to complete the essential courses in their area of study from the undergraduate program in order to be prepared for the graduate courses. Other course work from the undergraduate program may be required depending upon the area of study selected by the student.

Transition students should contact the graduate coordinator for an evaluation of the undergraduate transcript.

Program of Study. All candidates for the Master of Science in Engineering or M.S. degree in Chemical Engineering, or in the area of study of materials science and engineering under the Engineering Science major, are required to complete an approved program of study consisting of the minimum required semester hours, including research report (M.S.E.) or thesis (M.S.). Special course requirements for the different areas of study are established by the faculty and are available from the departmental graduate coordinator. In addition to the course/thesis requirements, all full-time graduate students must successfully complete a seminar course during each semester of attendance; part-time students must enroll in a seminar course at least three times during the course of study. Candidates whose undergraduate degree was in a field other than chemical engineering or materials science may be required to complete more than 30 semester hours.

Thesis Requirements. A thesis or equivalent is required.

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

MASTER OF SCIENCE IN ENGINEERING

See "Master of Science in Engineering," page 200, for information on the Master of Science in Engineering degree.

DOCTOR OF PHILOSOPHY

The Ph.D. degree in Chemical Engineering, or in the area of study of materials science and engineering under the Engineering Science major, is conferred upon evidence of

excellence in research resulting in a scholarly dissertation that is a contribution to existing knowledge.

See "Doctor of Philosophy," page 103, for general requirements.

Doctoral Program. Upon successful completion of the qualifying examination, a research supervisory committee is formed and the doctoral student is required to submit a research proposal. Following the acceptance of the research proposal, the student is given a comprehensive examination to determine initiative, originality, breadth, and high level of professional commitment to the problem selected for investigation. Upon successful completion of the comprehensive examination, the student applies for admission to candidacy.

Master's Degree in Passing. Students who are enrolled in the Ph.D. degree program in Chemical Engineering, but who do not hold a previously earned master's degree in chemical engineering, can obtain the M.S.E. degree (the "Master's in Passing") upon completion of course requirements, the Ph.D. qualifying examination, prospectus, and the comprehensive examination.

As this degree is only available to students who are enrolled as regular students in the Ph.D. program in Chemical Engineering, all of the above requirements (including course work) can be applied toward the Ph.D. requirements.

Foreign Language Requirements. Candidates in the program leading to the Ph.D. degree in Chemical Engineering, or in the area of study materials science and engineering under the Engineering Science major, normally are not required to pass an examination showing reading competency of a foreign language. However, the supervisory committee may establish such a requirement in special cases depending upon the research interests of the candidate. If the foreign language is required, the student must successfully fulfill the requirement before taking the comprehensive examination.

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

Research in the department is centered on core programs in analytical chemistry, biochemistry, inorganic chemistry, organic chemistry, physical and solid state chemistry, and geochemistry. Some examples of specific research areas are nonequilibrium gas-phase chemical systems, chemistry at high pressures, bacterial and artificial photosynthesis, design of potential antitumor agents, separations and chromatographic detectors, novel materials containing supramolecular motifs, and dynamics in disordered materials. A complete listing of the research interests of faculty members can be found at www.asu.edu/clas/chemistry.

In addition to the strong core programs, the department emphasizes multidisciplinary research at the leading edge of science, where departmental strengths interface with materials and solid-state research, life sciences and photobiology, physics, engineering, geology and space science, and environmental studies.

Approximately 30 faculty members from the Departments of Chemistry and Biochemistry, Physics and Astronomy, and Geology and the College of Engineering and Applied Sciences are associated with the center for Solid-State Science. The center includes a number of specialized facilities such as electron microscopy and crystal-growing laboratories. Fourteen faculty members from the Departments of Chemistry and Biochemistry and Plant Biology are associated with the Center for the Study of Early Events in Photosynthesis. This center has unique instrumentation for studying the earliest energy storing reactions of photosynthesis. The Center for Meteorite Studies and the Cancer Research Institute also foster interdisciplinary research efforts. Faculty in the Department of Chemistry and Biochemistry also participate in collaborative programs in the science and engineering of materials and in molecular and cellular biology.

CHEMICAL ENGINEERING (CHE)

CHE 458 Semiconductor Material Processing. (3)

not regularly offered

Introduction to the processing and characterization of electronic materials for semiconductor applications. Prerequisites: CHE 333, 342.

CHE 475 Biochemical Engineering. (3)

not regularly offered

Application of chemical engineering methods, mass transfer, thermodynamics, and transport phenomena to industrial biotechnology. Prerequisite: instructor approval.

CHE 476 Bioreaction Engineering. (3)

not regularly offered

Principles of analysis and design of reactors for processing with cells and other biologically active materials; applications of reaction engineering in biotechnology. Prerequisite: instructor approval.

CHE 477 Bioseparation Processes. (3)

not regularly offered

Principles of separation of biologically active chemicals; the application, scale-up, and design of separation processes in biotechnology. Prerequisite: instructor approval.

CHE 501 Introduction to Transport Phenomena. (3)

fall and spring

Transport phenomena, with emphasis on fluid systems. Prerequisite: transition student with instructor approval.

CHE 502 Introduction to Energy Transport. (3)

fall and spring

Continuation of transport principles, with emphasis on energy transport in stationary and fluid systems. Prerequisite: transition student with instructor approval.

CHE 503 Introduction to Mass Transport. (3)

fall and spring

Application of transport phenomena to mass transfer. Design of mass transfer equipment, including staged processes. Prerequisite: transition student with instructor approval.

CHE 504 Introduction to Chemical Thermodynamics. (3)

fall and spring

Energy relations and equilibrium conversions based on chemical potentials and phase equilibria. Prerequisite: transition student with instructor approval.

CHE 505 Introduction to Chemical Reactor Design. (3)

fall and spring

Application of kinetics to chemical reactor design. Prerequisite: transition student with instructor approval.

CHE 527 Advanced Applied Mathematical Analysis in Chemical Engineering. (3)

fall

Formulation and solution of complex mathematical relationships resulting from the description of physical problems in mass, energy, and momentum transfer and chemical kinetics.

CHE 528 Process Optimization Techniques. (3)

spring

Method for optimizing engineering processes. Experimental design and analysis; linear and nonlinear regression methods; classical, search, and dynamic programming algorithms.

CHE 533 Transport Processes I. (3)*fall*

Unified treatment of momentum, heat, and mass transfer from molecular theory, and continuum points of view. Continuum equations of microscopic and macroscopic systems and multicomponent and multiphase systems. Cross-listed as BME 533. Credit is allowed for only BME 533 or CHE 533.

CHE 534 Transport Processes II. (3)*spring*

Continuation of BME 533 or CHE 533, emphasizing mass transfer. Cross-listed as BME 534. Credit is allowed for only BME 534 or CHE 534. Prerequisite: BME 533 or CHE 533.

CHE 536 Convective Mass Transfer. (3)*not regularly offered*

Turbulent flow for multicomponent systems, including chemical reactions with applications in separations and air pollution. Prerequisite: CHE 533 or MAE 571.

CHE 543 Thermodynamics of Chemical Systems. (3)*fall*

Classical and statistical thermodynamics of nonideal physicochemical systems and processes; prediction of optimum operating conditions. Cross-listed as BME 543. Credit is allowed for only BME 543 or CHE 543.

CHE 544 Chemical Reactor Engineering. (3)*spring*

Reaction rates, thermodynamics, and transport principles applied to the design and operation of chemical reactors. Cross-listed as BME 544. Credit is allowed for only BME 544 or CHE 544. Prerequisite: BME 543 or CHE 543.

CHE 548 Topics in Catalysis. (3)*not regularly offered*

Engineering catalysis, emphasizing adsorption, kinetics, characterization, diffusional considerations, and reactor design. Other topics include mechanisms, surface analyses, and electronic structure.

CHE 552 Industrial Water Quality Engineering. (3)*not regularly offered*

Water pollutants, quality criteria and control, chemical treatment processing, and system design. Case studies. Prerequisite: CHE 331 (or its equivalent).

CHE 553 Air Quality Control. (3)*not regularly offered*

Air pollutant origins, effects, and control. Physical and chemical processes, including dispersion, combustion, sampling, control equipment design, and special topics. Prerequisite: CHE 331 (or its equivalent).

CHE 554 New Energy Technology. (3)*not regularly offered*

Gasification, liquefaction pyrolysis, and combustion processes for coal, wastes, and other raw materials. In-situ processes for coal, oil, shale, and geothermal energy. Environmental quality issues.

CHE 556 Separation Processes. (3)*not regularly offered*

Topics in binary/multicomponent separation, rate governed and equilibrium processes, mass transfer criteria, energy requirements, separating agents and devices, and staged operations.

CHE 558 Electronic Materials. (3)*not regularly offered*

Processing and characterization of electronic materials for semiconductor-type uses. Thermodynamics and transport phenomena, phase equilibria and structure, mass transfer, and diffusion and thermal properties.

CHE 561 Advanced Process Control. (3)*spring*

Dynamic process representation, linear optimal control, optimal state reconstruction, and parameter and state estimation techniques for continuous and discrete time systems.

CHE 563 Chemical Engineering Design. (3)*not regularly offered*

Computational methods; the design of chemical plants and processes.

Omnibus Graduate Courses. See page 50 for omnibus graduate courses that may be offered.

MATERIALS SCIENCE AND ENGINEERING (MSE)**MSE 510 X-ray and Electron Diffraction. (3)***spring*

Fundamentals of X-ray diffraction, transmission electron microscopy, and scanning electron microscopy. Techniques for studying surfaces, internal microstructures, and fluorescence. Lecture, demonstrations. Prerequisite: transition student with instructor approval.

MSE 511 Corrosion and Corrosion Control. (3)*not regularly offered*

Introduction to corrosion mechanisms and methods of preventing corrosion. Topics include: electrochemistry, polarization, corrosion rates, oxidation, coatings, and cathodic protection. Prerequisite: transition student with instructor approval.

MSE 512 Analysis of Material Failures. (3)*not regularly offered*

Identification of types of failures. Analytical techniques. Fractography, SEM, nondestructive inspection, and metallography. Mechanical and electronic components. Prerequisite: transition student with instructor approval.

MSE 513 Polymers and Composites. (3)*fall*

Relationship between chemistry, structure, and properties of engineering polymers. Design, properties, and behavior of fiber composite systems.

MSE 514 Physical Metallurgy. (3)*spring*

Crystal structure and defects. Phase diagrams, metallography, solidification and casting, and deformation and annealing. Prerequisite: transition student with instructor approval.

MSE 515 Thermodynamics of Materials. (3)*not regularly offered*

Principles of statistical mechanics, statistical thermodynamics of single crystals, solutions, phase equilibrium, free energy of reactions, free electron theory, and thermodynamics of defects. Prerequisite: transition student with instructor approval.

MSE 516 Mechanical Properties of Solids. (3)*fall*

Effects of environmental and microstructural variables of mechanical properties, including plastic deformation, fatigue, creep, brittle fracture, and internal friction. Prerequisite: transition student with instructor approval.

MSE 517 Introduction to Ceramics. (3)*fall*

Principles of structure, property relations in ceramic materials. Processing techniques. Applications in mechanical, electronic, and superconducting systems. Prerequisite: transition student with instructor approval.

MSE 518 Integrated Circuits Materials Science. (3)*not regularly offered*

Principles of materials science applied to semiconductor processing and fabrication in metals, ceramics, polymers, and semiconductors. Prerequisite: transition student with instructor approval.

MSE 519 Physical Metallurgy Laboratory. (1)*spring*

Analyzes microstructure of metals and alloys and includes some correlation with mechanical properties. Lab. Pre- or corequisite: MSE 514.

MSE 520 Theory of Crystalline Solids. (3)*not regularly offered*

Anisotropic properties of crystals; tensor treatment of elastic, magnetic, electric and thermal properties, and crystallography of Martensitic transformations.

MSE 521 Defects in Crystalline Solids. (3)*not regularly offered*

Introduction to the geometry, interaction, and equilibrium between dislocations and point defects. Discusses relations between defects and properties. Prerequisite: ECE 350 or instructor approval.

MSE 530 Materials Thermodynamics and Kinetics. (3)*not regularly offered*

Thermodynamics of alloy systems, diffusion in solids, kinetics of precipitation, and phase transformations in solids. Prerequisites: ECE 340, 350.

MSE 540 Fracture, Fatigue, and Creep. (3)*not regularly offered*

Relationship between microstructure and fracture; fatigue and creep properties of materials. Environmental effects and recent developments. Current theories and experimental results. Prerequisite: MSE 440 (or its equivalent).

MSE 550 Advanced Materials Characterization. (3)*not regularly offered*

Analytical instrumentation for characterization of materials; SEM, SIMS, Auger, analytical TEM, and other advanced research techniques.

MSE 556 Electron Microscopy Laboratory. (3)*fall*

Lab support for MSE 558. Cross-listed as SEM 556. Credit is allowed for only MSE 556 or SEM 556. Pre- or corequisite: MSE 558 or SEM 558.

MSE 557 Electron Microscopy Laboratory. (3)*spring*

Lab support for MSE 559. Cross-listed as SEM 557. Credit is allowed for only MSE 557 or SEM 557. Pre- or corequisite: MSE 559 or SEM 559.

MSE 558 Electron Microscopy I. (3)*fall*

Microanalysis of the structure and composition of materials using images, diffraction, X-ray, and energy loss spectroscopy. Requires knowledge of elementary crystallography, reciprocal lattice, stereographic projections, and complex variables. Cross-listed as SEM 558. Credit is allowed for only MSE 558 or SEM 558. Prerequisite: instructor approval.

MSE 559 Electron Microscopy II. (3)*spring*

Microanalysis of the structure and composition of materials using images, diffraction, X-ray, and energy loss spectroscopy. Requires knowledge of elementary crystallography, reciprocal lattice, stereographic projections, and complex variables. Cross-listed as SEM 559. Credit is allowed for only MSE 559 or SEM 559. Prerequisite: instructor approval.

MSE 560 Strengthening Mechanisms. (3)*not regularly offered*

Deformation of crystalline materials. Properties of dislocations. Theories of strain hardening, solid solution, precipitation, and transformation strengthening. Prerequisite: ECE 350 (or its equivalent).

MSE 561 Phase Transformation in Solids. (3)*not regularly offered*

Heterogeneous and homogeneous precipitation reactions, shear displacive reactions, and order-disorder transformation.

MSE 562 Ion Implantation. (3)*not regularly offered*

Includes defect production and annealing. Generalized treatment, including ion implantation, neutron irradiation damage, and the interaction of other incident beams. Prerequisite: MSE 450.

MSE 570 Polymer Structure and Properties. (3)*not regularly offered*

Relationships between structure and properties of synthetic polymers, including glass transition, molecular relaxations, crystalline state viscoelasticity, morphological characterization, and processing.

MSE 571 Ceramics. (3)*not regularly offered*

Includes ceramic processing, casting, molding, firing, sintering, crystal defects, and mechanical, electronic, and physical properties. Prerequisites: MSE 521, 561.

MSE 573 Magnetic Materials. (3)*not regularly offered*

Emphasizes ferromagnetic and ferrimagnetic phenomena. Domains, magnetic anisotropy, and magnetostriction. Study of commercial magnetic materials. Prerequisite: MSE 520 (or its equivalent).

MSE 598 Special Topics. (1-4)*not regularly offered*

Possible topics:

- (a) Growth and Processing of Semiconductor Devices. (3)

Omnibus Graduate Courses. See page 50 for omnibus graduate courses that may be offered.



Larry Duff, an instrument maker/designer in Engineering Technical Services, operates an automated lathe/shaping machine.

John Phillips photo