ASU East

Ben R. Forsyth, M.D.
Interim Provost

The creation of ASU East, the university's third anchor campus, was approved by the State Legislature in 1994 and is located at the former Williams Air Force Base at Williams Field Road and Power Road in Mesa. Starting fall 1996, ASU East is the home campus for the School of Agribusiness and Environmental Resources and the School of Technology, offering the only baccalaureate and master's degree programs of their kind in Arizona. Students in these programs have a choice of upper- and lower-division general education courses offered in partnership with the Maricopa Community College District, and students interested in other majors are able to get a solid program in general education at ASU East. Innovative programs in the arts and sciences and selected professional areas are under development. In addition to classrooms and laboratories, ASU East offers residential life in single family homes and dormitories as well as a computer center, library access, food service, student services and activities, and a full range of athletic and recreational facilities. ASU East will evolve as a residential full-service campus with its own unique character, serving 5,000 to 10,000 students by 2010.

For more information, call 602/965–3278.

School of Agribusiness and Resource Management

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PROFESSORS
CHALQUEST, EDWARDS, GORDON, KAGAN, STILES, THOR

ASSOCIATE PROFESSORS
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PATTERSON, RICHARDS

PROFESSORS EMERITI
BARRETT, LYTLE, MADDY, V. MILLER, MOODY, RASMUSSEN, RICHARDSON, ROBINSON, TAYSOM

PURPOSE

The School of Agribusiness and Resource Management provides academic programs directed toward agribusiness and resource management aspects of agriculture. Agribusiness is a dynamic industry that provides employment to a large percentage of the U.S. labor force. Resource management focuses

on the basics of agriculture management, marketing, and finance to provide a sustainable system for the needs of future generations. Courses in the School of Agribusiness and Resource Management are designed to prepare students for the wide range of job opportunities that exist in the agricultural industries and governmental agencies. The academic programs are especially designed to meet the needs of the urban student who has had little or no previous agriculture experience. An interest in plants, animals, or foods can be the starting point for career development in agricultural industries or resource management. The undergraduate programs also provide the necessary training for students preparing to enter graduate degree programs.

Center for Agribusiness Policy Studies

The Center for Agribusiness Policy Studies carries out research and development relating to agribusiness, rural development, multiple use of scarce resources, and public policy. The center addresses regional, national, and international development in the context of global and competitive markets for agricultural products and inputs. Of particular interest is the development of private sector strategies and public policy alternatives that go beyond traditional government subsidy programs to find innovative, market-oriented ways to enhance competitiveness in international markets, increase rural incomes and create new jobs. A related center concern is the development of "win-win" strategies for resource management and the multiple use of scarce resources by competing interest groups. The goal of such policy development is to resolve or manage conflict regionally, nationally, or globally and to promote long-term, sustainable agriculture in terms of regional economic growth. Of particular interest to the center are innovative rural credit programs for developing nations, strategic marketing to identify profitable "niche" markets and further processing to create jobs and add value to agricultural products. For more information, contact the director of the Center for Agribusiness Policy Studies at 602/965–3585.

DEGREES

Bachelor of Science (B.S.). The School of Agribusiness and Resource Management offers the Bachelor of Science degree in Agribusiness with concentrations in agribusiness (with options in food industry, general agribusiness, and international agribusiness), computer analysis, and pre-veterinary medicine.

Master of Science (M.S.). The School of Agribusiness and Resource Management offers the Master of Science degree in Agribusiness. The program includes research and the preparation of a thesis. A minimum of 30 semester hours of graduate-level course work is required for the degree. Additional details for this degree are given in the *Graduate Catalog.*

ADMISSION

See pages 47–52, 63–64, and 264–265 for information regarding requirements for admission, transfer, retention, disqualification, and reinstatement.

In addition, students who are beginning their initial college work in the School of Agribusiness and Resource Management should present secondary school units in accordance with the minimum university requirements. There are no secondary school agricultural course requirements.

DEGREE REQUIREMENTS

The completion of a minimum of 120 semester hours—including First-Year Composition, General Studies, the school and major cores and option courses—leads to the B.S. degree. An overall GPA of 2.00 is required. Of the semester hours required for graduation, a minimum of 50 semester hours must be upper division. Also see special graduation requirements under the pre-veterinary medicine concentration described on pages 423–424.

GRADUATION REQUIREMENTS

In addition to fulfilling school and major requirements, majors must satisfy the General Studies requirement as noted on pages 71–74 and all university graduation requirements as noted on pages 66–70, including First-Year Composition.

See pages 74–94 for a list of approved General Studies courses. Students should consult with a school academic advisor on courses that are most appropriate for fulfilling the various requirements.

MAJOR

The Agribusiness major is an applied, industry-oriented curriculum. The study of animals, plants, and their utilization in the food and fiber system forms the base of the program. Students learn to analyze firms involved in input supply activities, commodity processing, food manufacturing, and food distribution. Students also study government agricultural programs and national policy activities that affect agribusiness. Because of the U.S. role in supplying commodity and food products to the world markets, international aspects of agribusiness development and trade are emphasized.

The baccalaureate degree requirements in Agribusiness include the General Studies, the Agribusiness core, a proficiency core, the major core, and the option courses and elective courses to complete the graduation requirement of 120 semester hours. Before entering the junior year, each student, with the aid of an advisor, is expected to select an option.

COURSE REQUIREMENTS

All students pursuing a B.S. degree in the School of Agribusiness and Resource Management must satisfy First-Year Composition and General Studies requirement as follows:

First-Year Composition

ENG 101, 102 First-Year Composition* 6
or ENG 105 Advanced First-Year Composition (3)

General Studies

Literacy and Critical Inquiry
L1 course 3
AGB 444 Agribusiness Analysis *L2*..... 3

*Numeracy**
Numeracy courses 6

*See the school academic advisor for approved courses.

NOTE: For the General Studies requirement, codes (such as L1, N3, C, and H), and courses, see pages 71–94. For graduation requirements, see pages 66–70. Omnibus courses are offered that are not listed in the catalog; see pages 44–45.

Humanities and Fine Arts and Social and Behavioral Sciences
(15 semester hours minimum)
At least one course must be upper division, two courses must be from the same department, and two departments or more must be represented in the total selection.
HU courses 6–9
SB courses 6–9

*Natural Sciences**
S1/S2 courses 8

Total General Studies 35

*See the school academic advisor for approved courses.

Six semester hours taken in two of the three awareness areas are required in the final list of courses offered in the student's graduation program of study. If desired, these courses can be included in the HU and SB course selections.

Agribusiness Core

All students pursuing a B.S. degree in the school must complete the following general core courses:

AGB	300	Livestock Management 3
AGB	302	Introduction to Agribusiness 3
AGB	310	Crop Management 3
Total		9

The following proficiency core courses are required of all students except those in the pre-veterinary medicine option:

BIO	100	The Living World *S1/S2*..... 4
		or BIO 181 General Biology *S1/S2* (4)
CHM	101	Introductory Chemistry *S1/S2* 4
		or CHM 113 General Chemistry *S1/S2* (4) and CHM 115 General Chemistry with Qualitative Analysis *S1/S2* (5)
ECN	111	Macroeconomic Principles *SB* 3
MAT	117	College Algebra *N1*..... 3
		or MAT 210 Brief Calculus *N1* (3)
Computer course*		3
Total		17

*A list of acceptable courses is available in the School of Agribusiness and Resource Management Office.

AGRIBUSINESS

The Agribusiness major offers several concentrations and options. It combines business and technical agriculture as they relate to the management, marketing, and financial objectives of agribusiness firms. Topics of interest include the supplying of input resources and services to agricultural producers, the management of crop and livestock enterprises, the processing of raw agricultural products and the management and quality assurance of food manufacturing. Food distribution is examined from the points of view of food wholesalers and retailers as well as food service firms, which include restaurants and specialized food firms. The study of agribusiness also includes analysis of the critical roles of government in regulating certain aspects of agribusiness and promoting international trade in agribusiness products.

Agribusiness. The agribusiness concentration contains the general agribusiness, international agribusiness, and food industry options.

General agribusiness integrates the knowledge and skills needed to manage people, products, and services in agribusiness enterprises. Agribusiness management combines the agricultural sciences, behavioral science, and common sense. Functional, institutional, and behavioral aspects of marketing are examined while studying the flows of products and services through the various market channels for agricultural inputs, commodities, and food. Emphasis is placed on up-to-date management/marketing methods that allow graduates to meet challenges in the food and fiber industries. Graduates are qualified to make significant contributions in a broad range of career opportunities that exist in agribusiness. Many start career paths that lead to upper-level agribusiness management/marketing positions.

International agribusiness relates worldwide agricultural resources to the requirements and potentials of the various nations. Particular emphasis is given to economic development and to the international trade of food and fiber products. Special courses are offered to form a unique curriculum that is designed to train either the U.S. or foreign student to work in the enhancement of agricultural programs of foreign countries. Provided is a basic knowledge of U.S. agricultural techniques that is extended to the global aspects of agriculture. Graduates in this area are particularly qualified to aid in the development of the world's agricultural potential to provide food to meet the expanding populations. Jobs exist in commercial industries and in government agencies—national, international, and foreign. A language capability in addition to English is recommended.

Food industry focuses on the scientific and technical competence required for employment in this field. Strong emphasis is given to basics such as chemistry, food processing, and food safety. This unique program offers employment opportunities for graduates in food industries, regulatory agencies, and consumer organizations.

Students selecting the agribusiness concentration are required to take the following courses:

AGB	312	Agribusiness Marketing 3
AGB	332	Agribusiness Finance 3
AGB	342	Agribusiness Management I..4
AGB	364	Agribusiness Technology.....3
AGB	390	Agribusiness Accounting 3
		or ACC 230 Introductory Accounting I (3)
AGB	412	Agricultural Commodities.....3
AGB	444	Agribusiness Analysis *L2*..... 3
AGB	490	Recent Advances in Agribusiness 1
Total		23

Also recommended are:

AGB	443	Agribusiness Management II 3
AGB	455	Agricultural Marketing Channels 3
AGB	458	International Agribusiness *G* 3
AGB	474	Agribusiness Policy and Government Regulations.....3
ECN	112	Microeconomic Principles *SB* 3

Typical Curriculum for the Agribusiness Concentration

First Year

AGB	101	Food Chain *G* 2
CHM	101	Introductory Chemistry *S1/S2* 4
ENG	101, 102	First-Year Composition 6
MAT	117	College Algebra *N1*..... 3
General elective courses		9
SB awareness area courses		6
Total		30

Second Year

AGB	302	Introduction to Agribusiness	3
AGB	390	Agribusiness Accounting	3
ECN	111	Macroeconomic Principles *SB*	3
ECN	112	Microeconomic Principles *SB*	3
Agribusiness electives courses			6
General elective courses			6
HU awareness area courses			6
Total			30

Third Year

AGB	300	Livestock Management	3
AGB	310	Crop Management	3
AGB	312	Agribusiness Marketing	3
AGB	332	Agribusiness Finance	3
AGB	342	Agribusiness Management I	4
AGB	364	Agribusiness Technology	3
Numeracy elective *N2/N3*			3
Option courses			6
Electives			3
Total			31

Fourth Year

AGB	412	Agricultural Commodities	3
AGB	443	Agribusiness Management II	3
AGB	444	Agribusiness Analysis *L2*	3
AGB	455	Agricultural Marketing Channels	3
AGB	458	International Agribusiness *G*	3
AGB	474	Agribusiness Policy and Government Regulations	3
AGB	490	Recent Advances in Agribusiness	1
General elective courses			4
Option courses			6
Total			29

Pre-veterinary Medicine. This concentration is primarily designed to meet the entrance requirements of professional veterinary medical schools in the United States and Canada. Selection of this area permits students to complete the pre-veterinary requirements for entrance to professional veterinary school. The curriculum permits the student to obtain some course work in agribusiness, especially as it relates to professional practice and industry. This background also provides an important alternative for the student who does not actually enter veterinary school. Com–pletion of all requirements for a B.S. degree in Agribusiness at ASU is provided by completing additional credits, if desired. A pre-veterinary medicine student who has been accepted to a school of veterinary medicine and who also elects to earn a B.S. degree in the School of Agribusiness and Resource Management may do so by completing a minimum of 30 semester hours at ASU and by completing the school requirements and the General Studies requirement. The student may then receive a written statement from the dean of the College of Engineering and Applied Sciences giving senior-in-absentia privileges. The student is eligible to receive the B.S. degree after the Office of the Registrar receives a recommendation from the dean of the professional school and a transcript of credit indicating the student has completed a total of 120 semester hours with a cumulative GPA of 2.00 or better.

Although this concentration is primarily intended for the student preparing to enter professional veterinary medicine as a career, it is also an excellent basis for future graduate degree programs or many of the scientifically related jobs in agribusiness and government.

Students selecting the pre-veterinary medicine concentration are required to take these proficiency core courses:

BIO	181, 182	General Biology *S1/S2*	8
CHM	113	General Chemistry *S1/S2*	4
CHM	115	General Chemistry with Qualitative Analysis *S1/S2*	5
CHM	231	Elementary Organic Chemistry *S1/S2*[1] or CHM 331 General Organic Chemistry, 335 General Organic Chemistry Laboratory, 332 General Organic Chemistry, and 336 General Organic Chemistry Laboratory (8)	4
MAT	117	College Algebra *N1* or MAT 210 Brief Calculus (3)	3
MIC	206	Microbiology Laboratory *S2*[2]	1
MIC	220	Biology of Microorganisms	3
Total			28

[1] Both CHM 231 and 235 must be taken to secure S1 or S2 credit.

[2] Both MIC 205 and 206 must be taken to secure S2 credit.

Typical Curriculum for the Pre-veterinary Medicine Concentration

First Year

CHM	113	General Chemistry *S1/S2*	4
CHM	115	General Chemistry with Qualitative Analysis *S1/S2*	5
ENG	101, 102	First-Year Composition	6
MAT	117	College Algebra *N1* or MAT 210 Brief Calculus *N1* (3)	3
HU, SB awareness area courses			12
Total			30

Second Year

AGB	300	Livestock Management	3
AGB	353	Wildlife and Domestic Animal Nutrition	3
BIO	181, 182	General Biology *S1/S2*	8
CHM	231	Elementary Organic Chemistry *S1/S2*[1] or CHM 331 General Organic Chemistry, 335 General Organic Chemistry Laboratory, 332 General Organic Chemistry, and 336 General Organic Chemistry Laboratory (8)	4
General elective courses (upper division)			9
HU awareness area courses			3
Total			30–34

Third Year[2]

AGB	439	Veterinary Practices	3
BIO	340	General Genetics	4
CHM	361	Principles of Biochemistry	3
CHM	367	Elementary Biochemistry Laboratory	1
MIC	206	Microbiology Laboratory *S2*[3]	1
MIC	220	Biology of Microorganisms	3
PHY	111, 112	General Physics *S1/S2*[4]	6
PHY	113, 114	General Physics Laboratory *S1/S2*[4]	2
General elective courses			3
Numeracy elective *N2/N3*			3
Total			29

[1] Both CHM 231 and 235 must be taken to secure S1 or S2 credit.

[2] See "Veterinary College Acceptance" after this table.

[3] Both MIC 205 and 206 must be taken to secure S2 credit.

[4] Both PHY 111 and 113 or PHY 112 and 114 must be taken to secure S1 or S2 credit.

NOTE: For the General Studies requirement, codes (such as L1, N3, C, and H), and courses, see pages 71–94. For graduation requirements, see pages 66–70. Omnibus courses are offered that are not listed in the catalog; see pages 44–45.

Fourth Year[2]

General elective courses	4
Supporting courses (AGB)	15
Upper-division courses	12
Total	31

[2] See "Veterinary College Acceptance" after this table.

Veterinary College Acceptance. Assuming the student has applied and has been accepted to a veterinary college during the beginning of the third year, the courses from the first year of the veterinary program are substituted for the classes of the fourth year for the B.S. degree.

AGRIBUSINESS

AGB 101 Food Chain. (2) F
Dependence of the quality, quantity, and cost of national food supplies on technology, marketing, and world agricultural policies. *General Studies: G.*

150 Animal Science. (3) F
Comparative growth, development, and propagation of farm animals. Lecture, lab.

160 Veterinary Medicine Today. (3) F
Introduction to the role of the veterinarian as related to the fields of food supply and veterinary medicine.

300 Livestock Management. (3) F
Methods of managing livestock enterprises, economics, loss prevention, and marketing. Prerequisites: BIO 100.

302 Introduction to Agribusiness. (3) F
Impact of national policy and world agriculture on the cost, quantity, and quality of the U.S. food resources.

305 Cultural Diversity in Agribusiness. (3) F, S
A critical look at how different cultural traditions as practiced in the Southwest have impacted and continue to shape regional agricultural economies. Prerequisites: ENG 101, 102.

310 Crop Management. (3) S
Crop production, management principles, and their application to crop growth and development. Prerequisites: BIO 100.

312 Agribusiness Marketing. (3) F
Marketing arrangements for agricultural products. Prerequisite: ECN 111.

332 Agribusiness Finance. (3) S
Agribusiness investment management and financial institutions that serve agriculture. Prerequisites: ECN 111.

335 Establishing an Agribusiness. (3) F
Establishing entrepreneurship in agriculture, including legal status, financing, planning, marketing, and management. Prerequisite: junior standing.

342 Agribusiness Management I. (4) S
Principles of management, including planning, organizing, integrating, measuring, and developing people in agribusiness organizations. Lecture, computer lab.

353 Wildlife and Domestic Animal Nutrition. (3) S
Feedstuffs, feeding standards, and their application in meeting nutritional needs of animals producing food and fiber.

364 Agribusiness Technology. (3) S
Biotechnology and other technologies of the three sectors of agribusiness, including input, production, and commodity/food processing and distribution. Prerequisites: BIO 100.

368 Food Processing. (3) F
An introduction to processed food quality assurance, statistical sampling, and inspection procedures. Prerequisites: AGB 364.

369 Food Analysis. (3) F
Processing control and scientific instrumentation used in food quality assurance laboratories. Lecture, lab. Prerequisites: CHM 101.

390 Agribusiness Accounting. (3) N
Introduction to managerial accounting for agribusiness using computerized accounting systems for the development of financial data required for management decision making Prerequisite: computer literacy.

402 Agricultural Cooperatives. (3) N
Organization, operation, and management of agricultural cooperatives.

404 Sales and Merchandising in Agribusiness. (3) N
The principles and techniques of selling and commodity merchandising in the agricultural industries.

412 Agricultural Commodities. (3) F
Trading on futures markets. Emphasis on the hedging practices with grains and meats. Prerequisite: AGB 312 or 1 marketing or finance course.

413 Financial Commodities. (3) S
Trading on futures markets. Emphasis on the hedging practices with financial and currency instruments. Prerequisite: AGB 332 or FIN 300.

414 Advanced Commodity Trading. (3) N
Advanced analysis of trading techniques, with emphasis on hedging in the futures markets. Prerequisite: AGB 412 or 413.

423 Food and Industrial Microbiology. (4) F
Food and industrial related microorganisms; deterioration and preservation of industrial commodities. Lecture, lab. Prerequisite: MIC 205 or 206 or instructor approval.

424 Food and Industrial Fermentations. (4) S
Management, manipulation, and metabolic activities of industrial microbial cultures and their processes. Lecture, lab. Prerequisite: AGB 423 or instructor approval.

425 Food Safety. (3) S
Control, prevention, and prediction of microbial and chemical food borne diseases. Prerequisite: AGB 423 or instructor approval.

426 Food Chemistry. (4) S
The biochemical and chemical interactions that occur in raw and processed foods. Lecture, lab. Prerequisites: CHM 115, 231.

428 Comparative Nutrition. (3) N
Effects of nutrition on animal systems and metabolic functions. Prerequisite: CHM 231.

433 Diseases of Domestic Animals. (3) N
Control and prevention of infectious and noninfectious diseases of domestic animals. Prerequisite: MIC 206 or 220.

435 Animal Physiology I. (4) F
Control and function of the nervous, muscular, cardiovascular, respiratory, and renal systems of domestic animals. Prerequisites: BIO 181; CHM 113.

439 Veterinary Practices. (3) F, S
Observation of and participation in veterinary medicine and surgery supervised by local veterinarians. Prerequisite: advanced pre-veterinary student.

440 Food Marketing. (3) S
Food processing, packaging, distribution, market research, new food research and development, and social implications. Prerequisite: AGB 312.

443 Agribusiness Management II. (3) F
Principles of human resource management, with emphasis on the special problems of agribusiness systems. Prerequisite: AGB 302.

444 Agribusiness Analysis. (3) S
Analysis of agribusiness firm decisions in the ecological, economic, social, and political environments. Special emphasis on ethical issues surrounding food production and consumption. Prerequisites: AGB 312 and 332 *or* equivalents. *General Studies: L2.*

450 International Agricultural Development. (3) F
Transition of developing countries from subsistence to modern agriculture. Technology transfer and food improvement programs are emphasized. *General Studies: G.*

452 World Food Dynamics. (3) N
Transition and development of raw agricultural commodities into nutritional food products. Emphasis given to food expansion in developing countries. *General Studies: G.*

453 World Agricultural Resources. (3) S
World production and consumption of agricultural products, international relationships, and agencies concerned with world agricultural development problems. *General Studies: G.*

454 International Agricultural Trade. (3) N
Dimensions, locations, mix, methods, and changes of international trade in agricultural products. Prerequisite: AGB 312.

455 Agricultural Marketing Channels. (3) S
Operational stages of agricultural commodities in normal distribution systems and implementation of marketing strategies. Prerequisite: AGB 312.

458 International Agribusiness. (3) N
Identification and analysis of methods, problems, and future of international agribusiness operations. Emphasizes special problems associated with international agribusiness systems. Prerequisite: AGB 312. *General Studies: G.*

460 Agribusiness Management Systems. (4) S
The development and use of decision support systems for agribusiness management and marketing. Lecture, lab. Prerequisite: AGB 302.

474 Agribusiness Policy and Government Regulations. (3) F
The development and implementation of government food, drug, pesticide, and farm policies and regulations that affect the management of agribusiness. Prerequisite: AGB 302.

490 Recent Advances in Agribusiness. (1) F, S
Reports and discussions of current topics and problems associated with agribusiness. May be repeated for credit.

505 Commodity Analysis. (3) N
Analysis of commodity markets. Prerequisite: 1 year of economics or marketing.

508 Advanced Agribusiness Marketing. (3) F
Theory and analysis of marketing farm commodities, risks, and the effect of future trading on cash prices.

509 Advanced Agribusiness Marketing Channels. (3) S
Analysis of agribusiness market channel systems. Formulation of marketing strategies.

510 Advanced Agribusiness Management I. (4) F
Managing and financing agribusiness emphasizing environmental and economic sustainability in a global economy undergoing radical change. Prerequisite: AGB 342.

511 Advanced Agribusiness Management II. (3) S
Analysis of organization behavior, change, and resource requirements within agribusiness systems. Prerequisite: AGB 342.

512 Food Industry Management. (3) S
Operations and management of food-processing factories, food distribution centers, and retail food-handling firms.

516 International Agricultural Techniques. (3) N
Coordination of production and marketing techniques to consumption objectives with agricultural products in foreign countries.

518 World Agricultural Development. (3) N
Factors that influence production, processing, and marketing of agricultural products in developing countries.

520 Advanced Agribusiness Analysis I. (4) S
Vertical integration and differentiation in food and agricultural industries. Lecture, recitation. Prerequisites: AGB 508 or 510.

521 Agribusiness Coordination. (4) N
Organizational alternatives for agribusiness, with emphasis on cooperatives and trading companies. Lecture, recitation. Prerequisites: AGB 508 or 510.

525 Advanced Agribusiness Management Systems. (3) N
Development and use of decision support systems for agribusiness management decision making. Prerequisite: AGB 510.

527 Agribusiness Research Methods. (3) N
The use of model building, hypothesis testing, and empirical analysis in solving agribusiness problems.

530 Advanced Agribusiness Policy. (3) N
Policy-making history, structure, and process. Prerequisite: AGB 342.

532 Advanced Agribusiness Finance. (3) F
Financial management of agribusiness firms; agribusiness financial analysis, investment analysis, agricultural risk management, and introduction to agricultural financial intermediaries. Prerequisites: computer literacy and 1 finance course *or* instructor approval.

535 Advanced Food Science. (3) N
Chemical and physical nature of processed foods. Emphasis on food product development. Prerequisite: AGB 364.

School of Technology

Albert L. McHenry
Director
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PURPOSE

The primary purpose of the school is to provide students the opportunity to obtain a quality education in technology and to qualify them directly for positions of leadership and responsibility in industrial, commercial, educational, and government activity.

The technology programs provide the opportunity to earn a degree that stresses theory reinforced by laboratory application—a more applied approach than engineering students experience. The technology programs assist in preparing for challenging career opportunities in industry and government for the forward-looking student. The technology graduate in industry becomes a member of the total engineering effort, contributing an applications orientation to complement the engineer's more theoretical concepts. The student is educated to render practical decisions with safety and economy in mind, to install and operate technical systems, to develop or improve a product, to revise systems, and to provide customer support when needed.

DEGREES

Bachelor of Science degree programs and options within each major are offered in the three departments as shown on pages 266–268. Each curriculum includes some elective courses that are reserved for the student's use to add a unique emphasis or dimension. These credits are traditionally referred to as technical electives and are normally restricted to upper-division courses in technology, engineering, and computer science. In each case, the choice of technical electives must be approved by the student's faculty advisor and department chair. Requirements for each of the majors offered are described on the following pages.

In addition to the undergraduate degrees offered in the School of Technology, the Master of Technology degree (M.Tech.) is offered by each of the three departments in technology in accordance with the details given on page 269. See the *Graduate Catalog* for complete details.

ADMISSION

See pages 47–52, 63–64, and 264–265 for information regarding requirements for admission, transfer, retention, disqualification, and reinstatement.

A preprofessional category is available for applicants deficient in regular admission requirements.

Entry into a program in one of the departments of technology as a freshman student requires three years of high school math (algebra I and II and geometry). High school chemistry and physics are recommended. Students without the required math background must take appropriate deficiency courses before entry or immediately upon enrollment at ASU. Associate degree transfer students are expected to have completed college algebra and trigonometry.

Students who begin their college education at institutions other than ASU with intent to transfer to ASU should consult the given major requirements and seek equivalent courses at the transfer institution. Any transfer courses from a community college are applied only as lower-division credit.

The GPA requirement for admission of transfer students into the School of Technology is 2.25 for Arizona residents and 2.50 for nonresidents. The freshman and sophomore programs of study are designed to facilitate transfer of junior and community college students or associate degree graduates.

In addition, international students are required to have a TOEFL score of 500 for admission to a technology major.

DEGREE REQUIREMENTS

All baccalaureate degree programs in the School of Technology require completion of the university First-Year Composition requirement, a General Studies component, and a core component related to each program. The engineering technology programs also require completion of an engineering

technology core. Refer to the individual department descriptive material for specific departmental degree requirements. All programs require a minimum of 128 semester hours.

Graduation Requirements

In order to qualify for graduation from the School of Technology, a student must have an overall GPA of at least 2.00 and a GPA of at least 2.00 for the required courses in the major field.

Course Requirements

The specific course requirements for First-Year Composition, General Studies, technology core, and the engineering technology core are listed below. Refer to the individual majors or options for their additional required courses.

First-Year Composition

ENG	101, 102	First-Year Composition	6
		or ENG 105 Advanced First-Year Composition (3)	

General Studies

Literacy and Critical Inquiry

ITC	200	Impact of Communication Technology in Society *L1*	3
ETC	400	Technical Communications *L2*	3

Numeracy

ETC	100	Languages of Technology	4
MAT	170	Precalculus *N1*	3

Humanities and Fine Arts and Social and Behavioral Sciences
(15 semester hours minimum)
At least one course must be of upper-division level, two courses must be from the same department, and two or more departments must be represented in total selection.

HU and awareness area courses			6–9
SB and awareness area course(s)			3–6
ECN	111	Macroeconomic Principles *SB*	3

Natural Sciences

PHY	111	General Physics *S1/S2*[1]	3
PHY	112	General Physics *S1/S2*[2]	3
PHY	113	General Physics Laboratory *S1/S2*[1]	1
PHY	114	General Physics Laboratory *S1/S2*[2]	1
Total General Studies			36

[1] Both PHY 111 and 113 must be taken to secure S1 or S2 credit.

[2] Both PHY 112 and 114 must be taken to secure S1 or S2 credit.

Engineering Technology Core

The following courses constitute the engineering technology core and are required in all baccalaureate degree programs in the engineering technologies:

CHM	113	General Chemistry or CHM 114 General Chemistry for Engineers (4)	4
ETC	201	Applied Electrical Science or EET 208 Electric Circuits (3)	4
ETC	211	Applied Engineering Mechanics: Statics	3
ETC	340	Applied Thermodynamics and Heat Transfer	3
MAT	260	Technical Calculus I *N1*	3
MAT	261	Technical Calculus II	3
Total			19–20

PROFESSIONAL ACCREDITATION AND AFFILIATIONS

The undergraduate programs in Aeronautical Engineering Technology, Electronics Engineering Technology, and Manufacturing Engineering Technology are accredited by the Technology Accreditation Commission of the Accreditation Board for Engineering and Technology.

SPECIAL PROGRAMS

ASU 2+2 Programs. The School of Technology maintains a cooperative agreement with most community colleges within Arizona and also with selected out-of-state colleges and universities to structure courses that are directly transferable into the technology programs at ASU.

ENGINEERING TECHNOLOGY CORE

ETC 100 Languages of Technology. (4) F, S
Introduction to computer-aided design, programming, modeling, and technical documentation. Lecture, lab.

201 Applied Electrical Science. (4) F, S, SS
Principles of electricity, passive elements, and d-c/a-c circuit analysis. Laboratory exploration of circuits using instrumentation and the computer as tools. Lecture, lab. Prerequisites: ETC 100; MAT 170; PHY 112, 114.

211 Applied Engineering Mechanics: Statics. (3) F, S, SS
Vectors, forces and moments, force systems, equilibrium, analysis of basic structures and structural components, friction, centroids, and moments of inertia. Prerequisites: MAT 261 or equivalent; PHY 111, 113.

340 Applied Thermodynamics and Heat Transfer. (3) F, S
Thermodynamic systems and processes, first and second laws of thermodynamics, properties of pure substances, and applications to heat engines and special systems. Fundamentals of conduction, radiation, and convection. Prerequisites: MAT 261; PHY 112, 114.

400 Technical Communications. (3) F, S, SS
Planning and preparing technical publications and oral presentations based on directed library research related to current technical topics. Prerequisites: completion of first-year English requirements; L1 course; senior standing as a CEAS major. *General Studies: L2.*

Department of Aeronautical Technology

William K. McCurry
Program Coordinator
(ASU East) 602/965–7775

PROFESSOR
GESELL

ASSOCIATE PROFESSORS
McCURRY, REED

ASSISTANT PROFESSOR
JACKSON

LECTURERS
DOUGLAS, HOMAN, KARP, SPENCE

PROFESSORS EMERITI
CARLSEN, COX, MATTHEWS, PEARCE, ROPER, SALMIRS, SCHOEN, THOMASON

The Department of Aeronautical Technology offers two majors leading to a Bachelor of Science degree. The majors are Aeronautical Management Technology and Aeronautical Engineering Technology. The Aeronautical Management Technology major includes options in airway science aircraft systems management, airway science management, and *ab initio* airline pilot flight management.

Graduates are prepared for entry into the aviation and aerospace industry in productive, professional employment or, alternatively, for graduate study. The curricula emphasize the recognized principles underlying the application of technical knowledge as well as current technology, preparing the graduate to adapt to the rapid and continual changes in aviation and aerospace technology.

Admission

New and transfer students who have been admitted to the university, who meet the requirements for admission to the School of Technology, and who have selected Aeronautical Technology are admitted to Aeronautical Technology without separate application to the Department of Aeronautical Technology. Transfer credits are reviewed by department faculty advisors. To be acceptable for department credit, transfer courses must be equivalent in both content and level of offering.

Identified Lower-Division Courses

The 48 semester hours of *identified lower-division courses,* listed below, should be completed satisfactorily before any upper-division courses can be taken. Each of the *identified lower-division courses* must be completed with a grade of C or better.

Identified Lower-Division Courses

AET	182	Private Pilot Ground School	3
		or AET 184 *Ab Initio* Theoretical Preparation I (3)	
AET	280	Aeronautical Structures, Materials, and Systems	4
AET	287	Aircraft Powerplants	4
CHM	114	General Chemistry for Engineers *S1/S2*	4
CSE	181	Applied Problem Solving with BASIC *N3*	3
		or CSE 183 Applied Problem Solving with FORTRAN *N3* (3)	
ECN	111	Macroeconomic Principles *SB*	3
ENG	101	First-Year Composition	3
ENG	102	First-Year Composition	3
ETC	100	Languages of Technology	4
MAT	170	Precalculus *N1*	3
MAT	260	Technical Calculus I *N1*	3
PGS	101	Introduction to Psychology *SB*	3
PHY	111	General Physics *S1/S2*[1]	3
PHY	112	General Physics *S1/S2*[2]	3
PHY	113	General Physics Laboratory *S1/S2*[1]	1
PHY	114	General Physics Laboratory *S1/S2*[2]	1
Total			48

[1] Both PHY 111 and 113 must be taken to secure S1 or S2 credit.

[2] Both PHY 112 and 114 must be taken to secure S1 or S2 credit.

AERONAUTICAL MANAGEMENT TECHNOLOGY—B.S.

The Aeronautical Management Technology curriculum is designed to provide a thorough technical background combined with an interdisciplinary general university education. The graduate is prepared to assume responsibilities in a wide area of managerial and technically related areas of aviation. The student gains a background in aircraft structures, reciprocating and turbine engines, aircraft performance, design, management skills, business principles, systems analysis, and a variety of course work specific to aircraft flight, airport operations, and air transportation systems. The degree offers three options: *ab initio* airline pilot flight management, airway science management, and airway science aircraft systems management. Airway science management and airway science aircraft systems management curricula have the approval of the Federal Aviation Administration as airway science programs and can lead to employment in that agency. The options are described separately below.

All degree requirements are shown on Curriculum Check Sheets for the options. The requirements (see pages 277–278) include First-Year Composition, General Studies, technology core, and aeronautical management technology core. Refer to the individual option degree requirements for additional required courses.

Aeronautical Management Technology Core

AET	182	Private Pilot Ground School	3
AET	280	Aero Structures, Materials, and Systems	4
AET	287	Aircraft Powerplants	4
AET	342	Aviation Law/Regulations	3
CSE	181	Applied Problem Solving with BASIC	3
		or CSE 100 Introduction to Computer Science (3) or CSE 183 Applied Problem Solving with FORTRAN (3)	
ETC	100	Languages of Technology	4
ETC	201	Applied Electrical Science	4
MET	230	Engineering Materials	3
Total			28

Ab Initio Airline Pilot Flight Management Option

Flight training is certified by the Federal Aviation Administration.

Ab initio airline pilot flight management combines academic studies and flight training to prepare graduates for positions within the air transportation industry, primarily in the area of flight operations. Theoretical preparation and flight training are specifically intended to prepare the student for employment in the scheduled airline industry.

This curriculum concentrates on flying plus the technical, management, and computer-related applications necessary to operate in the high-density environment of modern airspace. The program emphasizes critical thinking and cognitive, analytical, and communication skills. The career option leads to airline piloting and the development, administration, and enforcement of safety regulations including airworthiness and operational standards in civil aviation.

Ground classes and flight training in the *ab initio* airline pilot flight management option are tightly integrated and highly organized as a single, continuous training program. Each student begins actual flight training with the first lesson of the flight training syllabus and completes each lesson block in sequence, throughout the training. Flight experience and certificates received before entering *ab initio* training at ASU may or may not allow the individual student to progress more easily through the training, but may not be used to replace training requirements in the ASU program.

While enrolled at ASU, students do not receive college credit for flight instruction received at flight schools other than schools under contract with the university for *ab initio* flight instruction.

Flight instruction costs are not included in university tuition and fees. The estimated cost of ab initio flight training is $60,000 in addition to normal university costs.

Degree Requirements

Ab initio airline pilot flight management students are required to complete a minimum of 128 semester hours, including at least 50 semester hours of upper-division courses. Students in the *ab initio* airline pilot flight management option must also successfully complete qualification screening examinations before beginning *ab initio* flight training. Qualification screening includes a first-class medical examination, psychological evaluation, and a psychomotor skills tests. Students who do not pass the qualification screening examinations but are otherwise qualified may continue in Aeronautical Engineering Technology or in Aeronautical Management Technology, in either the airway science management option or the airway science aircraft systems management option.

Course Requirements

All degree requirements are shown on the student's Curriculum Check Sheet.

In addition to the required courses (see pages 277–278) for First-Year Composition, General Studies, and the aeronautical management technology core, the following additional courses are required:

AET	183	Private Pilot Certificate	1
AET	220	Aviation Meteorology	3
AET	222	Instrument Pilot Ground School	3
AET	300	Aircraft Design I	3
AET	304	*Ab Initio* Theoretical Preparation II	6
AET	314	Commercial Pilot Ground School	3
AET	324	*Ab Initio* Theoretical Preparation III	6
AET	330	*Ab Initio* Theoretical Preparation IV	3
AET	335	*Ab Initio* Airline Pilot Flight Training II	2
AET	362	*Ab Initio* Theoretical Preparation V	6
AET	363	*Ab Initio* Airline Pilot Flight Training III	6
AET	382	Air Navigation	3
AET	387	Multi-engine Ground School	3
AET	462	*Ab Initio* Theoretical Preparation VI	6
AET	463	*Ab Initio* Airline Pilot Flight Training IV	6
AET	487	Aircraft Design II	3
CHM	114	General Chemistry for Engineers *S1/S2*	4
MAT	260	Technical Calculus I *N1*	3

Suggested Course Pattern for Freshmen

First Semester

AET	182	Private Pilot Ground School	3
ECN	111	Macroeconomic Principles *SB*	3
ENG	101	First-Year Composition	3
MAT	170	Precalculus *N1*	3
PHY	111	General Physics *S1/S2*[1]	3
PHY	113	General Physics Laboratory *S1/S2*[1]	1
Total			16

Second Semester

AET	183	Private Pilot Certificate	1
AET	220	Aviation Meteorology	3
ENG	102	First-Year Composition	3
ETC	100	Languages of Technology	4
MAT	260	Technical Calculus I *N1*	3
PHY	112	General Physics *S1/S2*[2]	3
PHY	114	General Physics Laboratory *S1/S2*[2]	1
Total			18

[1] Both PHY 111 and 113 must be taken to secure S1 or S2 credit.

[2] Both PHY 112 and 114 must be taken to secure S1 or S2 credit.

Airway Science Aircraft Systems Management Option

Flight training is certified by the Federal Aviation Administration.

Airway science aircraft systems management combines academic studies and flight training to prepare graduates for a wide variety of positions within the air transportation industry, including military, airline, and general aviation. Ground school and flight training are available, allowing the student to obtain private pilot, commercial pilot, and flight instructor certificates and also the instrument pilot, instrument instructor, and multiengine pilot ratings. Type rating in the Boeing 737 airliner is optionally available.

This curriculum concentrates on flying plus the technical, management, and computer-related applications necessary to operate in the high-density environment of modern airspace. This career leads to the development, administration, and enforcement of safety regulations, including airworthiness and operational standards in civil aviation. The program emphasizes critical thinking, and cognitive, analytical, and communication skills. The airway science aircraft systems management option is approved by the Federal Aviation Administration as an Airway Science Program.

While enrolled at ASU, students do not receive college credit for flight activity or instruction received at flight schools other than schools with which the university has currently contracted for such instruction. Consideration is given for flight experience received before enrollment at the university. *Flight instruction costs are not included in university tuition and fees. The estimated cost of flight training is $25,000 in addition to normal university costs.*

Degree Requirements

Airway science flight systems management students are required to complete a minimum of 128 semester hours, including at least 50 semester

hours of upper-division courses. All degree requirements are shown on the student's Curriculum Check Sheet.

Course Requirements

In addition to the required courses (see pages 277–278) for First-Year Composition, General Studies, the technology core, and the aeronautical management technology core, the following additional courses are required:

AET	183	Private Pilot Certificate	1
AET	220	Aviation Meteorology	3
AET	222	Instrument Pilot Ground School	3
AET	283	Instrument Pilot Rating	1
AET	300	Aircraft Design I	3
AET	308	Air Transportation *G*	3
AET	314	Commercial Pilot Ground School	3
AET	344	Airport Management and Planning	3
AET	382	Air Navigation	3
AET	383	Commercial Pilot Certificate	2
AET	385	Flight Instructor Ground School	3
AET	386	Flight Instructor Certificate	1
AET	387	Multi-engine Ground School	1
AET	389	Multi-engine Rating	1
AET	391	Multi-engine Instructor Ground School	2
AET	392	Flight Instructor Instrument Ground School	2
AET	393	Flight Instructor Instrument Rating	1
AET	395	Multi-engine Land, Airplane Flight Instructor Rating	1
AET	408	National Airspace System	2
AET	410	Aviation Safety	3
AET	489	Airline Administration	2
CHM	114	General Chemistry for Engineers *S1/S2*	4
IST	346	Management Dynamics	3
IST	452	Industrial Human Resource Management	3
MAT	260	Technical Calculus I *N1*	3
STP	420	Introductory Applied Statistics *N2*	3
Technical electives			2

Suggested Course Pattern for Freshmen

First Semester

AET	182	Private Pilot Ground School	3
ECN	111	Macroeconomic Principles *SB*	3
ENG	101	First-Year Composition	3
MAT	170	Precalculus *N1*	3
PHY	111	General Physics *S1/S2*[1]	3
PHY	113	General Physics Laboratory *S1/S2*[1]	1
Total			16

Second Semester

AET	183	Private Pilot Certificate	1
AET	220	Aviation Meteorology	3
ENG	102	First-Year Composition	3
ETC	100	Languages of Technology	4
MAT	260	Technical Calculus I *N1*	3
PHY	112	General Physics *S1/S2*[2]	3
PHY	114	General Physics Laboratory *S1/S2*[2]	1
Total			18

[1] Both PHY 111 and 113 must be taken to secure S1 or S2 credit.

[2] Both PHY 112 and 114 must be taken to secure S1 or S2 credit.

Airway Science Management Option

The airway science management option is designed to prepare graduates for managerial and supervisory positions throughout the air transportation industry. A depth of technical education is included along with a broad exposure to business and management courses. This program of study, interdisciplinary in nature, prepares the aeronautical career-oriented student for such positions as air traffic control specialist, air carrier manager, airport manager, and general aviation operations manager.

Degree Requirements

Airway science management students are required to complete a minimum of 128 semester hours, including at least 50 semester hours of upper-division courses. All degree requirements are shown on the student's Curriculum Check Sheet.

Course Requirements

In addition to the required courses (see pages 277–278) for First-Year Composition, General Studies, the technology core, and the aeronautical management technology core, the following additional courses are required:

ACC	230	Uses of Accounting Information I	3
AET	201	Air Traffic Control	3
AET	308	Air Transportation *G*	3
AET	344	Airport Management and Planning	3
AET	408	National Airspace System	2
AET	410	Aviation Safety	3
AET	489	Airline Administration	2
CHM	114	General Chemistry for Engineers *S1/S2*	4
HIS	304	American Cultural History *SB, H*	3
IEE	431	Engineering Administration	3
IST	346	Management Dynamics	3
IST	430	Ethical Issues in Technology	3
IST	452	Industrial Human Resource Management	3
IST	480	Organizational Effectiveness	3
IST	491	Introduction to Labor Concerns	3
MAT	260	Technical Calculus I *N1*	3
PGS	101	Introduction to Psychology *SB*	3
STP	420	Introductory Applied Statistics *N2*	3
Technical electives			9

Suggested Course Pattern for Freshmen

First Semester

ECN	111	Macroeconomic Principles *SB*	3
ENG	101	First-Year Composition	3
MAT	170	Precalculus *N1*	3
PGS	101	Introduction to Psychology *SB*	3
PHY	111	General Physics *S1/S2*[1]	3
PHY	113	General Physics Laboratory *S1/S2*[1]	1
Total			16

Second Semester

AET	182	Private Pilot Ground School	3
ENG	102	First-Year Composition	3
ETC	100	Languages of Technology	4
MAT	260	Technical Calculus I *N1*	3
PHY	112	General Physics *S1/S2*[2]	3
PHY	114	General Physics Laboratory *S1/S2*[2]	1
Total			17

[1] Both PHY 111 and 113 must be taken to secure S1 or S2 credit.

[2] Both PHY 112 and 114 must be taken to secure S1 or S2 credit.

AERONAUTICAL ENGINEERING TECHNOLOGY—B.S.

The Aeronautical Engineering Technology degree program is accredited by the Technology Accreditation Commission of the Accreditation Board for Engineering and Technology. The curriculum is designed to prepare the graduate for professional-level technical support of engineering activities throughout the aerospace field. Areas of responsibility include the application of applied engineering practice related to aircraft and aerospace vehicle design, internal combustion engines, combustion processes, turbomachinery,

NOTE: For the General Studies requirement, codes (such as L1, N3, C, and H), and courses, see pages 71–94. For graduation requirements, see pages 66–70. Omnibus courses are offered that are not listed in the catalog; see pages 44–45.

systems analysis, computer modeling, quality assurance and nondestructive testing, and wind tunnel applications.

Degree Requirements

Aeronautical Engineering Technology students are required to complete a minimum of 128 semester hours, including at least 50 semester hours of upper-division courses. All degree requirements are shown on the student's Curriculum Check Sheet.

GRADUATION REQUIREMENTS

In addition to fulfilling school and major requirements, majors must satisfy all university graduation requirements. See pages 66–70.

COURSE REQUIREMENTS

In addition to the required courses listed on pages 277–278 for First-Year Composition, General Studies, and the engineering technology core, the following courses are required:

AET	182	Private Pilot Ground School....3
AET	280	Aerospace Structures, Materials, and Systems....4
AET	287	Aircraft Powerplants....4
AET	300	Aircraft Design I....3
AET	312	Applied Engineering Mechanics: Dynamics 3
AET	320	Applied Aerodynamics and Wind Tunnel Testing....4
AET	415	Gasdynamics and Propulsion....3
AET	487	Aircraft Design II 3
CET	483	UNIX Utilities Using C Language 3
CHM	114	General Chemistry for Engineers *S1/S2*.... 4
EET	406	Control System Technology....4
IEE	300	Economic Analysis for Engineers 3
MAT	262	Technical Calculus III 3
MET	230	Engineering Materials and Processing....3
MET	313	Applied Engineering Mechanics: Materials 4
MET	432	Applied Thermodynamics and Heat Transfer 3
MET	434	Applied Fluid Mechanics 3
MET	438	Design for Manufacturing II....4
Technical electives 10		

Suggested Course Pattern for Freshmen

First Semester

ECN	111	Macroeconomic Principles *SB* 3
ENG	101	First-Year Composition....3
MAT	170	Precalculus *N1*.... 3
PHY	111	General Physics *S1/S2*[1] 3
PHY	113	General Physics Laboratory *S1/S2*[1] 1
HU, SB, and awareness area course 3		
Total 16		

Second Semester

AET	182	Private Pilot Ground School..3
ENG	102	First-Year Composition....3
ETC	100	Languages of Technology 4
MAT	260	Technical Calculus I *N1* 3
PHY	112	General Physics *S1/S2*[2] 3
PHY	114	General Physics Laboratory *S1/S2*[2] 1
Total 17		

[1] Both PHY 111 and 113 must be taken to secure S1 or S2 credit.

[2] Both PHY 112 and 114 must be taken to secure S1 or S2 credit.

STUDENT ORGANIZATIONS

The department hosts the local chapter of Alpha Eta Rho, the international professional aviation fraternity, open to all with an interest in aviation. Students also are eligible for membership in Tau Alpha Pi, the national honor society for engineering technology, American Association for Airport Executives (AAAE), and the Precision Flight Team, which competes in regional and national flying safety competitions.

AERONAUTICAL TECHNOLOGY

Flight instruction costs are not included in university tuition and fees.

AET 100 Primary Flight Course. (0) F, S, SS
Allows student to accrue flight time in preparation for the Private Pilot Certificate. Flight participation is required. May be repeated. Pre- or corequisite: AET 182 or equivalent.

182 Private Pilot Ground School. (3) F, S, SS
Ground school preparation for Private Pilot Certificate. Aerodynamics, navigation, performance, and regulations.

183 Private Pilot Certificate. (1) F, S, SS
Flight training for the FAA Private Pilot Certificate. Prerequisites: AET 182; passed FAA written; satisfactory completion of FAA tests.

184 *Ab Initio* Theoretical Preparation I. (3) N
Theoretical background material in preparation for the pre-solo phase of *ab initio* flight training. Available to *Ab Initio* Airline Pilot Flight Management majors only. Prerequisites: MAT 170; PHY 111, 113. Corequisite: AET 185. Pre- or corequisites: PHY 112, 114.

185 *Ab Initio* Airline Pilot Flight Training I. (1) N
Pre-solo introduction to *ab initio* airline pilot flight training. Requires approximately 17 flight hours with *ab initio* training provider. Majors only. Lab. Pre- or corequisite: AET 184.

200 Interim Flight Course. (0) F, S, SS
Allows students to accrue flight experience in preparation for the Commercial Pilot Certificate. Flight participation required. May be repeated. Pre- or corequisite: AET 182, 183 or instructor approval.

201 Air Traffic Control. (3) S
Ground and air operations. Weather services communications and routing. Flight plans and IFR operations. Departures and arrivals. Airport conditions and emergencies. Prerequisite: AET 182.

220 Aviation Meteorology. (3) F, S
Evaluation, analysis, and interpretation of atmospheric phenomena. Low and high altitude weather from the pilot's viewpoint. Nephology. Prerequisite: AET 182.

222 Instrument Pilot Ground School. (3) F
Ground school leading to the FAA Instrument Pilot Rating. 10 hours ground trainer included. Prerequisite: Private Pilot Certificate. Pre- or corequisite: AET 220.

280 Aerospace Structures, Materials, and Systems. (4) F
Basic aerodynamics, aerospace vehicle structures materials and systems. Inspection requirements and methods. Lecture, lab. Prerequisites: PHY 111, 113.

283 Instrument Pilot Rating. (1) F, S, SS
Flight training for FAA Instrument Pilot Rating. Flight participation and satisfactory completion of FAA Instrument Rating required. Prerequisites: AET 222; passed FAA written.

287 Aircraft Powerplants. (4) F, S
Theory and performance analysis of gas turbine and reciprocating aircraft engines. Engine accessories, systems, and environmental control. Lecture, lab. Prerequisites: CHM 113 or 114; PHY 112, 114. Pre- or corequisite: MAT 260.

300 Aircraft Design I. (3) F, S
Basic applied aerodynamics, propeller performance, and airplane performance analysis. Prerequisites: AET 280, 287; ETC 100; MAT 260; PHY 112, 114.

304 *Ab Initio* Theoretical Preparation II. (3) F
The second of a series of six courses providing theoretical background in preparation for *ab initio* flight training. Available to *Ab Initio* Airline Pilot Flight Management majors only. Lecture, recitation. Prerequisites: AET 184, 185; junior standing.

308 Air Transportation. (3) F
Study of the historical and international development of air transportation and its social, political, and economic impact upon global interrelationships. Prerequisite: junior standing. *General Studies: G.*

310 Instrumentation. (3) F
Measurement systems, components, system response, and the characteristics of experimental data. Methods of collecting and analyzing data. Lecture, lab. Prerequisites: ETC 201; MAT 261. Pre- or corequisite: MET 313.

312 Applied Engineering Mechanics: Dynamics. (3) F, S
Masses; motion kinematics; dynamics of machinery. Prerequisites: ETC 211; MAT 261.

314 Commercial Pilot Ground School. (3) S
Ground school leading to Commercial Pilot certification. 10 hours ground trainer included. Prerequisite: Private Pilot Certificate. Pre- or corequisite: AET 222.

320 Applied Aerodynamics and Wind Tunnel Testing. (4) S
Introduction to viscous and inviscid flow and their relationship to aircraft lift and drag. Wind tunnel design and testing. Lecture, lab. Prerequisites: AET 300; ETC 100; MAT 262.

324 *Ab Initio* Theoretical Preparation III. (3) S
Third of a series of six courses providing theoretical background for *ab initio* flight training. Available to *Ab Initio* Airline Pilot Flight Management majors only. Lecture, recitation. Prerequisites: AET 304; junior standing.

330 *Ab Initio* Theoretical Preparation IV. (3) F, S, SS
Fourth in a series of six courses providing theoretical background for *ab initio* flight training. Available to *Ab Initio* Airline Pilot Flight Management majors only. Lecture, recitation. Prerequisites: AET 324; junior standing. Corequisite: AET 335.

335 *Ab Initio* Airline Pilot Flight Training II. (2) F, S, SS
Continuation of *ab initio* airline pilot flight training, beginning after first solo flight. Requires approximately 11 flight hours with *ab initio* training provider. Majors only. Lab. Prerequisites: AET 184, 185. Corequisite: AET 330.

342 Aviation Law/Regulations. (3) F
Study which encompasses the field of aviation within the context of the U.S. Common Law system. Public law, administrative rule making, sovereignty, enforcement, and case law analysis. Prerequisite: junior standing.

344 Airport Management and Planning. (3) S
Career orientation into administration and management of modern public airports, to include an overview of planning, funding, and development of airport facilities. Prerequisite: AET 308 or instructor approval.

360 Introduction to Helicopter Technology. (3) N
Introduction to the working functions of modern rotary wing aircraft. Rotary wing flight theory, aerodynamics, controls, flight, and power requirements. Prerequisites: PHY 111, 113; junior standing.

362 *Ab Initio* Theoretical Preparation V. (6) F, S, SS
Fifth in a series of six courses providing theoretical background for *ab initio* flight training. Available to *Ab Initio* Airline Pilot Flight Management majors only. Lecture, recitation. Prerequisites: AET 330, 335; senior standing. Corequisite: AET 363.

363 *Ab Initio* Airline Pilot Training III. (6) F, S, SS
Intermediate phase of *ab initio* airline pilot flight training. Requires approximately 96 flight and simulator hours with *ab initio* training provider. Majors only. Lab. Prerequisites: AET 330; senior standing. Corequisite: AET 362.

382 Air Navigation. (3) F
Advanced D.R., including theory/application of modern navigation systems, pressure pattern, and grid navigation. Prerequisite: AET 222.

383 Commercial Pilot Certificate. (2) F, S, SS
Flight training for the FAA Commercial Pilot Certificate. Satisfactory completion of FAA Commercial Pilot Certification required to pass the class. Prerequisites: AET 222, 314; passed FAA written exam; 150 hours flight.

385 Flight Instructor Ground School. (3) F
Ground school in preparation for the FAA Flight Instructor Certificate. Pre- or corequisite: AET 383.

386 Flight Instructor Certificate. (1) F, S, SS
Flight training for FAA Flight Instructor Certificate. Certificate required for course completion. Prerequisites: AET 385; passed FAA written.

387 Multiengine Ground School. (1) F
Ground school preparation for the FAA Multi-Engine Rating. Pre- or corequisite: AET 383 or instructor approval.

389 Multiengine Rating. (1) F, S, SS
Flight training for addition of an unrestricted FAA Multi-Engine Rating to a commercial pilot certificate. FAA rating required for course completion. Corequisite: AET 387.

391 Multiengine Instructor Ground School. (2) F, S
Ground school preparation for the FAA Multi-Engine Flight Instructor Rating. Prerequisites: AET 386, 387, 389.

392 Flight Instructor Instrument Ground School. (2) S
Ground School preparation for the FAA Instrument Flight Instructor Rating. Prerequisite: AET 386 or instructor approval.

393 Flight Instructor Instrument Rating. (1) F, S, SS
Flight training for the FAA CFII. CFII Rating required for course completion. Prerequisites: AET 386, 392; passed FAA written.

395 Multiengine Land, Airplane Flight Instructor Rating. (1) F, S, SS
Normal and emergency flight operations. Instruction techniques and procedures associated with light multiengine land, airplane. CFIAME Rating required for course completion. Prerequisites: AET 386, 389.

408 National Airspace System. (2) F
Airway facilities. Operations and communications, air route traffic control centers, and flight service stations. Navigation aids, airport environment, certification, and security. Prerequisites: AET 201 (or 222), 344.

409 Nondestructive Testing and Quality Assurance. (1) S
Purpose of inspection and quality assurance. Theory and application of nondestructive inspection methods. Application of pertinent standards, specifications, and codes. Lecture, lab. Prerequisite: AET 280 or MET 230.

410 Aviation Safety. (3) F
Aviation accident prevention, human factors, life support, fire prevention, accident investigation, and crash survivability. Development and analysis of aviation safety programs. Prerequisite: junior standing; completion of 1 semester of literacy and critical inquiry (L1) requirement.

415 Gasdynamics and Propulsion. (3) F
Introduction to compressible flow, internal and external flow, and aerothermodynamic analysis of propulsion systems. Prerequisites: ETC 340; MAT 262.

417 Aerospace Structures. (3) F
Analysis and design of aircraft and aerospace structures. Shear flow. Semimonocoque structures. Effects of dynamic loading. Prerequisites: AET 300, 312, 320; MAT 262; MET 313.

462 *Ab Initio* Theoretical Preparation VI. (6) F, S, SS
Last of a series of six courses providing theoretical background for *ab initio* flight training. Available to *Ab Initio* Airline Pilot Flight Management majors only. Lecture, recitation. Prerequisites: AET 362, 363; senior standing. Corequisite: AET 463.

463 *Ab Initio* Airline Pilot Flight Training IV. (6) F, S, SS
Completion phase of *ab initio* airline pilot flight training. Student must demonstrate mastery of theoretical and regulatory background of flight activities and achieve a high level of competence as a pilot. Lab. Prerequisites: AET 362, 363; senior standing. Corequisite: AET 462.

484 Aeronautical Internship. (1–3) F, S, SS
Work experience assignment at airports or with aerospace industry commensurate with student's program. Special projects guidance by industry with university supervision. Prerequisites: advisor approval; junior standing.

487 Aircraft Design II. (3) S
Basic aerodynamics and airplane performance analysis methods applied to practical design project. Prerequisite: AET 300.

489 Airline Administration. (2) S
Administrative organizations, economics of airline administration, operational structure, and relationship with federal government agencies. Prerequisite: AET 308 or instructor approval.

490 Advanced Applied Aerodynamics. (3) S
Study of fluid motion and aerodynamics. Essentials of incompressible aerodynamics and computational fluid dynamics. Elements of laminar and turbulent flows. Lecture, lab. Prerequisites: AET 312; ETC 100; MAT 262.

NOTE: For the General Studies requirement, codes (such as L1, N3, C, and H), and courses, see pages 71–94. For graduation requirements, see pages 66–70. Omnibus courses are offered that are not listed in the catalog; see pages 44–45.

Department of Electronics and Computer Technology

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PROFESSORS EMERITI
BAXTER, EDWARDS, STRAWN

Purpose. Electronics engineering technology is a technological field of specialization that requires the application of scientific and engineering knowledge and methods combined with technical skills in support of electrical/electronics engineering activities. It lies in the occupational spectrum between the craftsman and the engineer at the end of the spectrum closest to the engineer. The electronics engineering technologist is a member of the electronics engineering team that consists of electronics engineers, electronics engineering technologists, and electronics engineering technicians.

The electronics engineering technologist is applications oriented, and builds upon a background of applied science and mathematics including the concepts and applications of calculus. Using state-of-the-art technology, the electronics engineering technologist is able to produce practical, workable, and safe results quickly and economically, to install and operate technical systems, to configure hardware for unique applications, to develop and produce products, to service machines and systems, to manage manufacturing processes, and to provide customer support to technical products and systems.

Degrees. The Department of Electronics and Computer Technology offers the Bachelor of Science degree in Electronics Engineering Technology (B.S./EET). Four options are available: computer systems, electronic systems, microelectronics, and telecommunications.

The *computer systems* option combines applied electronics and computer hardware-software concepts and applications. It has been formulated to meet the needs of persons who wish to engage in digital and computer systems applications as a career focus.

The *electronic systems* option is aimed at preparing persons for careers in instrumentation, control, and power systems applications. This option allows a student to develop a broad-based knowledge of electrical/electronic fundamentals with an applications perspective. The Department of Electronics and Computer Technology has had a concentration in electronic systems or instrumentation and systems control for many years. The course patterns in support of these emphasis areas have been well developed and continue to provide strong support for the electronic systems option under the B.S./EET program.

The *microelectronics* (UET) option combines applied electronics, monolithic and hybrid integrated circuit processing and applications, device and component fabrication, and manufacturing. The objective of this option is to prepare persons to assume positions in the area of microelectronics manufacturing with immediately applicable knowledge as well as to develop a strong foundation of electronic fundamentals and methods. Students should be interested in the design, fabrication, and manufacture of imprinted circuitry, monolithic integrated circuits (bipolar and MOS), and hybrid thick film and thin film circuitry, components, and systems. The continuing explosion in semiconductor and related technologies and their applications to electronic and computer-related products offers unique and challenging opportunities. Graduates of this program option secure positions in processing, manufacturing, operations, and applications areas in industry as members of the diverse scientific engineering team.

The *telecommunications* option has been structured to take advantage of the recent changes in the telecommunications industry. The program encompasses the fundamentals of information and signal processing, modern bandwidth-efficient digital radio analysis with RF and microwave circuits and systems. Applications include telephone pulse code modulation, cable TV, fiber optic links, and satellite transmission circuits and systems.

A Master of Technology degree program with a concentration in electronics engineering technology is available for qualified B.S. graduates. The undergraduate program options are supported as emphasis areas in the master's degree program. See the *Graduate Catalog* for more information.

ELECTRONICS ENGINEERING TECHNOLOGY—B.S.

The departmental curriculum is organized into two categories, technical studies and General Studies. Technical studies consist of core areas and the option specialty area. General Studies consist of courses selected to meet the university General Studies requirement as well as the math/science requirement of TAC/ABET. A minimum of 50 upper-division hours is required, including at least 24 semester hours of EET, CET, or UET upper-division hours to be taken at ASU. Complete program of study guides with typical four-year patterns are available from the department.

The General Studies portion of the B.S./EET curriculum has been carefully structured to meet the specific requirements of the university and to include the content required by TAC/ABET, the professional accrediting agency for such curricula.

DEGREE REQUIREMENTS

In addition to the courses listed for First-Year Composition and General Studies, the following courses are required.

Engineering Technology Core

The following courses are required as part of the engineering technology core:

CHM	113	General Chemistry *S1/S2*	4
EET	208	Electronic Circuits	3
ETC	211	Applied Engineering Mechanics: Statics	3
ETC	340	Applied Thermodynamics and Heat Transfer	3
MAT	260	Technical Calculus I *N1*	3
MAT	261	Technical Calculus II	3
Total			19

Electronics Engineering Technology Core Requirements

CET	150	Digital Systems and Microprocessors *N3*	3
CET	350	Digital Logic Principles	4
CET	354	Microcomputer Principles	4
CSE	294	C++ Programming	3

EET	301	Electric Networks	3
EET	310	Electronic Circuits	4
EET	372	Communication Systems	4
EET	394	Electronic Circuits II	3
EET	396	Professional Orientation*	1
EET	407	Electrical Power Systems	4
UET	331	Semiconductor Materials Science/Devices	3
UET	415	Electronic Manufacturing Engineering Principles	3
Total			39

*Students must take EET 396 the semester in which they are enrolled in the 87th hour of credit (ASU plus transfer hours). If this occurs in summer session, students should take EET 396 the prior spring semester.

Electronics Engineering Technology Options

Computer Systems

CET	452	Digital Logic Applications	4
CET	456	Assembly Language Applications	3
CET	457	Microcomputer Systems Interfacing	4
CET	473	Digital/Data Communications	4
CET	483	UNIX Utilities Using C Language	3
Approved technical electives			7

Electronic Systems

CET	483	UNIX Utilities Using C Language	3
EET	406	Control System Technology	4
EET	430	Instrumentation Systems	4
EET	460	Power Electronics	4
Approved technical electives			10

Microelectronics

CHM	116	General Chemistry *S1/S2*	4
UET	416	Monolithic Integrated Circuit Devices	3
UET	417	Monolithic Integrated Circuit Laboratory	2
UET	418	Hybrid Integrated Circuit Technology	4
UET	432	Semiconductor Packaging and Heat Transfer	3
Approved technical electives			9

Telecommunications Systems

CET	473	Digital/Data Communications	4
EET	304	Transmission Lines and Waveguides	4
EET	401	Digital Filters and Applications	3
EET	470	Communication Circuits	4
Approved technical electives			10

Electronics Engineering Technology Program of Study Typical First- and Second-Year Sequence

Freshman Year

First Semester

CET	150	Digital Systems and Microprocessors *N3*	3
ENG	101	First-Year Composition	3
MAT	170	Precalculus *N1*	3
PHY	111	General Physics *S1/S2*[1]	3
PHY	113	General Physics Lab *S2/S2*[1]	1
HU, SB, and awareness area courses			3
Total			16

Second Semester

EET	208	Electric Circuits	3
ENG	102	First-Year Composition	3
ETC	100	Languages of Technology	4
MAT	260	Technical Calculus I *N1*	3
PHY	112	General Physics *S1/S2*[2]	3
PHY	114	General Physics Laboratory *S1/S2*[2]	1
Total			17

Sophomore Year

First Semester

CHM	113	General Chemistry *S1/S2*	4
CSE	294	C++ Programming	3
ECN	111	Macroeconomic Principles *SB*	3
MAT	261	Technical Calculus II	3
HU, SB, and awareness area courses			3
Total			16

Second Semester

ITC	200	Impact of Communications Technology on Society *L1*	3
EET	301	Electric Networks	3
ETC	211	Applied Engineering Mechanics: Statics	3
MAT	262	Technical Calculus III	3
HU, SB, and awareness area courses			3
Total			15

[1] Both PHY 111 and 113 must be taken to secure S1 or S2 credit.

[2] Both PHY 112 and 114 must be taken to secure S1 or S2 credit.

STUDENT ORGANIZATIONS

The department hosts one of the local chapters of the Institute of Electrical and Electronics Engineers (IEEE), the International Society for Hybrid Microelectronics (ISHM), and the Instrument Society of America (ISA). Students may also be elected to membership in Tau Alpha Pi, the national honor society for engineering technology.

ELECTRONICS ENGINEERING TECHNOLOGY

EET 205 Electronic Devices and Circuits. (4) F, S
Active device characteristics, models, and basic circuit analysis. Lecture, lab. Prerequisite: ETC 201.

208 Electrical Circuits. (3) F, S
Graphical and analytical solutions of electric circuits, transients, and sinusoidal excitation. Applications of circuit theorems and computer solutions. Pre- or corequisite: MAT 261.

301 Electric Networks. (3) F, S
Analysis of electric networks, transients, steady-state sinusoidal frequency response, and transfer function using Laplace transforms and Fourier Series. Prerequisite: EET 208. Pre- or corequisite: MAT 262.

304 Transmission Lines and Waveguides. (4) S
Theory and application of transmission lines, waveguides, antennas, microwave components, and impedance matching techniques. Lecture, lab. Prerequisite: EET 301.

310 Electronic Circuits I. (4) F, S
Multistage amplifier, analysis, and design using models and computer simulation. Lecture, lab. Prerequisites: EET 208.

372 Communication Systems. (4) F, S
Systems analysis and design of AM, FM, PCM, and SSB communication systems. Noise and distortion performance of communication systems. Lecture, lab. Pre- and corequisites: EET 301, 310.

396 Professional Orientation. (1) F, S
Technical, professional, economic, and ethical aspects of electronics/computer engineering technology practice and industrial organization. Lecture, projects. Prerequisite: junior standing.

401 Digital Filters and Applications. (3) S
Analysis and design of digital filters. Time frequency and Z-transform techniques and waveform analysis. Computer applications. Prerequisites: EET 301; MAT 262.

406 Control System Technology. (4) S
Control system components, analysis of feedback control systems, stability, performance, and application. Lecture, lab, computer simulations. Prerequisites: EET 301; MAT 262.

407 Electrical Power Systems. (4) F
Electrical power systems analysis, generation, transmission, distribution, and utilization, including system protection. Lecture, lab. Prerequisite: EET 208.

410 Linear Filters and Applications. (3) A
Frequency response and feedback design of multistage electronic circuits. Active and passive filter design. Computer analysis. Prerequisites: EET 301, 310.

420 Operational Amplifier Theory and Application. (4) A
Differential and operational amplifiers, feedback configurations, op-amp errors and compensation, and linear and nonlinear applications. Lecture, lab. Prerequisites: EET 301, 310.

422 Electronic Switching Circuits. (4) A
Analysis and design of electronic circuits operating in a switching mode. Waveshaping, timing, and logic. Computer simulation. Lecture, lab. Prerequisites: CET 350; EET 301, 310.

430 Instrumentation Systems. (4) F
Measurement principles and instrumentation, techniques. Signal and error analysis. Lecture, lab. Prerequisites: EET 301, 310.

440 Electrical Power Systems Technology. (4) S
Principles and analysis of rotating machines, transformers, and related control equipment. Lecture, lab. Prerequisite: EET 307.

460 Power Electronics. (4) S
Analysis of circuits for control and conversion of electrical power and energy. Lecture, lab. Prerequisites: EET 301, 307, 310.

470 Communication Circuits. (4) S
Analysis and design of passive and active communication circuits. Coupling networks, filters, and impedance matching. Modulation and demodulation techniques. Computer solutions. Lecture, lab. Prerequisites: EET 372; MAT 262.

478 Digital Communication Systems. (3) S
Theory, design, and application of digital, data, and fiber optics communication systems. Prerequisites: EET 304, 372; MAT 262.

482 Industrial Practice: Internship/Coop. (1–4) F, S, SS
Specially assigned or approved activities in electronic industries or institutions. Report required. Maximum of 10 credits. Prerequisite: majors only enrolled at junior-senior level.

490 Electronics Project. (1–4) F, S, SS
Individual or small group projects in applied electronics, with emphasis on laboratory practice or hardware solutions to practical problems. Prerequisite: instructor approval.

501 Digital Signal Processing and Applications I. (3) F
Applications of discrete-time signals and systems, design of IIR and FIR filters using computer aided design techniques. Prerequisites: EET 401 or instructor approval; MAT 262.

502 Digital Signal Processing and Applications II. (3) S
Application of FFT, fundamentals of probability theory and random processes, and quantization effects in digital filters. Prerequisite: EET 501.

506 System Dynamics and Control. (3) S
Time, frequency, and transform domain analysis of physical systems. Transfer function analysis of feedback control systems performance and stability. Compensation. Prerequisites: EET 301, 501 (or MAT 262).

508 Digital Real-Time Control. (3) A
Sample data control techniques and applications to process control. Prerequisites: CET 354; EET 406.

510 Linear Integrated Circuits and Applications. (3) F
Analysis, design, and applications of linear integrated circuits and systems. Prerequisites: CET 350; EET 301, 310.

522 Digital Integrated Circuits and Applications. (3) S
Analysis, design, and applications of integrated circuits and systems. Prerequisites: CET 350; EET 301, 310.

530 Electronic Test Systems and Applications. (3) F
Analysis, design, and application of electronic test equipment, test systems, specifications, and documentation. Prerequisites: CET 354; EET 301, 310.

540 Electrical Power Systems. (3) S
Electrical power system analysis, transmission, distribution, instrumentation, protection, and related system components. Prerequisites: EET 301, 307.

560 Industrial Electronics and Applications. (3) A
Analysis, design, and application of special electronic devices and systems to industrial control, power, communications, and processes. Prerequisites: CET 350; EET 301, 307, 310.

574 Microwave Amplifier-Circuits Design. (3) F
Analysis and design of microwave amplifier-circuits using s-parameter theory and computer aided design. Prerequisites: EET 304, 470.

576 Modern Telecommunication Systems. (3) F
Applied design and integration of microwave and satellite communication systems. Prerequisites: CET 473; MAT 262; *or* instructor approval.

578 Digital Filter Hardware Design. (3) S
Hardware design of FIR and IIR filters, including adaptive filters, based on DSP chips. Develop new applications using DSP microprocessor systems. Prerequisites: EET 401; CET 354.

COMPUTER ENGINEERING TECHNOLOGY

CET 150 Digital Systems and Microprocessors. (3) F, S
Fundamentals of digital systems and microprocessors, with Boolean Algebra and combinational logic. Microprocessor programming and applications. Lecture, lab. Prerequisite: freshman standing. *General Studies: N3.*

350 Digital Logic Principles. (4) F, S
Combinational and sequential logic analysis, design concepts, and applications. Lecture, lab. Prerequisite: CET 150.

354 Microprocessor Principles. (4) F, S
Microprocessor organization, programming, and interfacing. Prerequisite: CET 150.

452 Digital Logic Applications. (4) S
Design of sequential machines using system design techniques and complex MSI/LSI devices with lab. Prerequisite: CET 350.

456 Assembly Language Applications. (3) F
Programming using BIOS and DOS routines. High level language interfacing. Disk operations, TSR routines, and device drivers. Prerequisite: CET 354.

457 Microcomputer Systems Interfacing. (4) S
Applications of microcomputer hardware and software. Special purpose controllers, interface design. Lecture, lab. Prerequisites: CET 354; CSE 183; EET 310.

458 Digital Computer Networks. (3) A
Network technology, topologies, protocols, control techniques, reliability and security. Prerequisite: CET 354.

473 Digital/Data Communications. (4) F, S
Signals, distortion, noise, and error detection/correction. Transmission and systems design. Interface techniques and standards. Lecture, lab. Prerequisites: CET 354; EET 372.

483 UNIX Utilities Using C Language. (3) S
Applications of C language to the development of practical programs for the UNIX operating system. Prerequisite: senior standing in technology or equivalent.

485 Digital Testing Techniques I. (3) A
Hardware/software aspects of digital testing technology; systems, board, and logic testing and equipment. Lecture, lab. Cross-listed as UET 485. Prerequisites: CET 350; EET 310.

486 Electronics Computer Aided Design. (3) F
CAD/EHDL for digital logic simulations and electronic circuit designs. Various software packages will be used. Prerequisites: CET 350; EET 310.

552 Digital Systems Design. (3) S
Digital system design techniques and applications. Prerequisite: CET 452 or instructor approval.

556 Computer Software Technology. (3) A
Assembly language programming techniques and operations, operating system characteristics, and systems software applications. Prerequisite: CET 456.

557 Microcomputers and Applications. (3) F
Applications of small computer systems, mini- and microcomputer hardware and software. Prerequisites: CET 354; CSE 100 or 183; EET 310.

583 UNIX Utilities Using C Language II. (3) S
C language applications using the UNIX operating system. Also Fourth Generation languages and other UNIX utilities. Prerequisite: graduate standing in technology.

585 Digital Testing Techniques II. (3) F
Testing technology as applied to digital systems, boards, and chips. Lecture, lab. Prerequisite: CET 354.

586 Digital Modeling Techniques. (3) S
Digital system modeling and simulation using hardware description languages. Prerequisites: CET 350, 354.

MICROELECTRONICS ENGINEERING TECHNOLOGY

UET 331 Electronic Materials. (3) F, S
Physical, chemical, electromagnetic, and mechanical properties of electronic materials. Solid state device characteristics and their material properties. Prerequisites: CHM 113; EET 205; PHY 112, 114.

415 Electronic Manufacturing Engineering Principles. (3) F, S
Electronic equipment design and fabrication principles and practice. Completion of electronics hardware design project and report. Lecture, lab. With lab fee. Prerequisite: EET senior standing (113 hours).

416 Monolithic Integrated Circuit Devices. (3) F
Physics and electronics of bipolar and MOS devices used in integrated circuits. Prerequisite: UET 331. Corequisite: UET 417.

417 Monolithic Integrated Circuit Laboratory. (2) F
Laboratory practice in the fabrication of integrated circuits. Lab. Prerequisite: UET 331. Corequisite: UET 416.

418 Hybrid Integrated Circuit Technology. (4) S
Layout, fabrication, design, and manufacture of thin and thick film hybrid circuits. Lecture, lab. Prerequisites: EET 310; UET 331.

432 Semiconductor Packaging and Heat Transfer. (3) S
Packaging theory and techniques; hermetic and plastic assembly; thermal management; electrical characteristics and reliability. Prerequisites: ETC 340; UET 331; *or* equivalents.

437 Integrated Circuit Testing. (3) S
Principles, techniques, and strategies employed at wafer level and final product testing, both destructive and nondestructive. Prerequisite: UET 416.

513 Microelectronics Technology. (3) S
Special processes, techniques, and advances in monolithic and hybrid technology. Emphasis on manufacturing practice and product application for LSI and VLSI. Seminar. Prerequisite: UET 416.

516 IC Processing Technology and Integration. (3) F
Monolithic IC process integration and fabrication technology. Lecture, lab. Prerequisite: UET 416.

518 Hybrid IC Technology and Applications. (3) S
Theory, processing, fabrication, and manufacturing of hybrid microelectronics devices and products. Applications. Prerequisite: UET 331 or equivalent or instructor approval.

Department of Manufacturing and Industrial Technology

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PROFESSORS EMERITI
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Purpose. Technology is the application of science, systematic methods, techniques, procedures, machines, materials, and devices for the development, improvement, and implementation of state-of-the-art solutions to industrial problems. Increased complexity and sophistication have created great demand for those individuals who possess a working knowledge of the technical phases of planning, testing, production, and fabrication of consumer and industrial products and equipment. Emphasis is placed on health and safety within the workplace.

The mission of the department is to prepare graduates who are able to develop and communicate technological solutions to industrial problems, to perform management functions in systems operations, to improve and evaluate products, to provide customer support, and to facilitate technology transfer in industry and government.

Majors and Emphases. To accomplish the mission, the department offers two majors leading to the Bachelor of Science degree, Industrial Technology and Manufacturing Engineering Technology. Three emphasis areas are available under the Industrial Technology major, which is accredited by the North Central Association of Colleges and Secondary Schools (NCACSS): graphic communications, industrial management, and interactive computer graphics. Five emphasis areas are available under the Manufacturing Engineering Technology (MET) major, which is accredited by the Technology Accreditation Commission of the Accreditation Board for Engineering and Technology: computer-integrated manufacturing engineering technology, manufacturing engineering technology, mechanical engineering technology, robotic and automation engineering technology, and welding engineering technology.

The department fosters research in disciplines of technology to support its educational programs, offers courses in support of the general education requirements of the university, and offers Master of Technology degree programs.

DEGREE REQUIREMENTS

Manufacturing Engineering Technology—B.S.

Engineering technology core	14
General Studies/Department Requirements	45
Manufacturing Engineering Technology major	51
Selected emphasis area	12
First-Year Composition	6
Total	128

The following courses constitute the Manufacturing Engineering Technology major and are required of all Manufacturing Engineering Technology students. Refer to the specific emphasis areas below for additional requirements.

Manufacturing Engineering Technology Major

EET	406	Control System Technology	4
MET	231	Manufacturing Processes	3

NOTE: For the General Studies requirement, codes (such as L1, N3, C, and H), and courses, see pages 71–94. For graduation requirements, see pages 66–70. Omnibus courses are offered that are not listed in the catalog; see pages 44–45.

MET	300	Applied Material Science	4
MET	302	Welding Survey	3
MET	313	Applied Engineering Mechanics: Materials	4
MET	331	Design for Manufacturing I	3
MET	341	Manufacturing Analysis	3
MET	344	Casting and Forming Processes	3
MET	345	Advanced Manufacturing Processes	3
MET	346	Numerical Control Point to Point and Continuous Path Programming	3
MET	401	Statistical Process Control	3
MET	416	Applied Computer Integrated Manufacturing	3
MET	444	Production Tooling	3
MET	451	Introduction to Robotics	3
MET	460	Manufacturing Capstone Project I	3
MET	461	Manufacturing Capstone Project II	3
Total			51

Computer-Integrated Manufacturing Engineering Technology. Computer-integrated manufacturing (CIM) has proved to be a powerful tool for increasing productivity in manufacturing. This impact will be greater in the future as the full potential of computers is integrated into the manufacturing factory. Computer-integrated manufacturing engineering technology is concerned with the coordination of computer information and computer implementation in manufacturing.

Required courses: MET 448 Expert Systems in Manufacturing (3), MET 452 Implementation of Robots in Manufacturing (3), and six hours approved technical electives.

Manufacturing Engineering Technology. This emphasis area is designed to prepare technologists with both conceptual and practical applications of processes, materials, and products related to metalworking industries. Accordingly, this concentration is intended to prepare students to meet the responsibilities in planning the processes of production, developing the tools and machines, and integrating the facilities of production or manufacturing.

Another area within manufacturing engineering technology prepares the student for the implementation of design and manufacturing strategies that favorably impact the environment prior to manufacturing and during manufacturing. Students will be able to address design, materials, and manufacturing problems with a focus on the environment. Concepts like design for recyclability, manufacturing fluids, and air quality control during manufacturing will be addressed.

Required courses: MET 442 Specialized Production Processes (3) and nine hours approved technical electives.

Mechanical Engineering Technology. The primary objective of the mechanical engineering technology emphasis area is to prepare the student for entry-level work in mechanical design and testing either in engineering or manufacturing departments in product-oriented industries. Major emphasis is placed on reducing the amount of time required by industry to make the graduate productive in any area of work. The student obtains a well-rounded academic background with an emphasis in mechanics and thermal sciences.

Required courses: AET 415 Gasdynamics and Propulsion (3), MET 434 Applied Fluid Mechanics (3), MET 438 Design for Manufacturing II (4), and two hours of approved technical electives.

Robotic and Automation Engineering Technology. The challenges to improve productivity, product quality, and reliability and to reduce costs must be addressed by integrating robots and automation in manufacturing. This emphasis area addresses the field of automating manufacturing processes.

Required courses: MET 448 Expert Systems in Manufacturing (3), MET 453 Safety Management (3); six hours approved technical electives.

Welding Engineering Technology. This emphasis area is designed primarily to prepare individuals for technical positions in industries utilizing welding and related processes. The focus is on the application of welding technology as applied to current and near future industrial needs. The program is structured to provide the individual with a balance of theory, application, and hands-on experience. The general areas covered by the courses are welding processes, materials, nondestructive testing, and weldment design. The student also has the opportunity to work with robots in robotic welding applications. Also, a laser is available for investigating the area of high-energy welding processes.

Graduates of this program have the capability to function in a variety of technical positions related to welding and manufacturing. Typically, a graduate from this program may work in the areas of robotic welding, metallurgy, quality control, nondestructive evaluation, welding process evaluation, and technical sales.

Graduates may find employment in the aerospace, automotive, heavy machinery, heavy fabrication, and energy production industries.

Required courses: MET 321 Engineering Evaluation of Welding Processes (3), MET 420 Welding Metallurgy I (4), MET 421 Welding Metallurgy II (3); two hours of approved technical electives.

Industrial Technology—B.S.

The curriculum consists of General Studies and technical courses. The technical part of the curriculum includes a required core by all Industrial Technology majors and an emphasis area. The technical emphasis part of the curriculum specifies the required courses for each emphasis area and electives selected with approval of an advisor. Three emphasis areas are available: graphic communications, industrial management, and interactive computer graphics. The following is a summary of degree requirements:

First-Year Composition requirement	6
General Studies/Department Requirements	39
Industrial Technology core	19
Industrial Technology major/emphasis	64
Total	128

The following courses constitute the Industrial Technology Core and are required of all Industrial Technology students. Refer to the specific emphasis areas for additional requirements.

Industrial Technology Core

ETC	100	Languages of Technology	4
GRC	294	Desktop Publishing and Information Graphics	3
GRC	331	Quality Assurance for the Reproduction Processes	3
GRC	337	Production Management	3
IST	346	Management Dynamics	3
IST	494	ST: Project Management	3
Total			19

Graphic Communications (GRC). The purpose of the graphic communications emphasis is to prepare people for a wide variety of professional positions in the printing and graphic communications industry. This area of emphasis offers a blend of technological and managerial skills and knowledge.

It has been specifically designed to prepare graduates to address the opportunities and increased competitive challenges taking place in the industry as a result of technological change and turbulent economic and human relations concerns.

All courses are industry responsive. The students are exposed to case histories and problems related to actual industry issues. Throughout the entire four-year curriculum, students are exposed to practical, situational analysis and effective problem-solving techniques. As a prerequisite for graduation, students are expected to acquire job-related industry experience as practical preparation for making an immediate contribution to an employer's business.

The graphic communications curriculum is an integral part of the future trends in computer graphics, imaging, and technical communications. To achieve its objectives, the graphic communications emphasis area requires 27 semester hours of related courses and 37 semester hours of technical GRC elective courses to be determined by advising.

Typical career paths may include operations management, sales and marketing, and technology described below:

Operations Management. Computer graphics applications; conformance requirements for government regulation; decision making in a manufacturing environment; industrial cost accounting; instrumentation for graphic arts manufacturing; manufacturing strategy; materials testing and performance prediction; optimization of production systems; organizations and layout; planning and scheduling for manufacturing; plant design, plant information systems; printing systems maintenance; product development and management; production management; production coordination; supervisory techniques; traffic management.

Sales/Marketing. Customer education; estimating and job costing; finance, personnel and human relations; markets for printing; print and electronic media; sales management; sales service; strategic planning; market planning.

Technology. Analytical modeling for manufacturing systems; applied electronics for the graphic communications industry; creation, management and transmission of digital imaging information; environmental control; evaluation of new technologies; integrated computer graphics; printing plant engineering; quality management and process control; scientific properties of graphic communications materials; technological planning and forecasting.

Industrial Management. The purpose of this emphasis is to prepare supervisors and high-level personnel for management functions in industry, manufacturing, and public service organizations.

The industrial management emphasis area courses are articulated with the Maricopa Community College District, Pima Community College, and Yavapai College. Consultation with an advisor is required to coordinate the course selection for transfer to the industrial management areas of emphasis.

To achieve its objectives, the industrial management emphasis area requires 31 semester hours of related courses and 33 semester hours of technical IST elective courses to be determined by advising.

Technical electives to support the area of emphasis must be chosen by the student in consultation with an advisor. Typical areas for technical electives are aeronautics, construction, electronics, fire science, graphic communications, hazardous materials and waste management, interactive computer graphics, safety and health, technology, and manufacturing. Articulation agreements are to be followed by consulting an advisor.

Interactive Computer Graphics. The purpose of the interactive computer graphics (ICG) emphasis is to prepare students for entry into the diverse field of computer graphics. The ICG emphasis provides a strong academic foundation in the technological, managerial, and discipline-specific applications of graphics analysis, communication, databases, design, documentation, image generation, modeling, programming, visualization, and multimedia.

Graduates are qualified computer graphics technologists who have acquired extensive knowledge and technical competency, thereby preparing them to advance into professional positions of leadership within the industry. The ICG courses are industry responsive and provide a high level of technical applicability in the use of computer graphics systems, hardware, and software within a variety of discipline environments.

Typical career paths may include: applications development, applications management and supervision; business and analytical graphics; design (specialty areas such as electronics, advertising/graphics design, mechanical, manufacturing, multimedia, animation, rendering and illustration, and computer-aided design and drafting); field engineering, service and support; graphics systems and database analysis; sales and marketing; technical graphics and publication; testing, and implementation; training (administration and instruction).

The interactive computer graphics curriculum is an integral part of future trends in computer graphics, imaging, and technical communications. To achieve its objectives, the interactive computer graphics emphasis area requires 27 semester hours of related courses and 37 semester hours of technical ICG elective courses to be determined by advising.

Technical electives to support the emphasis area must be chosen by the student in consultation with an advisor.

Certificate Program in Hazardous Materials and Waste Management. The Certificate Program in Hazardous Materials and Waste Management is designed to provide current and prospective employees of industry and government with a comprehensive and practical curriculum of study in hazardous materials management. The certificate program features instruction by ASU faculty, attorneys and professionals who work in the specific area in which they teach. The program is offered through the Department of Manufacturing and Industrial Technology.

Participation in the certificate program is available in three options: a certificate program for noncredit, and undergraduate degree in Industrial Management with a Certificate in Hazardous Materials and Waste Management, and a Master of Technology degree in Industrial Management and

NOTE: For the General Studies requirement, codes (such as L1, N3, C, and H), and courses, see pages 71–94. For graduation requirements, see pages 66–70. Omnibus courses are offered that are not listed in the catalog; see pages 44–45.

Supervision with a Certificate in Hazardous Materials and Waste Management. Candidates for option one should call 602/965–3781 to request a registration form. Candidates for options 2 and 3 should apply for admission through the Office of Undergraduate Admissions or the Graduate College respectively.

Students must complete seven selected courses (five required and two electives) and earn a grade of "C" or better to receive the certificate. Except for the introductory course, IST 501 Principles of Hazardous Materials and Waste Management, the remainder of the courses may be taken in any sequence.

Details of this program and the registration form are available from the Department of Manufacturing and Industrial Technology, 602/965–3781.

INDUSTRIAL TECHNOLOGY

ITC 200 Impact of Communications Technology on Society. (3) F, S
Organizational issues and development of technical communication. Activities include research, evaluations, and presentation of oral arguments in support of positions. Prerequisite: ENG 102 or 105 or 108. *General Studies: L1.*

202 Creative Thinking and Design. (3) F, S
Fundamental methods, concepts, and techniques of creative thinking, design, and problem solving. Also includes communication, managerial, cultural, and societal influences. Lecture, lab. Prerequisite: ECE 106 or instructor approval.

343 Occupational Safety. (3) F
Accident prevention, accident factors, methods of recording and reporting, analysis, psychological aspects, attitudes, recent legislation, safety consciousness, and liability. Prerequisite: junior status.

444 Industrial Organization. (3) S
Industrial organization concepts. Topics relate to industrial relations, governmental regulations, organizational structure, labor relations, human factors, and current industrial practices. Field trips. Prerequisite: junior status.

GRAPHIC COMMUNICATIONS

GRC 135 Graphic Communications. (3) F, S
Introduction to the technologies involved in the design image generation, transmission, and production of multiple images for consumer utilization. Lecture, lab, field trips.

237 Introduction to Composition Systems. (3) F
An introduction to traditional and electronic composition systems and procedures used in the graphics communication industry including desktop publishing. Lecture, lab.

331 Quality Assurance for the Reproduction Processes. (3) S
Instrumentation and methodologies for materials testing and quality control in the major reproduction processes. Field trips.

332 Film Assembly and Platemaking. (3) F
Stripping negatives and positives; line, halftone, duo-tone, and full color; contacting flats onto various types of image carriers. Lecture, lab, field trips. Prerequisite: GRC 135.

333 Sheetweb Press Technology. (3) S
Function of the offset printing equipment. Lithographic dynamics of both sheetfed and sheetweb systems. Lecture, lab. Prerequisite: GRC 332 or instructor approval.

334 Image Conversion. (3) F
Theory and production of line work, halftones, contact work, and special effects for the graphic arts industry. Lecture, lab.

335 Printing and Finishing Techniques. (3) S
Analysis of major printing processes of flexography, screen process, and relief; production bindery and finishing procedures. Prerequisite: GRC 135.

336 Color Separation. (3) S
Methods of producing separation negatives and positives. Prerequisite: GRC 334.

337 Production Management. (3) F
Planning and controlling work flow of manufacturing processes. Prerequisite: ITC 200.

339 Estimating and Cost Analysis. (3) S
Management relationship between financial, production, and sales departments in printing industries; analysis of equipment, labor, and material costs; use of paper and standard pricing catalogs. Prerequisite: GRC 135.

433 Production Techniques. (3) N
Systematic production planning experience. Lecture, lab. Prerequisites: GRC 333, 334.

435 Plant Management. (3) F
Concepts, practices, and processes used by the commercial printing plant manager relating to the operation of the plant. Prerequisite: GRC 135 or instructor approval.

436 Gravure Technology. (3) S
In-depth study of the market profile and production sequences related to the gravure method of printing. Prerequisite: GRC 336.

437 Advanced Color Reproduction. (3) F
Scientific analysis for the engineering of color reproduction systems used in the graphic arts industry. Field trips. Prerequisite: GRC 336.

438 Graphic Arts Techniques and Processes. (3) F, S, SS
Survey of production sequences and profile of the printing and publishing industry. Lecture, lab. Prerequisite: junior standing.

439 Electronic Publishing Systems. (3) S
The study of electronic publishing systems and how text and graphics are integrated into a publication using desktop publishing technologies.

537 Current Issues in Quality Assurance. (3) N
Directed group study of selected issues relating to quality assurance in the printing and publishing industry.

INDUSTRIAL MANAGEMENT

IST 346 Management Dynamics. (3) S
Management challenges and the leadership skills needed to achieve organizational objectives in the changing industrial and technical environments.

402 Industrial Laws, Contracts, and Regulations. (3) F
Review of city, state, county, and federal laws that affect industrial and construction operations, materials, supplies, and acquisition procedures.

430 Ethical Issues in Technology. (3) N
Topics in social responsibility for industrial technology and engineering.

445 Industrial Internship. (1–10) F, S, SS
Work experience assignment in industry commensurate with student's program. Specialized instruction by industry with university supervision. Prerequisites: advisor approval; junior status; 2.50 GPA.

451 Materials Control. (3) N
Activities of material handling, including purchasing, receiving, warehousing, traffic, plant layout, inventory, and production control and shipping relating to technical procedures.

452 Industrial Human Resource Management. (3) F, S
Concepts and practices of human resource management in a global industrial environment.

453 Safety Management. (3) N
Development and management of safety programs, education and training, and relationships within an organization. Prerequisite: ITC 343 or instructor approval.

454 Occupational Hygiene. (3) S
Offers an overview of occupational health hazards, their recognition, evaluation, and control. Discusses how industries are regulated and how occupational health standards are promulgated. Prerequisites: CHM 101 or 113 or 114; MAT 170.

455 Industrial Sales and Demand. (3) N
Customer and sales strategies for industrial organizations, including current practice and future planning. Prerequisites: ECN 111; advisor and instructor approval; junior standing.

461 Production Supervision Principles. (3) F
Introduction to supervisory principles as applied to production of goods and services. Prerequisite: ITC 444.

480 Organizational Effectiveness. (3) F, S
Human aspects of supervisory behavior in the industrial setting and how they influence efficiency, morale, and organizational practice. Prerequisite: IST 346.

491 Introduction to Labor Concerns. (3) S
Introduction to labor relations, organization of labor unions and federations, collective bargaining, grievances and arbitration, and applicable labor legislation.

501 Principles of Hazardous Materials and Waste Management. (3) F
Foundation for courses in curriculum. Topics include definitions of toxic and hazardous substances and wastes, RCRA classification, and OSHA criteria. Pre- or corequisites: CHM 113 and 115; MAT 170.

502 Regulatory Framework for Toxic and Hazardous Substances. (3) F
Provides an in-depth examination of federal, state, and local regulations and requirements for hazardous materials and wastes. Includes an overview of legislative history and trends, industry's role in regulatory development, and its impact. Prerequisite: IST 501.

503 Principles of Toxicology. (3) S
Interaction of chemicals with life and environment. Mechanisms of toxic action, dose-response relationships, toxicity testing models, predictive toxicology, epidemiology. Prerequisite: CHM 113 and 115.

504 Technology for Storage, Treatment, and Disposal of Hazardous Materials. (3) F
Current and state-of-the-art technologies, and future trends for storage, treatment, and disposal of hazardous materials and waste. Prerequisites: CHM 113 and 115; IST 501.

505 Quantitative Analysis and Practical Laboratory Techniques. (3) F, S
Examines lab techniques for evaluation of hazardous materials, and discusses how to interpret data from analytical processes and regulatory lab requirements like SW 846. Lab will be arranged off site. Prerequisites: CHM 101 or 113 or 114; MAT 170.

506 Chemistry of Hazardous Materials. (3) F
Chemical information needed for handling spilled hazardous substances. Response needs for oxidizers, organics and inorganics, and basic toxicology needs. Prerequisites: CHM 113 and 115; IST 501; MAT 170. Corequisite: CHM 231.

522 Air Pollution and Toxic Chemicals. (3) F
Examines issues in the measurement analysis and control of toxic chemicals in air pollution. Prerequisites: CHM 113 and 115; IST 501; MAT 170.

523 Soils and Groundwater Contamination. (3) N
Theoretical and practical hydrogeology as it applies to cleaning up contamination. Investigative techniques, monitoring, risk assumptions, and assessment methodology. Prerequisites: CHM 113 and 115; IST 501; MAT 170. Corequisite: CHM 231.

524 Emergency Preparedness, Response, and Planning for Hazardous Materials. (3) S
In-house or on-site emergency response contingency planning. Preemergency assessment, resources for cooperation, equipment requirements, and coordination with other agencies. Prerequisites: CHM 113 and 115; IST 501; MAT 170.

525 Risk Assessment for Hazardous Materials. (3) F
Examines the risk assessment process and its application in various situations ranging from citing hazardous facilities regulation to control of toxic substances in the environment. Prerequisites: CHM 101 or 113 or 114; IST 501; MAT 170.

526 Current Issues: Radon, Asbestos. (3) S
Deals with the latest up-to-date topics in toxics management. New subjects may be added and others deleted as issues of the day become apparent. Prerequisites: CHM 101 or 113 or 114; IST 501; MAT 170.

527 Environmental/Resources Regulations Concepts. (3) S
Covers development of environmental, natural resources and water law, from common law to modern statutory requirements. Specifics on Superfund, hazardous materials and toxics regulations and liability contracts. Prerequisites: CHM 101 or 113 or 114; IST 501.

542 Global Management Philosophies. (3) N
Analysis and comparison of significant supervision philosophies developed in various industrial nations and their potential application in the United States.

549 Research Techniques and Applications. (3) F, S
Selection of research problems, analysis of literature, individual investigations, preparing reports, and proposal writing.

550 Industrial Training. (3) N
Training techniques and learning processes. Planning, developing, and evaluating training programs in industry and governmental agencies. Prerequisite: advisor approval.

570 Project Management. (3) S
Planning, organizing, coordinating, and controlling staff and project groups to accomplish the project objective.

INTERACTIVE COMPUTER GRAPHICS

ICG 212 Design Documentation. (3) S
Using microcomputer-based graphics systems for product design and documentation. Geometric shape analysis and description. Documentation techniques and standards. Dimensioning. Lecture, lab, field trips. Prerequisite: ECE 106.

310 Computer Graphics Fundamentals. (3) S
Computer image creation, transformation, and manipulation. Current techniques for database generation. Concepts of applications software development. Hands-on experience. Lecture, lab, field trips. Prerequisite: programming background helpful but not necessary. *General Studies: N3.*

312 Computer-Aided Design and Drafting. (3) F
Using computer-aided design and drafting application software for advanced geometric construction. System and workstation configuration and productivity. Modeling applications. Lecture, lab, field trips. Prerequisite: ICG 212. *General Studies: N3.*

313 Technical Illustration. (3) F
Pictorial drawing, shades and shadows, and multimedia rendering techniques. Lecture, lab. Prerequisite: ICG 212.

314 Computer Graphics Database. (3) S
Preparing the product definition database for computer-integrated manufacturing. Documentation and process requirements, systems, and standards. Precision dimensioning. Lecture, lab, field trips. Prerequisite: ICG 212 or instructor approval.

412 Computer Graphics Modeling. (3) F
Establishing and manipulating 3-dimensional computer models. Applications, including solids modeling concepts, design analysis, dynamic simulation, and graphic data exchange files. Lecture, lab, field trips. Prerequisite: ICG 312. *General Studies: N3.*

413 MicroCADD Applications. (3) F
Student selected modules, including architectural, construction, civil utility, and electronic drawing; mechanical manufacturing, animation, computer graphics, and others. Lecture, lab, field trips. Prerequisite: ICG 212.

417 Graphics Systems Management. (3) S
Planning, implementing, and managing computer graphics systems. Applications, needs assessment, analysis of components, system ergonomics, interfacing, maintenance, and human resources management. Lecture, lab, field trips. Prerequisite: instructor approval.

461 Computer Animation. (3) F
Fundamental technology used in creating 2-dimensional and 3-dimensional animation through modeling, scripting, and rendering as related to engineering simulation. Lecture, lab, field trips. Prerequisite: ICG 310 or instructor approval.

517 Graphics Systems Development. (3) S
Research and development in computer graphics systems. Applied project management, development, evaluation, and implementation. Lecture, lab, field trips. Prerequisite: ICG 412 or instructor approval.

MANUFACTURING TECHNOLOGY

MET 230 Engineering Materials and Processing. (3) F, S, SS
Materials, their structures, properties, fabrication characteristics, and applications. Material forming, joining, and finishing processes. Automation and quality control. Prerequisite: CHM 101 or 113 or 114.

231 Manufacturing Processes. (3) F
Metal removal processes, emphasizing drilling, milling, and lathe processes, including tool bit grinding. Emphasis on production speeds and feeds. Lecture, lab. Prerequisites: ETC 100; MET 230.

300 Applied Material Science. (4) F
Principles of materials science emphasizing concepts relevant to manufacturing and use. Discuss metals, polymers, ceramics, and composites. 3 hours lecture, 1 hour lab. Prerequisite: MET 230 or instructor approval.

302 Welding Survey. (3) F
Theory and application of industrial welding processes; introductory welding metallurgy and weldment design; SMAW, GTAW, GMAW, Oxyacetylene, and brazing experiences. Lecture, lab. Prerequisite: upper-class standing.

303 Machine Control Systems. (3) S
Theory and application of electromechanical, hydraulic, pneumatic, fluidic, and electrical control systems for manufacturing. Lecture, lab. Prerequisites: ETC 201 or PHY 112; MAT 260.

313 Applied Engineering Mechanics: Materials. (4) F, S, SS
Stress, strain, relations between stress and strain, shear, moments, deflections, and combined stresses. 3 hours lecture, 1 hour lab. Prerequisite: ETC 211.

321 Engineering Evaluation of Welding Processes. (3) N
Theory and application of the arc welding processes and oxy-fuel cutting; fixturing, procedures, safety, codes, and experimental techniques are covered. Lecture, lab. Prerequisites: MET 302; PHY 112.

322 Engineering Evaluation of Nontraditional Welding Processes. (3) N
Theory and applications of EBW, LBW, solid state bonding, brazing, and soldering. Lecture, lab. Prerequisites: MET 302; PHY 112.

325 Electrical Power Source Analysis. (4) S
Design and operating characteristics of electrical power sources and related equipment. Equipment selection, setup, and troubleshooting procedures covered. Lecture, lab. Prerequisites: ETC 201; MET 302; PHY 112, 114.

331 Design for Manufacturing I. (3) S
Introduction to design of machines and structures, with emphasis on layout design drawing. Basics of gears, cams, fasteners, springs, bearing linkages, cylindrical fits, flat pattern development, and surface finish requirements emphasized. Prerequisite: MET 313.

341 Manufacturing Analysis. (3) S
Introduction to the organizational and functional requirements for effective production. Includes writing production operation plans. Prerequisite: MET 231.

343 Material Processes. (4) S
Industrial processing as applied to low, medium, and high volume manufacturing. Basic and secondary processing, fastening and joining, coating, and quality control. Lecture, lab.

344 Casting and Forming Processes. (3) S
Analysis of various forming processes to determine load requirements necessary for a particular metal forming operation. This information is used to select equipment and design tooling. Metal casting processes and design of castings. Introduction to powder metallurgy. Prerequisites: MET 300, 313; *or* instructor approval.

345 Advanced Manufacturing Processes. (3) S
Metal removal processes, emphasizing milling, grinding, turret and tracer lathe, and cutter sharpening. Application of machinability theory to practice. Production feeds, speeds, and tool wear measurement. Lecture, lab. Prerequisites: MET 231, 300; *or* instructor approval.

346 Numerical Control Point to Point and Continuous Path Programming. (3) N
Methods of programming, set up, and operation of numerical control machines, emphasizing lathe and mill systems. Lecture, lab. Prerequisite: MET 231.

354 Mechanics of Materials. (4) F
Vectors, force systems, friction, equilibrium, centroids, and moment of inertia. Concepts of stress, strain, and stress analysis as applied to beams, columns, and combined loading. Nonmajors only. Prerequisites: MAT 170; PHY 111.

401 Statistical Process Control. (3) S
Introduction to statistical quality control methods as applied to tolerances, process control, sampling, and reliability. Prerequisite: MAT 117 or 170.

416 Applied Computer Integrated Manufacturing. (3) F
Techniques and practices of Computer Integrated Manufacturing, with an emphasis on Computer-Aided Design and Computer-Aided Manufacturing. Prerequisite: MET 346 or instructor approval. *General Studies: N3.*

420 Welding Metallurgy I. (4) N
Metallurgical principles applied to structural and alloy steel and aluminum weldments; laboratory emphasis on welding experiments, metallography, and mechanical testing. Lecture, lab. Prerequisites: MET 300, 302.

421 Welding Metallurgy II. (3) N
Metallurgical principles as applied to stainless steel, super alloy, titanium, and other refractory metal weldments and braze joints. Prerequisite: MET 300.

425 Welding Codes. (2) N
Familiarization with and application of the various codes, standards, and specifications applicable to weldments. Prerequisite: MET 302 or equivalent.

432 Applied Thermodynamics and Heat Transfer. (3) F, S
Thermodynamics of mixtures. Combustion process. Applications of thermodynamics to power and refrigeration cycles. Heat transfer, including steady state conduction, convection, and radiation. Prerequisite: ETC 340.

433 Thermal Power Systems. (4) N
Analysis of gas power, vapor power, and refrigeration cycles. Components of air conditioning systems. Direct energy conversion. Psychrometry. Analysis of internal combustion engines and fluid machines. Lecture, lab. Prerequisite: MET 432 or instructor approval.

434 Applied Fluid Mechanics. (3) N
Fluid statics. Basic fluid flow equations. Viscous flow in pipes and channels. Compressible flow. Applications to fluid measurement and flow in conduits. Prerequisite: ETC 340.

436 Turbomachinery Design. (3) N
The application of thermodynamics and fluid mechanics to the analysis of machinery design and power cycle performance predictions. Prerequisite: MET 432 or instructor approval.

438 Design for Manufacturing II. (4) F
Application of mechanics in design of machine elements and structures. Use of experimental stress analysis in design evaluation. Lecture, lab. Prerequisite: AET 312 or MET 331 *or* instructor approval.

442 Specialized Production Processes. (3) F
Nontraditional manufacturing processes, emphasizing EDM, ECM, ECG, CM, PM, HERF, EBW, and LBW. Prerequisite: MET 230.

443 N/C Computer Programming. (3) F
Theory and application of computer-aided N/C languages with programming emphasis with APT and suitable postprocessors. Lecture, lab. Prerequisite: MET 346 or instructor approval.

444 Production Tooling. (3) F
Fabrication and design of jigs, fixtures, and special industrial tooling related to manufacturing methods. Lecture, lab. Prerequisite: MET 345.

448 Expert Systems in Manufacturing. (3) F
Introduction to expert systems through conceptual analysis, with an emphasis on manufacturing applications. Prerequisite: MET 231.

451 Introduction to Robotics. (3) F
Introduction to industrial robots. Topics included are robot geometry, robot workspace, trajectory generation, robot actuators and sensors, design of end effectors, and economic justification. Prerequisite: MET 303 or instructor approval.

452 Implementation of Robots in Manufacturing. (3) N
Robotic workcell design, including end effectors, parts presentors, and optimum material flow. Prerequisite: MET 451 or instructor approval.

453 Robotic Applications. (3) S
Lab course utilizing robots and other automated manufacturing equipment to produce a part. Students are required to program robots, as well as interface the robots with other equipment. Prerequisite: MET 303 or 325 or instructor approval.

460 Manufacturing Capstone Project I. (3) F
Small-group projects to design, evaluate and analyze components, assemblies, and systems. Lecture, lab. Prerequisite: MET 303 or instructor approval.

461 Manufacturing Capstone Project II. (3) S
Small-group projects applying manufacturing techniques, with an emphasis on demonstrating state-of-the-art technology. Lecture, lab. Prerequisite: MET 460 or instructor approval.

462 Capstone Project/Weldment Design. (3) S
Design of welded structures and machine elements in terms of allowable stresses, joint configurations, process capabilities, and cost analysis; welding procedures emphasized. Prerequisites: MET 302, 313.

517 Applied Computer Integrated Manufacturing. (3) F
Techniques and practices of Computer Integrated Manufacturing, with an emphasis on Computer-Aided Design and Computer-Aided Manufacturing. Prerequisite: MET 346 or instructor approval.

542 N/C Computer Programming. (3) F
Theory and application of computer-aided N/C languages with programming emphasis with APT and suitable postprocessors. Application case studies are included. Lecture, lab. Prerequisite: MET 346 or instructor approval.

552 Introduction to Robotics. (3) F
Introduction to industrial robots. Topics included are robot workspace, trajectory generation, robot actuators and sensors, design of end effectors, and economic justification. Application case studies. Prerequisite: MET 303 or instructor approval.