ACTG—ACCOUNTING

ACTG 211 Financial Accounting for Nonbusiness Majors (4)
Introduction to financial accounting theory and practice with an emphasis on financial statement preparation and analysis. Not open to Business majors. 4 lectures.

ACTG 224 Financial Accounting (5)
Principles of financial accounting for Business majors. The course prepares students to read and interpret financial statement information. Financial reporting standards are explored to give students an understanding of how financial transactions and events are reflected in financial statements. 5 lectures. Prerequisite: Sophomore standing.

ACTG 225 Managerial Accounting (4)
Applications of accounting to management decision-making, planning and control including cost behavior, budget preparation, performance reporting, motivational and behavioral considerations, and ethics. 4 lectures. Prerequisite: MATH 221, STAT 252, ECON 222, CSC 120 or equivalent, and ACTG 211 or ACTG 224 or consent of instructor.

ACTG 302 Microcomputer Applications in Accounting (2)
Microcomputer applications in accounting. Advanced electronic spreadsheets, including integration with word processing and database software. Selection and use of accounting software on microcomputers. 1 lecture, 1 activity. Prerequisite: ACTG 211 or ACTG 224 and CSC 120 or equivalent.

ACTG 304 Tax Accounting (4)
Federal income taxation of individuals. 4 lectures. Prerequisite: ACTG 211 or ACTG 224 or consent of instructor.

ACTG 321, 322, 323 Intermediate Accounting I, II, III (4) (4) (4)
Comprehensive coverage of financial reporting. 321 covers financial statements, assets, leases, and long-term debt. 322 covers revenue recognition, income taxes, pensions, liabilities, equities, accounting changes, and cash flows. 323 covers accounting for inflation, international accounting, interim and segment reporting, special measurement problems, financial disclosures and analysis. 4 lectures. Prerequisite: 321: ACTG 224 and junior standing; 322: ACTG 321 with minimum grade of C-; 323: ACTG 322 with minimum grade of C-.

ACTG 400 Special Problems for Advanced Undergraduates (1–4)
Individual investigation, research, studies, or surveys of selected problems. Total credit limited to 4 units. Prerequisite: Junior standing and consent of instructor.

ACTG 402 Advanced Cost Accounting (4)
Product costing systems including hybrid costing systems, management control systems, cost allocation, activity based costing, cost information for decision making, new manufacturing environment, backflush costing and strategic control systems. International dimension integrated in the course content. 4 lectures. Prerequisite: ACTG 225.

ACTG 404 Taxation of Partnerships, Estates and Trusts and Complex Capital Transactions (4)
Federal income taxation of sales and exchanges, Subchapter S corporations, partnerships, estates and trusts. Federal gift and estate taxes. 4 lectures. Prerequisite: ACTG 304.

ACTG 405 Corporate Tax Accounting and Tax Administration (4)
Federal income taxation of regular corporations, tax research, tax administration, and IRS practice. 4 lectures. Prerequisite: ACTG 304.

ACTG 421 Accounting for Business Combinations (2)
Concepts and techniques of accounting for various forms of business combinations including acquisitions, mergers, and consolidations. Emphasis is placed on the preparation of consolidated financial statements for acquisitions classified as purchases and poolings-of-interests. 2 lectures. Prerequisite: ACTG 323 with minimum grade of C-, or consent of instructor.

ACTG 422 Accounting for Governments and Not-For Profit Entities (2)
Accounting concepts and techniques used by state and local units of governments and private not-for-profit entities. Emphasis is placed on the accounting and reporting practices of state and local units of governments. 2 lectures. Prerequisite: ACTG 321 with minimum grade of C-, or consent of instructor.

ACTG 423 Financial Reporting by Public Companies (2)
A study of the Securities and Exchange Commission and its reporting requirements. Emphasis is placed on the Commission’s regulation of accounting, reporting, internal controls, and auditing. Impact on accountants’ legal liability is also examined. 2 lectures. Prerequisite: ACTG 323 with minimum grade of C-, or consent of instructor.

ACTG 431 Professional Accounting (4)
Development of the accounting profession. Past, present and future. Emphasis on contemporary issues confronting the professional accountant and his/her social and ethical responsibilities and opportunities. 4 lectures. Prerequisite: ACTG 323 with minimum grade of C-, or consent of instructor.

ACTG 446 Auditing (4)
Survey of the auditing environment including institutional, ethical, and legal liability dimensions. Introduction to audit planning, assessing materiality and audit risk, collecting and evaluating audit evidence, considering the internal control structure, substantive testing, and reporting. 4 lectures. Prerequisite: ACTG 323 with minimum grade of C-, or consent of instructor. Recommended: MIS 221.

ACTG 447 Advanced Auditing (4)
Advanced coverage of selected topics including assessing materiality and audit risk, applying nonstatistical and statistical sampling, auditing computerized accounting systems, performing other attestation and accounting services, and researching auditing problems. 3 lectures, 1 activity. Prerequisite: ACTG 446. Recommended: MIS 321.
ACTG 461 Senior Project (1)
Provides practice in using primary research resources and materials in accounting and auditing. Original authoritative sources used include professional standards, academic journals, and computerized data bases. 1 seminar. Prerequisite: ACTG 323, senior standing, and completion of graduation writing requirement.

ACTG 462 Senior Project (3)
Selection and analysis of a problem under faculty supervision. Problems typical of those which graduates must solve in their fields of employment. Formal report is required. Minimum 90 hours total time. Prerequisite: ACTG 461.

ACTG 470 Selected Advanced Topics (1–3)
Directed group study of selected topics for advanced students. Open to undergraduate and graduate students. Class Schedule will list topic selected. Total credit limited to 6 units. 1 to 3 lectures. Prerequisite: Consent of instructor.

ACTG 500 Individual Study (1–4)
Advanced study planned and completed under direction of departmental faculty member. Open only to graduate students demonstrating ability to do independent work. Enrollment by petition. Prerequisite: Consent of department head.

AE-AGRICULTURAL ENGINEERING

AE 121 Agricultural Mechanics (2) GEB F.2.
Identification and use of tools and materials; shop safety; tool sharpening and care; concrete mixes and materials; simple electric wiring; metal work; pipe fitting; basic woodworking; estimating quantities and costs. Students are required to meet safety regulations in laboratory work. Miscellaneous course fee required—see Class Schedule. 1 lecture, 1 laboratory.

AE 128 Introduction to Fundamentals of Agricultural Technology (3)
Introduction to agricultural engineering and agricultural engineering technology. Career opportunities. Problem solving techniques. Selection of materials for fabrication. Laboratory skills development in wood, metal, concrete, plumbing and projects in creative design. Strength tests of wood joints and concrete. Performance test of student design projects. Miscellaneous course fee required—see Class Schedule. 2 lectures, 1 laboratory. Prerequisite: MATH 116 or equivalent, high school drafting or concurrent enrollment in AE 133 or ETME 131.

AE 133 Agricultural Drafting (3)
Technical drawing oriented toward working drawings of agricultural engineering components and systems. Freehand sketching and instrument techniques. Multiview projection and pictorial drawings. Not open for credit to students with previous college level drafting course work. 1 lecture, 2 laboratories.

AE 143 Power and Machinery (4)
Performance of tractors and machinery. Evaluation of tillage, planting, and harvesting operations. Analysis and development of optimum mechanical systems. Use of microcomputers for evaluation, analysis, and report presentation. Miscellaneous course fee required—see Class Schedule. 3 lectures, 1 laboratory. Prerequisite: AE 128, MATH 116 or equivalent.

AE 151 CAD for Agricultural Engineering (1)
Computer aided drafting on the Macintosh or similar computer using Autocad software. Drawing setup. 2-D projections including automatic dimensioning and hatching. Isometric construction, drawing layers, library symbols. Use of 3-D drawing software. 1 laboratory. Prerequisite: ETME 142 or equivalent.

AE 200 Special Problems for Undergraduates (2–4)
Individual investigation, research, studies or surveys of selected problems. Total credit limited to 8 units, with a maximum of 4 units per quarter. Prerequisite: Consent of department head.

AE 232 Agricultural Structures Planning (3)
Environmental factors affecting crop storage structures and animal housing. Insulation, heating, ventilation, water supply, and waste disposal. Functional planning of production systems. Application of solar energy to agriculture. 2 lectures, 1 laboratory. Prerequisite: AE 128, PHYS 132 and college drafting.

AE 236 Principles of Irrigation (4)
Land grading design, operation, management, and evaluation of irrigation methods. Miscellaneous course fee required—see Class Schedule. 3 lectures, 1 laboratory. Prerequisite: MATH 141, AE 237, SS 121, a computer programming course.

AE 237 Engineering Surveying I (2)
Use and care of tapes, levels, transit, and electronic distance measuring instruments (EDMI). Keeping field notes, measurements by tape. Differential and profile leveling. Turning angles and determining directions of lines. Map reading. 1 lecture, 1 laboratory. Prerequisite: MATH 119 or an understanding of trigonometric functions.

AE 238 Engineering Surveying II (2)

AE 240 Agricultural Engineering Laboratory (1–2)
Individual projects. Total credit limited to 4 units, with a maximum of 2 units per quarter. 1 or 2 laboratories. Prerequisite: Consent of instructor.

AE 312 Hydraulics (4)
Static and dynamic characteristics of liquids, flow in open and closed channels, uniform and nonuniform flow, flow measurement, pumps. 3 lectures, 1 laboratory. Prerequisite: PHYS 132, ME 211.

AE 321 Agricultural Safety (3)
Principles of agricultural safety. Accident causation and prevention, hazard identification and abatement, laws and regulations. Machinery, electrical, chemical, livestock, shop and fire safety. Rural crime prevention and safety program development. 3 lectures. Prerequisite: Junior standing.
AE 326 Energy Systems for Agriculture (3)
Theory and application of energy sources and systems. Covering such sources as heat systems, biomass, direct energy conversion, and power application to the soil. 2 lectures, 1 laboratory. Prerequisite: AE 143, ME 211, ME 302. ME 302 may be taken concurrently.

AE 328 Measurements and Computer Interfacing (3)
Transducers and engineering measurements in agricultural engineering. Transducer characteristics, signal processors and controllers, instrumentation techniques and the use of the computer in the measurement interface. 2 lectures, 1 laboratory. Prerequisite: CSC 251, EE 311.

AE 331 Irrigation Theory (3)
Plant-water-soil relations using evapo-transpiration, plant stress, soil moisture deficiency, frequency and depth of irrigation, salinity, infiltration, drainage and climate control. Miscellaneous course fee required—see Class Schedule. 3 lectures. Prerequisite: AE 236, SS 121, MATH 141 or consent of instructor.

AE 337 Landscape Irrigation (3)
Design of landscape irrigation systems including soil factors, hydraulics, site information, selection of system components, back flow prevention, plumbing codes and cost estimating. 2 lectures, 1 laboratory. Prerequisite: SS 121 or consent of instructor.

AE 339 Agricultural Mechanics Skills (2)
Advanced shop skills. Carpentry, electricity, plumbing, surveying, power mechanics, tractor equipment operation and maintenance. 2 lectures, 2 laboratories weekly for five weeks per session—two sessions per quarter. Prerequisite: Agricultural teacher candidates starting/returning from student teaching, senior or graduate standing or consent of instructor.

AE 340 Irrigation Water Management (4) GEB F.2.
Soil-plant-water relationships, evapotranspiration rates and irrigation schedules. Water quality, salinity and drainage. Water rights and irrigation institutions. Water measurement. For non-AE majors only. Miscellaneous course fee required—see Class Schedule. 3 lectures, 1 laboratory. Prerequisite: MATH 118, SS 121, or consent of instructor.

AE 345 Aerial Photogrammetry and Remote Sensing (3)
Object recognition, three-dimensional equipment, and interpretation. Print alignment, stereoscopic viewing, scales, elevation determination, and application. Application of aerial photos to regional studies. 2 lectures, 1 laboratory. Prerequisite: MATH 116.

AE 348 Energy for a Sustainable Society (3)
Transition from fossil-fuel to renewable energy sources including hydro, biomass, solar, wind, and energy conservation. Environmental, economic, and political consequences of a sustainable, energy-based society. 3 lectures. Prerequisite: Junior standing, GEB B.1. course.

AE 399 Graphical Interface Computing in Agriculture (1)
Macintosh or similar computer and available software as an effective educational tool. Applications of word processing, spreadsheets, graphics, drawing/drafting, data base and some basic programming to the problems and designs encountered in the Agricultural Engineering and Agricultural Engineering Technology programs. 1 laboratory. Prerequisite: AG 250 or ARCH 250 or CSC 251.

AE 400 Special Problems for Advanced Undergraduates (2–4)
Individual investigation, research, studies, or surveys of selected problems in agriculture. Total credit limited to 8 units, with a maximum of 4 units per quarter. Prerequisite: Consent of department head.

AE 403 Agricultural Systems Engineering (3)
Engineering principles combined with mathematical optimization techniques to evaluate parameters in agricultural production and processing systems. Project planning techniques, linear and nonlinear modeling, response surface methodology. 2 lectures, 1 laboratory. Prerequisite: CSC 251, IME 314, MATH 242, STAT 321.

AE 405 Chemigation (1)
Fertilizer and chemical injection through irrigation systems. Hardware, fertilizer compounds, and distribution uniformity. Matching chemicals and equipment to specific irrigation methods. Miscellaneous course fee required—see Class Schedule. 1 laboratory. Prerequisite: AE 236 or AE 340, SS 121.

AE 414 Irrigation Engineering (4)
Design of on-farm irrigation systems; micro, surface, and sprinkler irrigation systems; canals and pumps; economic and strategies of pipe design; pipeline protection. Miscellaneous course fee required—see Class Schedule. 3 lectures, 1 laboratory. Prerequisite: AE 331 or AE 340; hydraulics.

AE 415 Hydrology (3)
Collection, organization and use of precipitation and runoff data, flood frequency and economics of structures, stream gauging and use of hydrograph, principles of groundwater management and flood routing. 3 lectures. Prerequisite: MATH 141 or consent of instructor.

AE 421 Equipment Engineering (4)
Design and construction of specialized agricultural components and equipment. 2 lectures, 2 laboratories. Prerequisite: CE 205, ME 212, IME 142.

AE 422 Equipment Engineering (3)
Design and construction of specialized agricultural components and equipment. 2 lectures, 1 laboratory. Prerequisite: AE 421.

AE 425 Computer Controls for Agriculture (3)
Computer activated controls as applied to agricultural machinery, agricultural structures, processing and irrigation industries. Encompassing control logic to evaluate stability behavior of systems of computer interfacing, data input and control output. 2 lectures, 1 laboratory. Prerequisite: ASM 324, CSC 110 or AG 250.

AE 427 Agricultural Process Engineering (3)
Agricultural engineering principles applied to air, water, air-water mixtures, drying, heating, refrigeration, fluid flow, size reduction, fan laws and materials handling. 2 lectures, 1 laboratory. Prerequisite: AE 312, AE 333, ME 302.
AE 430  Finite Element Analysis (3)
Introduction to the theory of finite element analysis and its application to drainage, pipe flow, fruit and vegetable damage predictions, structural strength, heat transfer, and other agricultural engineering applications. 2 lectures, 1 laboratory. Prerequisite: CE 204, MATH 242, ME 302.

AE 433  Agricultural Structures Design (4)
Structural analysis and design of agricultural service and processing buildings. Emphasis on use of wood, metals, and reinforced concrete in light construction. 3 lectures, 1 laboratory. Prerequisite: AE 232, CE 205.

AE 435  Drainage (3)
Flow of water in porous media. Intrinsic permeability and hydraulic conductivity. Flow nets, wells and ground water, design of sub-surface drains. 2 lectures, 1 laboratory. Prerequisite: AE 312, AE 331, or AE 340 or SS 432 and consent of instructor.

AE 437  Conservation Engineering (3)
Engineering solutions of soil and water conservation problems. Applications of engineering fundamentals of hydraulics, hydrology, and soils used in the design and construction of soil and water conservation structures. 2 lectures, 1 laboratory. Prerequisite: AE 312, AE 415, SS 121, or consent of instructor.

AE 440  Agricultural Irrigation Systems (4)
On-farm irrigation system evaluation and management. Drip, micro-spray, furrow, border strip, sprinkler systems. Irrigation efficiency and uniformity. Pumping costs. For non-AE majors only. Miscellaneous course fee required—see Class Schedule. 3 lectures, 1 laboratory. Prerequisite: SS 121 or consent of instructor.

AE 446  Geographic Information Data Sources (2)
Techniques for preparing data for geographic information systems. Digital data from surveying, aerial photographs, satellite imagery, and government data sources will be entered, displayed, and edited using computer software and translated for use in other software packages. 1 lecture, 1 laboratory. Prerequisite: AE 237 or AE 131, and GEB F.1. computer literacy course.

AE 448  Bioconversion (3)
Thermal mechanics and physical techniques for converting biomass into useful energy forms for agriculture and industry. Laboratory exercises include experiments with methane and alcohol production and combustion of agricultural residue. Miscellaneous course fee required—see Class Schedule. 2 lectures, 1 laboratory. Prerequisite: MATH 117 or equivalent, or consent of instructor.

AE 450  Advanced Graphical Interface Computing (1)
Macintosh or similar computer as an effective intellectual tool. Applications in problem solving, project planning, numerical analysis, advanced word processing, spreadsheets and modeling. Communications and data transfer. 1 laboratory. Prerequisite: AE 399 or equivalent.

AE 461, 462  Senior Project (2) (3)
Solution of an engineering problem in agriculture. Involves research methodology: problem statement, analysis, synthesis project design, construction (when feasible), and evaluation. Project requires 150 hours with a minimum of faculty supervision.

AE 464  Professional Practice (3)
Contracts, specifications, and legal aspects of agricultural engineering. Safety and human factors. Engineering ethics and professional registration. 3 lectures. Prerequisite: Senior standing.

AE 470  Selected Advanced Topics (1–3)
Directed group study of selected topics for advanced students. Open to undergraduate and graduate students. Class Schedule will list topic selected. Total credit limited to 6 units. 1–3 lectures. Prerequisite: Consent of instructor.

AE 471  Selected Advanced Laboratory (1–3)
Directed group laboratory study of selected topics for advanced students. Open to undergraduate and graduate students. Class Schedule will list topic selected. Total credit limited to 6 units. 1–3 laboratories. Prerequisite: Consent of instructor.

AE 492  Pumps and Pump Drivers (3)
Pump characteristics and system head. Net positive suction head. Series and parallel operation. Pump contracts and protection. Selection of pumping systems for different water sources. Design of pump intakes for surface water supplies. Driver selection. Servicing motors and engines. Hand pumps and wind mills. 2 lectures, 1 laboratory. Prerequisite: Senior standing.

AE 500  Individual Study (1–3)
Advanced study planned and completed under the direction of a member of the department faculty. Open only to graduate students who have demonstrated ability to do independent work. Enrollment by petition. Prerequisite: Consent of instructor.

AE 521  Engineering of Agricultural Systems (4)
Problem solving by analyzing the need, establishing boundaries and developing creativity. Examples worked through in practicality analysis, transportation problems, linear programming and system analysis with an emphasis on optimum system operation. 3 lectures, 1 laboratory. Prerequisite: Consent of instructor.

AE 522  Instrumentation Control/Microprocessors (4)
Engineering input/output instrumentation for sensing and controlling functions through data acquisition, analysis and response to agricultural processing. Miscellaneous course fee required—see Class Schedule. 3 lectures, 1 laboratory. Prerequisite: BASIC language programming or consent of instructor.

AE 529  Small Farm Mechanization (3)
Principles of farm machinery used for tillage, seeding, weeding, harvesting and transport of agricultural crops. Small-scale equipment, suitable for subsistence farming in developing countries. Small tractors, hand tools, animal power, and fuel from renewable sources. Miscellaneous
course fee required—see Class Schedule. 2 lectures, 1 laboratory. Prerequisite: AE 143 or equivalent, graduate standing, or consent of instructor.

**AE 531 Water Wells (3)**
Groundwater resources drilling methods and development of wells. Water well design for pollution prevention. Well rehabilitation. Destruction of abandoned wells. Design of domestic water systems. Water quality standards and water conditioning for different applications. 2 lectures, 1 laboratory. Prerequisite: Graduate standing.

**AE 533 Irrigation Project Design (4)**
Formation of water user associations and social/financial aspects of development of irrigation projects. Engineering solutions for improved water delivery and canal automation. Interaction between engineering and social factors. Prerequisite: AE 340. 3 lectures, 1 laboratory. Prerequisite: Graduate standing or consent of instructor.

**AE 581 Graduate Seminar in Agricultural Engineering (3)**
Group study of current problems of the agricultural engineering industry; current experimental and research findings as applied to field of agricultural engineering. Class Schedule will list topic selected. Total credit limited to 9 units. 3 seminars. Prerequisite: Graduate standing or consent of instructor.

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**AERO–AERONAUTICAL ENGINEERING**

**AERO 102 General Aviation (3)**

**AERO 121 Aerospace Fundamentals (1)**
Introduction to the engineering profession including the aeronautical and aerospace fields. Engineering approach to problem-solving and analysis of data obtained from experiments. Basic nomenclature and design criteria used in the aerospace industry. Applications to basic problems in the field. 1 laboratory.

**AERO 200 Special Problems for Undergraduates (1–2)**
Individual investigation, research, studies, or surveys of selected problems. Total credit limited to 4 units, with a maximum of 2 units per quarter. Prerequisite: Consent of department head.

**AERO 210 History of Aviation (3) GEB F.2.**
History of technological innovations which led to modern aviation. People and circumstances that contributed to the major breakthroughs in aeronautics and astronautics. Impact of aviation on society. Discussion of current events in aviation. 3 lectures.

**AERO 215 Aerospace Engineering Analysis I (2)**
Introduction to problem solving techniques in aerospace engineering using digital computers. Primary emphasis on the solution of problems in aerodynamics, aerospace structures, performance, stability and control, and astronautics. 2 laboratories. Prerequisite: CSC 251, MATH 143.

**AERO 240 Additional Engineering Laboratory (1–2) (CR/NC)**
Total credit limited to four units, with not more than two units in any one quarter. Credit/No Credit grading. 1 or 2 laboratories.

**AERO 301, 302, 303 Aerothermodynamics (5) (5) (3)**
Properties and characteristics of fluids, fluid statics and dynamics, the thermodynamic relations, laminar and turbulent subsonic flows as applied to flight vehicles. Introduction to heat transfer. 5 lectures, fall and winter; 3 lectures, spring. Prerequisite: ME 211, MATH 242.

**AERO 304 Experimental Aerothermodynamics (2)**
Laboratory experiments verify the momentum and energy equations. Fan performance, boundary layer measurements, diffuser performance, heat transfer and solar collector performance experiments are evaluated. 1 lecture, 1 laboratory. Prerequisite: ENGL 218. Concurrent: AERO 302.

**AERO 306 Aerodynamics I (3)**

**AERO 307 Wind Tunnel and Flight Test Laboratory (3)**
Wind tunnel testing of basic aerodynamic properties of airfoils, finite wings, aircraft models, and aircraft flight performance. Emphasis on both static and dynamic responses of aircraft. Various measurement techniques, data reduction schemes, and analysis methods. 1 lecture, 2 laboratories. Prerequisite: AERO 302, AERO 306, ENGL 218.

**AERO 315 Aerospace Engineering Analysis II (3)**
Analysis methods for aerospace engineering problems. Applications of analysis methods to solving problems in aerodynamics, aerospace structures, stability and control, and astronautics. 3 lectures. Prerequisite: AERO 215, MATH 242.

**AERO 320 Fundamentals of Guidance and Control (3)**
Introduction to state-space and transfer function models for aircraft, missiles, and helicopters. Elementary classical and modern analysis techniques using interactive computer graphics. 3 lectures. Prerequisite: AERO 215. Concurrent: AERO 315.

**AERO 330 Stress Analysis (4)**
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<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Description</th>
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<tbody>
<tr>
<td>AERO 400</td>
<td>Special Problems for Advanced Undergraduates</td>
<td>(1–2) Individual investigation, research, studies, or surveys of selected problems. Total credit limited to 4 units, with a maximum of 2 units per quarter.</td>
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<tr>
<td>AERO 404</td>
<td>Gas Dynamics (3)</td>
<td>Fundamental theory of one dimensional gas dynamics: Inertioal flow, flow in converging-diverging nozzles, shock propagation, normal and oblique shock theory, Prandtle-Meyer expansions, Fanno line flow, and measurement methods. 3 lectures. Prerequisite: AERO 302.</td>
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<tr>
<td>AERO 405</td>
<td>Aerodynamics II (3)</td>
<td>Review of gas dynamics, shock-wave and boundary-layer interaction, compressible subsonic and transonic flows over airfoils, 2-dimensional supersonic flows around thin airfoil, finite wing in supersonic flow. 3 lectures. Prerequisite: AERO 306, AERO 404.</td>
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<tr>
<td>AERO 406</td>
<td>Hypersonic Flow Theory (3)</td>
<td>Theoretical and analytical methods for the high-speed flight of aerospace vehicles. Review of gas dynamics, local surface inclination methods, inviscid methods, boundary layer and aerodynamic heating, and viscous interactions. 3 lectures. Prerequisite: AERO 306, AERO 404.</td>
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<tr>
<td>AERO 409</td>
<td>Flight Test (3)</td>
<td>Principles of flight testing with applications to performance, stability and control, and avionics system test. Data analysis and presentation. Test planning and principles of in-flight simulation. 1 lecture, 2 laboratories. Prerequisite: AERO 306, AERO 320.</td>
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<tr>
<td>AERO 418</td>
<td>Fundamentals of Flight Simulation (3)</td>
<td>Overview of flight simulators and supporting facilities. Aircraft equations of motion and navigation equations with respect to the earth’s surface. Ground, environmental, avionics systems models. Lab simulation and flight evaluation. 2 lectures, 1 laboratory. Prerequisite: AERO 320 or EE 301 or CSC 360 or ME 422.</td>
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<tr>
<td>AERO 420</td>
<td>Stability and Control of Aerospace Vehicles (4)</td>
<td>Steady-state and perturbed equations of motion for a rigid body in flight. Static and dynamic stability derivatives. Modes of motion in response to control inputs. State-space and transfer function analysis. Introduction to feedback control. 4 lectures. Prerequisite: AERO 306 and AERO 320 or ME 212.</td>
</tr>
<tr>
<td>AERO 432</td>
<td>Experimental Stress Analysis (1)</td>
<td>Employing the knowledge of stress analysis and aerospace structural analysis in an individual and group design project dealing with aerospace structures. 1 laboratory. Prerequisite: AERO 430.</td>
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<tr>
<td>AERO 447, 448, 449</td>
<td>Spacecraft Design (2) (4) (4)</td>
<td>Preliminary layout of typical space vehicle using design and calculation techniques developed in previous aeronautical engineering courses. Design of selected components and preparation of necessary drawings. AERO 447: 2 laboratories. AERO 448 and AERO 449: 2 lectures, 2 laboratories. Prerequisite: AERO 315, senior standing. Concurrent: AERO 401, AERO 420, AERO 451, AERO 430.</td>
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<tr>
<td>AERO 451</td>
<td>Orbital Mechanics I (3)</td>
<td>Motion of a body in the central force field. Space vehicle trajectories, guidance systems, power generators for interplanetary travel, structural loading, and principles of space vehicle design. 3 lectures. Prerequisite: ME 212.</td>
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</table>
AERO 461, 462  Senior Project (2) (3)  
Selection and completion of a project which is typical of problems which graduates must solve in their fields of employment. Project results are presented in a formal report. Minimum 150 hours total time. Prerequisite: Senior standing.

AERO 470  Selected Advanced Topics (1–3)  
Directed group study of selected topics for advanced students. Open to undergraduate and graduate students. Class Schedule will list topic selected. Total credit limited to 6 units. 1 to 3 lectures. Prerequisite: Consent of instructor.

AERO 471  Selected Advanced Laboratory (1–3)  
Directed group laboratory study of selected topics for advanced students. Open to undergraduate and graduate students. Class Schedule will list topic selected. Total credit limited to 6 units. 1 to 3 laboratories. Prerequisite: Consent of instructor.

AERO 485  Cooperative Education Experience (6) (CR/NC)  
Part-time work experience in business, industry, government, and other areas of student career interest. Positions are paid and usually require relocation and registration in course for two consecutive quarters. Formal report and evaluation by work supervisor required. Total credit limited to 16 units. Credit/No Credit grading only. Prerequisite: Sophomore standing and consent of instructor.

AERO 495  Cooperative Education Experience (12) (CR/NC)  
Full-time work experience in business, industry, government, and other areas of student career interest. Positions are paid and usually require relocation and registration in course for two consecutive quarters. Formal report and evaluation by work supervisor required. Total credit limited to 16 units. Credit/No Credit grading only. Prerequisite: Sophomore standing and consent of instructor.

AERO 500  Individual Study (1–3)  
Advanced study planned and completed under the direction of a member of the department faculty. Open only to graduate students who have demonstrated ability to do independent work. Enrollment by petition. Prerequisite: Consent of department head, graduate adviser and supervising faculty member.

AERO 515  Continuum Mechanics (3)  
Rules of index notation and transformation laws of Cartesian tensors as applied to a continuous medium. Application of these methods to fluids and solids provides the student with a unified understanding of the fundamental laws of physics for a continuum. 3 lectures. Prerequisite: AERO 302, AERO 315, AERO 330, graduate standing or consent of instructor.

AERO 520  Theoretical Aerodynamics (3)  
Fundamentals of analytic aerodynamics; potential flow, Kutta-Joukowski theorem, Schwarz-Christoffel transformation, lifting line theory, thin wing theory, three-dimensional lift and drag of wings, slender body theory. 3 lectures. Prerequisite: AERO 306, MATH 502, graduate standing or consent of instructor.

AERO 521  Boundary-Layer Theory (3)  
Concept of boundary-layer. Boundary-layer equations, similarity transformation, integral methods for steady, two-dimensional laminar and turbulent boundary layers. 3 lectures. Prerequisite: AERO 302, graduate standing or consent of instructor. Concurrent: MATH 501.

AERO 523  Turbulence (3)  

AERO 526  Computational Fluid Dynamics I (3)  
Classification of partial differential equations. Numerical methods for solving elliptic, parabolic, and hyperbolic sets of partial differential equations, including implicit and explicit methods. Consideration of accuracy, stability of numerical methods, and programming complexity. Fundamental equations of fluid dynamics and appropriate numerical solutions. 3 lectures. Prerequisite: CSC 311, AERO 303, graduate standing or consent of instructor.

AERO 527  Computational Fluid Dynamics II (3)  
Application of computational techniques to solving fluid dynamic problems using potential equations, Euler's equation, boundary-layer equations, and Navier-Stokes equations. Grid generation. Turbulence modeling. 2 lectures, 1 laboratory. Prerequisite: AERO 526.

AERO 530  Inelastic Structural Analysis (3)  

AERO 532  Advanced Composite Structures Analysis and Design (4)  

AERO 535  Advanced Aerospace Structural Analysis (3)  
Advanced flight vehicle and fracture mechanics analysis and design. Fundamentals and applications of modern fatigue analysis in the aerospace industry. 3 lectures. Prerequisite: AERO 430, graduate standing or consent of instructor.

AERO 540  Elements of Rocket Propulsion (3)  
Analysis and design of liquid and solid rockets using basic design parameters such as droplet atomization, droplet and particle combustion, heat transfer, combustion stability and control, and thermochemical computations. 3 lectures.
Prerequisite: AERO 401, AERO 404, graduate standing or consent of instructor.

AERO 541 Aircraft Gas Turbine Engines (4)
Aerothermodynamics of propulsion systems, characterization of power plant utilization and operation cycle analysis, on-off design performance, component characterization, component design, component matching, optimization, and introduction to power plant and airframe integration systems for aircraft. 4 lectures. Prerequisite: AERO 401 or ME 443, graduate standing or consent of instructor.

AERO 545 Non-Impulsive Orbit Design (3)
Review of ion chemical design, 2-body orbital mechanics, and expected perturbing forces. Emphasis on Encke methods of perturbed orbit determination. 1 lecture, 2 activities. Prerequisite: AERO 451.

AERO 550 Analysis and Design of Flight Control Systems (3)
Fundamental principles of flight control design for modern aircraft. Automatic control of aircraft and missiles. Selected advanced topics in computer analysis of control systems. 2 lectures, 1 laboratory. Prerequisite: AERO 420 or ME 422, graduate standing or consent of instructor.

AERO 551 Advanced Topics in Estimation and Control (3)
Principles of multi-loop analysis and design using state representations of actual systems. Optimal design for regulators and trackers, Observers and Kalman filter applications. Current research in robust control. 2 lectures, 1 laboratory. Prerequisite: AERO 420 or AERO 550 or ME 422, graduate standing or consent of instructor.

AERO 555 Flying Qualities and Flight Test of Piloted Vehicles (3)
Principles of flight test applied to handling qualities research. Flying qualities prediction from reduced-order models. Transfer function models for the pilot. Cooper-Harper scale, pilot-induced-oscillation, fly-by-wire systems, in-flight simulation and testing. 2 lectures, 1 laboratory. Prerequisite: AERO 550.

AERO 565 Advanced Topics in Aircraft Design (3)
Application of advanced analytic engineering methods to aircraft design problems. Analysis and synthesis of advanced topics related to design of aircraft. 3 lectures. Prerequisite: AERO 522, AERO 530 and AERO 550, graduate standing or consent of instructor. Concurrent: AERO 520.

AERO 570 Selected Advanced Topics (3)
Directed group study of selected topics for graduate students. Open to undergraduate and graduate students. Class Schedule will list topic selected. Total credit limited to 6 units. 3 lectures. Prerequisite: Graduate standing or consent of instructor.

AERO 590 Graduate Seminar (1)
Current developments in the field of Aeronautical Engineering. Participation by students, faculty and guest lecturers. 1 two-hour seminar. Prerequisite: Graduate standing or consent of instructor.

AERO 599 Design Project (Thesis) (2) (2) (5)
Each individual or group will be assigned a project for solution under faculty supervision as a requirement for the master's degree, culminating in a written report/thesis. Prerequisite: Graduate standing.

AG—AGRICULTURE

AG 100 Agriculture Enterprise Project (1–4) (CR/NC)
Selection and completion of a management/production project under faculty supervision. Project participation is subject to approval by the department head and the Cal Poly Foundation. Degree credit limited to 12 units. Registration is through department offices and subtopics will list the department supervising the project. Credit/No Credit grading only.

AG 124 Small Engines (2)
Operating principles of the small internal combustion engine. Maintenance and trouble-shooting applications of small power units to mowers and other landscape equipment. Repair procedures related to economic justifications. 1 lecture, 1 activity.

AG 201 Closed Circuit Hydraulics (3)
Selection, application and use of hydraulic components from manufacturer's specifications and literature. Use of standardized circuit design procedures with related calculation and selection criteria. 2 lectures, 1 laboratory. Prerequisite: AE 234.

AG 231 Agricultural Building Construction (3)
Development of practical skills in carpentry and light construction. Selection of materials. Agricultural buildings repaired, constructed, or modified during laboratory periods. 1 lecture, 2 laboratories. Prerequisite: AE 128 or consent of instructor.

AG 234 Agricultural Power Transmission and Mechanics (3)
Elements in the utilization and transmission of power in agricultural equipment. Emphasis on V-belt, roller chain, gear, and shaft drive. 2 lectures, 1 laboratory. Prerequisite: AE 142, PHYS 121.

AG 235 Agricultural Power (3)
Principles of spark ignition and compression ignition engines and related accessories. Service, trouble-shooting, and repair procedures. 1 lecture, 2 laboratories.

AG 241 Gasoline Engine Diagnosis (3)
Use of modern engine testing equipment in the evaluation of engine components and accessories such as: cylinder condition, ignition systems, electrical and electronic systems and fuel systems. 2 lectures, 1 laboratory. Prerequisite: AG 235.

AG 242 Diesel Fuel Systems (3)
Use of modern test and service equipment in evaluating and servicing diesel fuel systems. Miscellaneous course fee required—see Class Schedule. 2 lectures, 1 laboratory. Prerequisite: AG 235 or equivalent or consent of instructor.
AG 243 Competitive Intercollegiate Rodeo (2) (CR/NC)
Beginning through advanced skills in the event areas of college rodeo. Areas include saddle bronc, bareback, and bull riding; calf, team, and breakaway roping; steer wrestling, goat tying, and barrel racing. Minimum of 10 hours of laboratory per week. Total credit limited to 8 units. Credit/No Credit grading. Enrollment limited to those qualified to compete in intercollegiate rodeo. Consent of coach required.

AG 244 Project Analysis (5)
Analysis of projects for structural design, applied elements of statics, dynamics, strength of materials, fabrication, and fasteners. 3 lectures, 2 laboratories. Prerequisite: AE 133 or equivalent, PHYS 104, AG 234.

AG 245 Agricultural Equipment Projects (3)
Construction of special agricultural equipment related to any agricultural enterprise. 1 lecture, 2 laboratories. Prerequisite: AG 244.

AG 250 Computer Application to Agriculture (3)  GEB F.1.
Microcomputers and commercial software used in agricultural industries. Word processing, spreadsheets, data base management programs, and programs applied to agriculturally oriented problems. Miscellaneous course fee required—see Class Schedule. 3 lectures.

AG 301 Agriculture and American Life (3)  GEB F.2.
Relationship of agriculture and natural resources to man and his society. Impact of soil, water, and land uses on animal and crop production within the United States. Relative importance of resources used and commodities produced. Not open to students with majors in agriculture. 3 lectures. Prerequisite: Junior standing.

AG 339 Internship in Agriculture (1–12) (CR/NC)
Selected students will spend up to 12 weeks with an approved agricultural firm engaged in production or related business. Time will be spent applying and developing production and managerial skills and abilities. One unit of credit may be allowed for each full week of completed and reported internship. Credit/No Credit grading only. Prerequisite: Consent of internship instructor.

AG 485 Cooperative Education Experience (6) (CR/NC)
Part-time work experience in business, industry, government, and other areas of student career interest. Positions are paid and usually require relocation and registration in course for two consecutive quarters. Formal report and evaluation by work supervisor required. Total credit limited to 16 units. Credit/No Credit grading only. Prerequisite: Sophomore standing and consent of instructor.

AG 495 Cooperative Education Experience (12) (CR/NC)
Full-time work experience in business, industry, government, and other areas of student career interest. Positions are paid and usually require relocation and registration in course for two consecutive quarters. Formal report and evaluation by work supervisor required. Total credit limited to 16 units. Credit/No Credit grading only. Prerequisite: Sophomore standing and consent of instructor.

AG 500 Individual Study (1–6)
Advanced independent study planned and completed under the direction of a member of the school faculty. Total credit limited to 6 units. Prerequisite: Consent of department head, graduate adviser and supervising faculty member.

AG 539 Graduate Internship in Agriculture (1–9)
Application of theory to the solution of problems of agricultural production or related businesses in the field. Analyze specific management problems and perform general management assignments detailed in a contract between the student, the firm or organization, and the faculty adviser before the internship commences. Degree credit limited to 6 units. Prerequisite: Consent of internship instructor.

AG 585 Cooperative Education Experience (6) (CR/NC)
Advanced study analysis and part-time work experience in student's career field; current innovations, practices, and problems in administration, supervision, and organization of business, industry, and government. Must have demonstrated ability to do independent work and research in career field. Total credit limited to 9 units. Credit/No Credit grading only. Prerequisite: Graduate standing and consent of instructor.

AG 595 Cooperative Education Experience (12) (CR/NC)
Advanced study analysis and full-time work experience in student's career field; current innovations, practices, and problems in administration, supervision, and organization of business, industry, and government. Must have demonstrated ability to do independent work and research in career field. Total credit limited to 9 units. Credit/No Credit grading only. Prerequisite: Graduate standing and consent of instructor.

AG 598 Reading and Conference (1–12) (CR/NC)
Systematic development of an agricultural thesis research project including literature searches, reports and experimental design. Repeatable for up to 12 units. Credit/No Credit grading only. Prerequisite: Graduate standing and instructor consent.

AG 599 Thesis (1–9)
Systematic research of a significant problem. Thesis will include problem identification, significance, methods, data analysis, and conclusion. Students must enroll every quarter in which facilities are used or advisement is received. Degree credit limited to 6 units. Prerequisite: Graduate standing and consent of instructor.

AGB–AGRIBUSINESS

AG 101 Introduction to Agribusiness and Agricultural Economics (4)
Understanding the breadth, depth and structure of the agribusiness industry. Introduction to the economic aspects of agriculture and their implications to the agricultural producer, consumer, and the food system. The role of agricultural resources, major agricultural resource issues, and their policy remedies. 4 lectures.

AG 200 Special Problems for Undergraduates (1–2) (CR/NC)
Individual investigation, research, studies, or surveys of selected problems. Total credit limited to 4 units, with a maximum of 2 units per quarter. Credit can only be used to
satisfy free electives. Credit/No Credit grading only.  
Prerequisite: Consent of department head.

AGB 201 Agribusiness Sales and Service (3) 
Emphasis on relationship selling focusing on building trust 
and providing valuable service. Critical skills of self-
management, communication, and interpersonal values 
through role playing and presentations. Sales opportunities in 
the entire food industry surveyed, ranging from input 
industries such as seeds and fertilizers, to output industries 
such as produce and wine. 3 lectures.

AGB 212 Agricultural Economics (3) 
Changes in agriculture and agricultural production in 
response to changing economic conditions. Optimum 
methods of agricultural production. Impact of technological 
change. Evaluating market structure and price formulating 
factors for agricultural products and inputs. 3 lectures. 
Prerequisite: AGB 101, ECON 201, or ECON 211.

AGB 213 Agricultural Economic Analysis (4) 
Advanced agricultural microeconomics with emphasis on 
mathematical problem solving; production and cost 
functions, single and multiple input allocation, agricultural 
output combinations, agricultural market structures, and 
economies of size. 4 lectures. Prerequisite: AGB 212, MATH 
required for major.

AGB 300 Successful California Farms (2) 
Visits to successful California farms involving many types of 
farming. Farm resources and organization, techniques of 
operation, yields, problems. Different regions visited on 
different trips. Miscellaneous course fee required—see Class 
Schedule. Can only be taken once for credit in the major.

AGB 301 Agricultural Marketing (3) 
Agricultural commodity marketing systems from farm to 
consumer. Middlemen types and marketing alternatives. Role 
of futures markets in pricing and risk minimization. Storage, 
transportation and grading systems. Selected topics such as 
foreign trade and marketing orders. 3 lectures. Prerequisite: 
AGB 212 or ECON 201 or ECON 212.

AGB 302 Agricultural Associations and Cooperatives (3) 
Purpose, kinds, organization and management of agricultural 
cooperatives. Emphasis on California cooperatives, their 
characteristics, operation and future. One-day field trip 
visiting agricultural cooperatives included. 3 lectures. 
Prerequisite: AGB 301.

AGB 304 Agribusiness Marketing Management (3) 
Marketing management applied to agricultural and food 
industries. Marketing concept, role of today's middlemen and 
growing importance of consumerism, ecology and 
conservation in today's changing market place. Exploration of 
marketing mix decisions including planning, product 
management, pricing, promotion and distribution. 3 lectures. 
Prerequisite: AGB 212 or ECON 201.

AGB 307 World Agricultural Resources (3) 
World agricultural production areas with emphasis on natural 
and human resources, existing production, economic 
implications, population growth and potential food supply. 3 
lectures. Prerequisite: AGB 212 or ECON 201 or ECON 211.

AGB 310 Agribusiness Credit and Finance (3) 
Fundamentals of financing California's agribusiness industry. 
Principles of making investment decisions and costs of credit. 
Developing credit strategies within the framework of sources of 
credit and types of loans available to farms, ranches, and 
other agribusiness firms. 3 lectures. Prerequisite: One quarter 
of accounting or AGB 321.

AGB 312 Agricultural Policy (3) 
Agricultural policy objectives and formulation, resource 
allocation and production adjustments. Survey of State and 
Federal agricultural policy and the trade policies of other 
countries as they influence the planning and practices of 
agribusiness. 3 lectures. Prerequisite: AGB 212 and ECON 
222, or ECON 201 or ECON 211.

AGB 314 Fair Management (3) 
Principles and procedures in organizing, managing and 
promoting fairs. Emphasis on California and Western fairs. 
Career opportunities, programs and problems in fair 
management and growth of fairs in America. A one-day field 
trip is required. 3 lectures. Prerequisite: Upper division 
standing.

AGB 315 Land Economics (3) 
Supply of land, population pressure on land, input-output 
relations affecting land use, economic returns, land values, 
development and investment costs, locational factors, 
conservation, institutional factors, leasing, land use planning, 
taxation, public regulations. 3 lectures. Prerequisite: AGB 
213 and ECON 222.

AGB 317 Agriculture–Consumer Relationships (3) 
Basic facts, public opinion and ways of developing greater 
understanding of agriculture, its nature, characteristics, 
problems and relationship to nonfarm persons. Consumer 
education programs and procedures. Field trip is required. 3 
lectures. Prerequisite: Upper division standing.

AGB 318 Agricultural Trade Policies (3) 
Analysis of American trade policies and their relationship to 
agriculture. International trade pacts and their influence on 
agricultural production and marketing. 3 lectures. 
Prerequisite: AGB 213, AGB 312, and ECON 222.

AGB 321 Farm Records (4) 
Fundamentals of record keeping, kinds of records, inventory, 
depreciation, payrolls, cash and accrual basis of income tax 
reporting, financial statements and analysis. 3 lectures, 1 
activity. Prerequisite: AG 250 or equivalent, upper division 
standing.

AGB 322 Principles of Farm Management (4) 
Organization and operation of farm and ranch businesses. 
Identification of factors affecting profitability. Evaluation of 
the business for increased efficiency and profit. Application of 
budgeting to laboratory farms and independent analysis of a 
farm. 3 lectures, 1 activity. Prerequisite: AGB 321 or ACTG
211, AGB 212, a course in the plant sciences, and a course in the animal sciences.

AGB 323 Agribusiness Managerial Accounting (4)
Agribusiness management with an emphasis on using accounting procedures that will provide useful information in making management decisions, setting objectives, and controlling operations. 3 lectures, 1 activity. Prerequisite ACTG 211.

AGB 324 Agricultural Property Management and Sales (4)
Economic, legal and real estate principles in the investment, development, mortgaging and transferring of agricultural real estate. 3 lectures, 1 activity. Prerequisite: AGB 310 or consent of instructor.

AGB 326 Farm Appraisal (4)
Methods of farm appraisal, use of county records, appraisal practice on different types of farms, discussions with professional appraisers. 3 lectures, 1 activity. Prerequisite: AG 250 or equivalent, and upper division standing.

AGB 331 Farm Accounting (4)
Application of commercial accounting process to farm and ranch accounting problems. Emphasis on accounting systems that facilitate financial statement presentation, tax preparation and ADP enterprise analysis. Income tax laws pertaining to agriculture. 3 lectures, 1 activity. Prerequisite: ACTG 211.

AGB 336 Commodity Markets in Agribusiness (4)
Commodity market history, performance, and use in management of agribusiness. Techniques of analysis, hedging, speculation with applications to the agricultural business firm. 4 lectures. Prerequisite: AGB 212 and ECON 222, or consent of instructor.

AGB 360 Agribusiness Research Methods (3)
Concepts of research methodology and data presentation in agribusiness. Emphasis on advanced computer applications to problems in the field. Selection of methodology compatible with the problem. 3 lectures. Prerequisite: STAT 212 and AG 250.

AGB 400 Special Problems for Advanced Undergraduates (1–2) (CR/NC)
Individual investigation, research, studies, or surveys of selected problems. Total credit limited to 4 units, with a maximum of 2 units per quarter. Credit can only be used to satisfy free electives. Credit/No Credit grading only. Prerequisite: Consent of department head or instructor.

AGB 401 Managing Cultural Diversity in Agricultural Labor Relations (4)
Agricultural labor trends and problems as determined by changes occurring in farming and farm related industries. Labor-management relations in agriculture; principles and procedures in organizing and managing the agricultural business personnel program. 4 lectures. Prerequisite: Senior standing.

AGB 405 Agribusiness Marketing Research Methods (3)
Collecting, tabulating and analyzing data for use in market research and sales. Techniques for determining market potential. Surveys, trends, correlation, market factor derivation, test marketing. Routing techniques, sampling procedures. 3 lectures. Prerequisite: AG 250, MKTG 301, AGB 213, STAT 212.

AGB 406 Agribusiness Marketing Planning (4)
Client centered course where self-managed teams develop agribusiness marketing plan. Emphasis on developing presentation skills. Integration of marketing mix, particularly promotional elements in developing agribusiness marketing strategy emphasized. 4 lectures. Prerequisite: AGB 405.

AGB 409 California Agricultural Law (3)
Historical and current sources of law, examination of judicial systems, application of contracts, agency, labor law, torts, property and water law, partnerships, corporations and corporate finance applicable to agricultural enterprises. 3 lectures. Prerequisite: BUS 207, senior standing or consent of instructor.

AGB 410 Management Practices in Agricultural Lending (4)
Structure and performance of the agricultural lending industry. Advanced agricultural loan analysis and risk assessment. Agricultural loan documentation, securitization of farm loans, and farm bankruptcy. Exploration of interest rate impacts on agricultural lending. 4 lectures. Prerequisite: ACTG 211, AGB 310 and senior standing.

AGB 412 Advanced Agricultural Policy (4)
Agricultural resource allocation issues with emphasis on policies that impact the production of food and fiber and inputs used in their production. Special topics in agricultural resource allocation stressing issues and policies emphasizing economic externalities. 4 lectures. Prerequisite: AGB 312, AGB 315, and AGB 421 or AGB 433.

AGB 418 U.S. and Asia Pacific Agricultural Trade (3)
Agricultural infrastructures and trade policies of major U.S. trading partners in the Asia Pacific region. Particular emphasis on Japan's influence on California agricultural trade. Cultural and geo-political influences on the development of agricultural policy in the Asia Pacific region. 3 lectures. Prerequisite: AGB 318 or consent of instructor.

AGB 421 Agribusiness Operations Analysis (4)
Principles and procedures in agricultural business operations analysis and research. Evaluation of programs and problems to achieve optimal decisions. Production and financial data, statistics, pricing, costs, inventories, production level, and plant expansion or contraction. 3 lectures, 1 activity. Prerequisite: AG 250, AGB 213, STAT 212.

AGB 427 Agricultural Estate Planning (3)
Principles and procedures in agricultural estate planning and conservation. Determining beneficiary needs, assets, valuation, and taxes. Utilizing wills, property transfers, gifts, insurance, business continuation agreements, trusts and other tools in estate planning. 3 lectures. Prerequisite: Upper division standing.

AGB 433 Agricultural Price Analysis (3)
Application of statistical tools for price analysis. Emphasis on price making process for specific agricultural commodities. Utilization of market reports and production estimate data in price forecasting and analysis. 2 lectures, 1 activity. Prerequisite: AG 250, AGB 213, STAT 212.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Description</th>
<th>Prerequisite(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGB 435</td>
<td>Linear Programming in Agriculture (3)</td>
<td>Application of linear programming to modern commercial agriculture; assumptions and data requirements; graphic and simplex solutions; preparation, coding and solutions of models simulating current problems. 2 lectures, 1 activity.</td>
<td>AGB 250, AGB 213, AGB 322.</td>
</tr>
<tr>
<td>AGB 440</td>
<td>Field Studies in Agribusiness (2)</td>
<td>Visitation to selected agribusinesses. Organization, operation, services and problems considered. Miscellaneous course fee required—see Class Schedule. Prerequisite: Senior standing or consent of instructor. Can only be taken once for credit in the major.</td>
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<tr>
<td>AGB 445</td>
<td>Produce Marketing (2)</td>
<td>Directed group study of fresh fruit and vegetable marketing. Includes analysis of terminal markets, retail marketing (supermarkets, farmer's markets, roadside stands), limited preserving and ripening, grading and inspection, economics of transportation, international marketing. 2 seminars.</td>
<td>Senior standing and AGB 301.</td>
</tr>
<tr>
<td>AGB 446</td>
<td>Wine Market Analysis (2)</td>
<td>Application of statistical theory to collection and interpretation of production/sales data. Also includes introduction to forecasting and decision theory. Financial ratios and industry averages. 2 seminars.</td>
<td>AGB 301 or consent of instructor.</td>
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<tr>
<td>AGB 447</td>
<td>Wine Distribution and Pricing (2)</td>
<td>Wine distribution channels with emphasis on agents, brokers, distributors, and retailers. Inventory management and distribution cooperatives. Domestic and international shipping regulations. The impact of price on distribution will be highlighted. 2 seminars.</td>
<td>AGB 304 or consent of instructor.</td>
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<tr>
<td>AGB 448</td>
<td>Governmental Wine Regulations and Compliance (2)</td>
<td>Legal aspects of wine marketing. Emphasis on federal (BATF) requirements as well as the operation and/or use of state tax laws and state monopolies that tend to restrict the free movement of wine. 2 seminars.</td>
<td>Consent of instructor.</td>
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<tr>
<td>AGB 449</td>
<td>Wine Promotion and Packaging (2)</td>
<td>All types of mass media promotional strategies and complete coverage of the following areas: personal selling, publicity, public relations, direct marketing, and direct promotions. Label design, packaging, and point of sale promotions. Ethics for responsible advertising. 2 seminars.</td>
<td>AGB 446 or consent of instructor.</td>
</tr>
<tr>
<td>AGB 450</td>
<td>Agribusiness Strategy Formulation (4)</td>
<td>Development of strategy for farms and farm related businesses where uncontrollable environment makes output and results highly unpredictable; emphasis on the total enterprise. Case analysis. 4 lectures.</td>
<td>Senior standing and AGB 323.</td>
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<tr>
<td>AGB 455</td>
<td>Advanced Fair Management Seminar (2)</td>
<td>Advanced studies in fair management with emphasis on budgets, contracts, entertainment, carnivals, exhibit programs, crowd control, master planning maintenance. 2 seminars.</td>
<td>AGB 314.</td>
</tr>
<tr>
<td>AGB 456</td>
<td>Crop Management Problems (4)</td>
<td>Management problems of crop farms and orchards. Crop enterprise costing procedures, equipment costing and replacement, scheduling of operations to obtain efficiencies. Determination of most profitable rotations and levels of input use. Includes whole farm budget development and analysis. 3 lectures, 1 activity.</td>
<td>AGB 322.</td>
</tr>
<tr>
<td>AGB 457</td>
<td>Livestock Management Problems (4)</td>
<td>Analysis of actual livestock enterprise. Budgeting a ranch by enterprises. Analysis of internal problems such as bull purchase economics, feed buying chart, feedyard economics, cattle price relationships, livestock systems. Includes whole farm budget development and analysis. 3 lectures, 1 activity.</td>
<td>AGB 322.</td>
</tr>
<tr>
<td>AGB 458</td>
<td>Dairy Management Problems (4)</td>
<td>Analysis of actual dairy enterprise. Budgeting a dairy farm by enterprises. Analysis of problems such as load by load milk- feed analysis, value of milk quotas, most profitable concentrate to hay feeding. Includes whole farm budget development and analysis. 3 lectures, 1 activity.</td>
<td>AGB 322.</td>
</tr>
<tr>
<td>AGB 460</td>
<td>Research Methodology in Agribusiness (2)</td>
<td>Empirical application of the scientific method as it relates to the design and development of Senior Project. 2 seminars.</td>
<td>Senior standing and AGB 213.</td>
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<tr>
<td>AGB 461, 462</td>
<td>Senior Project (2)</td>
<td>Selection and completion of a project under faculty supervision. Projects typical of problems which graduates must solve in their fields of employment. Project results are presented in a formal report. Minimum 150 hours total time.</td>
<td>Senior standing and AGB 460.</td>
</tr>
<tr>
<td>AGB 463</td>
<td>Undergraduate Seminar (2)</td>
<td>Individual or group presentation for discussion of subjects and problems within the agribusiness field. 2 seminars.</td>
<td>Senior standing.</td>
</tr>
<tr>
<td>AGB 510</td>
<td>World Agricultural Development (3)</td>
<td>Special problems of agriculture in less-developed countries considering the role of economic, social and institutional policies in directing development. 3 seminars. For students in M.S. in Agriculture Program/Specialization in International Agriculture Development. Prerequisite: Graduate standing or consent of instructor.</td>
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<tr>
<td>AGB 514</td>
<td>Agribusiness Managerial Leadership and Communication (4)</td>
<td>Current issues in agriculture addressed through the case analysis method. Emphasis on communication skills and leadership qualities, identifying key success requirements. 4 seminars. Prerequisite: Graduate standing or consent of instructor.</td>
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</tbody>
</table>
AGB 515  International Agricultural Marketing (3)
Organization and function of international agricultural markets with emphasis on developing countries. Factors inhibiting development of an improved agricultural market structure. 3 seminars. Prerequisite: Graduate standing or consent of instructor.

AGB 516  Agricultural Program Management in Developing Countries (3)
Overall context of decision making by program managers in developing countries. Case studies and proposal writing for effective program management. 3 seminars. Prerequisite: Graduate standing or consent of instructor.

AGB 543  Agribusiness Policy and Program Analysis (4)
Economic, political, and social objectives of domestic agricultural policies and programs. Consequences of government's policies and programs to control production, allocate resources, support market prices, and provide benefits to food and fiber producers, marketers, and consumers. Topical analysis of current effort of government to direct agriculture. 4 seminars. Prerequisite: Graduate standing or consent of instructor.

AGB 554  Managing Price Risk in Agribusiness (4)
Examination of alternatives available to the agribusiness manager to manage price risk. Use of forward contracts, cooperative seasonal pools, and hedging with futures contracts and options. Futures markets, their function and operation. Analysis of cash-futures price relationships, hedging guidelines, and other topics necessary for successful hedge program execution. Student involvement in a speculation and hedging simulation. 4 seminars. Prerequisite: Graduate standing or consent of instructor.

AGB 555  Technological and Economic Change in Agribusiness (4)
Ramifications and impacts in agribusiness firms from technological and economic changes. Emphasis on specific agribusiness firms and their managerial process of dealing with problems and opportunities in the operational environments of economic, technology, political, global, domestic and marketing. 4 seminars. Prerequisite: Graduate standing, or consent of instructor.

AGB 563  International Agricultural Trade and Market Development (4)
Changing agricultural trade prospects in a dynamic world economy. Interface between strategies of government and private firms to create and expand foreign markets for U.S. agricultural products. Impacts of agricultural trade policies, agricultural market development, and the activities of agricultural export marketing firms. 4 seminars. Prerequisite: Graduate standing or consent of instructor.

AGED 202  Introduction to Agricultural Education (2)
Overview of agricultural education programs including goals and purposes. Kinds of classes and types of programs. Qualifications essential to success in teaching agriculture. Planned program of studies to meet requirement for teaching. 2 lectures.

AGED 220  Agriculture Youth Conferences (2) (CR/NC)
Problems encountered and practices applied during the conduct of the annual FFA State Convention. Methods, procedures and materials adapted for use by the student in developing the committee system to produce conferences, conventions and workshops of all kinds and sizes. Total credit for AGED 220 and AGED 221 limited to 6 units. Credit/No Credit grading only. 2 activities. Prerequisite: Consent of instructor.

AGED 221  Agriculture Youth Conferences (3) (CR/NC)
Problems encountered and practices applied during the conduct of the annual FFA State Convention. Methods, procedures and materials adapted for use by the student in developing the committee system to produce conferences, conventions and workshops of all kinds and sizes. Total credit for AGED 220 and AGED 221 limited to 6 units. Credit/No Credit grading only. 3 activities. Prerequisite: Consent of instructor.

AGED 330  FFA and Supervised Agriculture Programs (6)
Implementation processes and operational procedures for initiating, conducting and integrating FFA activities and SOE Programs appropriate to community, school and student needs. Demonstration, application and observation of practices and techniques utilized by agriculture instructors in conducting organized classroom, shop, school farm, laboratory and home visit instruction in agriculture, FFA and SOE activities. 3 activities, and supervision. Prerequisite: AGED 202.

AGED 350  Undergraduate Field Experience (1) (CR/NC)
Presentations and group discussions of activities and programs unique to teaching vocational agriculture in California secondary schools. Credit/No Credit grading only. 1 lecture. Prerequisite: AGED 202 or consent of instructor. Concurrent: AGED 351.

AGED 351  Undergraduate Field Experience (1) (CR/NC)
Observation of the practices and techniques utilized by vocational agriculture teachers in conducting organized instruction in vocational agriculture classrooms, shops, school farms, laboratories. SOEP visits and FFA activities. Credit/No Credit grading only. Prerequisite: AGED 202 or consent of instructor. Concurrent: AGED 350.

AGED 404  Agricultural Leadership (2)
Emphasis is upon equipping current and prospective leaders in agriculture with the background and skills to achieve their potential. Class members will be encouraged to assess their status as leaders and to identify means whereby their effectiveness can be improved. 2 activities. Prerequisite: PSY 201 or PSY 202.
AGED 410 Computer Applications in Agricultural Education (2)
Development of computer literacy for teaching agriculture. Analysis and specialization of hardware. Instruction in video and telecommunication technology, CATI network systems and software applicable to vocational agriculture. Recommended for Agricultural Science majors and required for teaching credential candidates. Prerequisite: AG 250 or CSC 110 and consent of instructor.

AGED 424 Organizing and Teaching Agriculture (3)
Determining course objectives, content, and calendar for use by the teacher in classroom, shop and field instruction while assigned to community schools. Concurrent with student teaching. 3 activities. Prerequisite: AGED 438 and consent of instructor.

AGED 426 Presentation Methods (3)
Development and evaluation of effective means of communication by use of a variety of presentation methods including demonstration. 3 activities. Prerequisite: SPC 201.

AGED 438 Instructional Processes in Agricultural Education (3)
Preparation for student teaching in agriculture. Orientation to classroom situation. Development of plans for teaching including daily lessons and unit plans; utilization of source information and resources. Class demonstration in teaching procedures; analysis and evaluation. 1 lecture, 2 activities.

AGED 440 Student Teaching in Agricultural Education (6–12) (CR/NC)
Off-campus assignment to a selected cooperating public school. Participation in all phases of agriculture teacher duties and activities including departmental organization and administration. Prior approval and appointment necessary. Total credit limited to 18 units. Credit/No Credit grading only.

AGED 441 Student Teaching Practicum (2)
Problems encountered and practices applied during student teaching. Methods, procedures and materials adapted for use by the teacher concurrent with student teaching. 2 activities. Prerequisite: Consent of instructor.

AGED 461 Senior Project (2)
Empirical application of the scientific method as it relates to the selection of a project under faculty supervision. Projects typical of problems that graduates must solve in their field of employment. Minimum 60 hours total time.

AGED 462 Senior Project (3)
Completion of a project begun in AGED 461 under faculty supervision. Projects typical of problems that graduates must solve in their field of employment. Project results are presented in a formal report. Minimum 90 hours total time. Prerequisite: AGED 461 or consent of instructor.

AGED 470 Selected Advanced Topics (1–3)
Directed group study of selected topics for advanced students. Open to undergraduate and graduate students. Class Schedule will list topic selected. Total credit limited to 6 units. 1 to 3 lectures. Prerequisite: Consent of instructor.

AGED 471 Selected Advanced Laboratory (1–3)
Directed group laboratory study of selected topics for advanced students. Open to undergraduate and graduate students. Class Schedule will list topic selected. Total credit limited to 6 units. 1–3 laboratories. Prerequisite: Consent of instructor.

AGED 513 Field Experience–Vocational Agriculture (1–3)
Practice and techniques in management and supervision of vocational agriculture programs. Relationships among students, staff, community and school groups. Budgeting, staffing, records, reporting. Student activities and Future Farmers of America programs. Total credit limited to 6 units. Prerequisite: Prior approval and appointment.

AGED 520 Program Development in Agricultural Education (3)
Development of up-to-date approaches to a total integrated program based on occupational opportunities and community needs. Philosophy, organization and administration of agricultural education programs. Development in such areas as curriculum, supervised occupational experience, Future Farmers of America, and summer programs. 3 seminars.

AGED 522 Instructional Programs in Agricultural Mechanics (3)
Organizing the vocational agriculture mechanics curriculum and determining course content. Student demonstrations and presentations; evaluation and analysis. 1 seminar, 2 laboratories.

AGED 580 Special Problems in Agricultural Education (1–3)
Individual study of modern issues and problems conducted through research, planning and development. Field problems and in-service study in agricultural industry encouraged. Final written report required. Total credit limited to 9 units with not more than 3 units in any one quarter. Prior approval of instructor required.

ANT–ANTHROPOLOGY

ANT 201 Cultural Anthropology (3)   GEB D.4.a.
The study of contemporary human cultures throughout the world. Seeks general human patterns within the diversity of individual cultures. Includes such topics as: family organization and gender roles; adaptation to the environment; systems of economic exchange; political organization and leadership; religious beliefs and values; ethnicity and cultural pluralism; impact of Western culture on the developing world. 3 lectures.

ANT 202 World Prehistory (3)
Development of the diverse human cultures of both the Old and New worlds from the earliest times until the dawn of history; cultural growth. 3 lectures.

ANT 203 Biological Anthropology (3)
Biological aspects of human unity and diversity. Primate and human evolution, including anatomical, physiological and behavioral adaptations. Origin and diversity of modern races. 3 lectures.
ANT 310  California Archaeology (3)
Diversity of California Indian cultures; field studies in locating, surveying, and analyzing aboriginal sites; excavation of a site; laboratory techniques for recording, preserving, and reporting of artifacts; relating observations and finds to the natural environment in which the site is located; integrating knowledge of natural and social sciences for the use in archaeology. 2 lectures, 1 laboratory. Prerequisite: A course in anthropology or consent of instructor.

ANT 325  Material Culture (3)
Description of processes of invention and diffusion in a multicultural world. Role of environment and primitive technology on culture. Major preindustrial inventions and their social correlates throughout the world. 3 lectures. Prerequisite: ANT 201 or consent of instructor.

ANT 333  Language and Culture (3)
A global perspective on the social and cultural factors which influence language form and language use. Topics include: language and thought; the origins and development of human language; language learning; language and cultural metaphors; language and gender; dialects; bilingualism and multilingualism; language and ethnic identity; language and political persuasion. 3 lectures. Prerequisite: Junior standing.

ANT 341  Comparative Societies (3)
Comparative study of contemporary cultures. Uses the ethnographic case study approach to investigate solutions to human problems. Examines cultural themes across at least three different cultures in different areas of the world. 3 lectures. Prerequisite: ANT 201 and junior standing.

ANT 360  Human Cultural Adaptations (3)  GEB D.4.b.
Evolution of cultures and societies from an ecological perspective, emphasizing the material processes leading to both cultural diversity and similarity. 3 lectures. Prerequisite: Any course in GEB area D.4.a.

ANT 401  Culture and Health (3)

ANT 420  Development Anthropology (3)
Application of the basic concepts of anthropology to problems of development. Major theories of change and development. Sociocultural dimensions of economic development. Context of development in the Third World. Roles that anthropologists and other social scientists play in the development process. 3 lectures. Prerequisite: ANT 201 or consent of instructor.

ANT 444  Sex, Death and Human Nature (3)
How Darwinian processes of differential reproduction and mortality influence human interests, passions, and behaviors. Theories of inclusive fitness, parental investment and senescence. Sex differences, sexual attraction, life histories, violence and aggression, including rape, homicide and infanticide. 3 lectures. Prerequisite: One upper division ANT course or consent of instructor.

ANT 450  Area Studies (3)
Comparative analysis of cultural diversity and uniformity within a selected region (e.g., Latin America, Subsaharan Africa). Class Schedule will list topic selected. Total credit limited to 12 units. 3 lectures. Prerequisite: ANT 201 or consent of instructor.

ANT 470 Selected Advanced Topics (1–3)
Directed group study of selected topics for advanced students. Open to undergraduate and graduate students. Class Schedule will list topics selected. Total credit limited to 6 units. 1 to 3 lectures. Prerequisite: Consent of instructor.

ARCE–ARCHITECTURAL ENGINEERING

ARCE 221  Elementary Structures (3)
Forces on building structures. Static equilibrium and stability of structural systems. Shear and bending moment diagrams. 3 lectures. Prerequisite: PHYS 131, MATH 142.

ARCE 222  Mechanics of Structural Members I (3)
Stress-strain relationships. Stresses and deformations in structural members due to axial force, shear, torsion, and moment. 3 lectures. Prerequisite: ARCE 221.

ARCE 223  Mechanics of Structural Members II (3)

ARCE 224  Mechanics of Structural Members Laboratory (1)
Testing and analysis of structural members. Experiments pertaining to concepts examined in ARCE 222 and ARCE 223. 1 laboratory. Prerequisite: ARCE 222. Co-requisite: ARCE 223.

ARCE 226  Structural Systems for Architects (3)
Concepts of structural integrity and stability, structural subsystems, methods of analysis. 3 lectures. Prerequisite: ARCE 222.

ARCE 227  Structural Analysis I (2)
Continuation of ARCE 221. Advanced topics in two-dimensional equilibrium and three-dimensional equilibrium of structural building systems. 2 lectures. Prerequisite: ARCE 221.

ARCE 240  Additional Engineering Laboratory (1–2)
Total credit limited to 4 units, with a maximum of 2 units per quarter. 1 or 2 laboratories.

ARCE 302  Structural Analysis II (3)

ARCE 303  Steel Design I (3)
Analysis and design of steel structural members subjected to bending, shear and axial forces. 3 lectures. Co-requisite: ARCE 302.
ARCE 304 Timber Design (3)
Analysis and design of timber structural members subjected to bending, shear, and axial forces. Wood diaphragms, shear walls and their connections. 3 lectures. Prerequisite: ARCE 223 and ARCE 227.

ARCE 305 Masonry Design (2)
Design of load-bearing walls, shear walls, columns and beams in masonry. 2 lectures. Prerequisite: ARCE 223 and ARCE 227.

ARCE 306 Matrix Analysis of Structures (3)
Analysis of statically indeterminate structures by direct stiffness method including continuous beams, plane trusses, and introduction to three-dimensional structures. 3 lectures. Prerequisite: ARCE 302.

ARCE 309 Survey of Soil Mechanics and Foundation Engineering (3)
Fundamentals of foundation engineering, evaluation of soil reports, principles of determination of bearing capacity, soil classification, selection of types of foundations, evaluation of expansive properties of foundation soils, discussion of basic laboratory tests. 3 lectures. Prerequisite: ARCE 226.

ARCE 311 Structures for Landscape Architects (3)
Structural concepts related to landscape architecture. Design of retaining walls, decks, trellises, bridges and large-scale covered spaces. 3 lectures.

ARCE 321 Timber Design (3)
Design of timber structures. Limitations and potential of the material in relation to the design and construction process. For architecture and construction students. 3 lectures. Prerequisite: ARCE 226.

ARCE 322 Steel Design (3)
Design of steel structures. Limitations and potential of the material to the design and construction process. For architecture and construction students. 3 lectures. Prerequisite: ARCE 226.

ARCE 323 Concrete and Masonry Design (3)
Design of reinforced concrete and masonry structures. Limitations and potential of the material to the design and construction process. For architecture and construction students. 3 lectures. Prerequisite: ARCE 226.

ARCE 325 Dynamics (4)
Static and dynamic loads, rigid body dynamics. Vibrations of spring-mass systems. Degrees of freedom and vibration modes. 4 lectures. Prerequisite: ARCE 223 and MATH 242.

ARCE 351 Structural Computing Analysis I (1)
Computer calculations, programming and technical reporting. Emphasis on use of spreadsheets to generate structural analyses of buildings: the structural system and its individual elements. Miscellaneous course fee may be required—see Class Schedule. 1 laboratory. Prerequisite: ARCE 222.

ARCE 352 Structural Computing Analysis II (1)
Computer calculations, programming and technical reporting. Emphasis on use of two-dimensional structural analysis software to analyze a building's structural system and its individual elements. Miscellaneous course fee may be required—see Class Schedule. 1 laboratory. Prerequisite: ARCE 222.

ARCE 353 Structural Computing Analysis III (1)
Emphasis on the use of nonplanar structural analysis software to analyze a building's structural system and its individual elements. Miscellaneous course fee may be required—see Class Schedule. 1 laboratory. Prerequisite: ARCE 302.

ARCE 371 Structural Systems Laboratory (3)
Studies in the relationship of structural framing to overall building geometry with emphasis on the statical stability of structural configurations. 3 laboratories. Prerequisite: ARCE 231. Co-requisite: ARCE 302.

ARCE 372 Steel Structures Design Laboratory (3)
Design project utilizing structural steel. 3 laboratories. Prerequisite: ARCH 231, ARCE 302, ARCE 303, ARCE 352 and ARCE 371.

ARCE 400 Special Problems for Advanced Undergraduates (1–2)
Individual investigation, research, studies, or surveys of selected problems. Total credit limited to 4 units, with a maximum of 2 units per quarter. Prerequisite: Consent of department head.

ARCE 403 Advanced Steel Structures Laboratory (3)
Advanced topics in design of steel structures with emphasis on plate girders, plastic design of continuous beams and frames and composite steel-concrete design. 3 laboratories. Prerequisite: ARCE 303, ARCE 372, or equivalent.

ARCE 412 Dynamics of Framed Structures (3)

ARCE 414 Precast Concrete (3)
Precast and prestressed concrete principles, materials and techniques of construction. Concrete mixes, forming, casting, finishing, curing and erection methods of precast concrete. Design potentials, aesthetics, cost and construction time as related to buildings and other structures. 3 lectures. Prerequisite: ARCE 323 or ARCE 444 or equivalent.

ARCE 421 Soil Mechanics (3)
Principles of soil mechanics, including rudiments of geology, soil classification, gravimetric and volumetric relations, compaction, methods and testing, shear strength of soil and strength theories, 2 lectures, 1 laboratory. Prerequisite: ARCE 222, GEOL 201 or consent of instructor.

ARCE 422 Foundation Design (3)
Soil-bearing capacity and settlement characteristics of soils. Sizing and design of spread footings. Design and analysis of earth-retaining structures. 3 lectures. Prerequisite: ARCE 421.

ARCE 423 Advanced Foundation Design (3)
Design and analysis of beams on elastic foundations and mat foundations. Pile foundations and sheet pile retaining structures. 3 lectures. Prerequisite: ARCE 422.
ARCE 444 Reinforced Concrete Laboratory (3)
Theory and design of basic reinforced concrete elements: columns, beams, tee beams and one way slabs. 3 laboratories. Prerequisite: ARCE 371 and ARCE 372.

ARCE 445 Prestressed Concrete Design Laboratory (3)
Design and analysis of prestressed concrete structures. 3 laboratories. Prerequisite: ARCE 444.

ARCE 446 Advanced Structural Systems Laboratory (3)
Concepts and issues involved in the design of complex structures including tall buildings, shells, arches and tension structures. 3 laboratories. Prerequisite: ARCE 226 or ARCE 371 or consent of instructor.

ARCE 447 Advanced Reinforced Concrete Laboratory (3)
Advanced topics in the design of reinforced concrete structures with emphasis on isolated and combined foundations, retaining walls, seismic-resistant ductile frames and plastic design method for slabs, plates, beams and shells. 3 laboratories. Prerequisite: ARCE 444 or equivalent.

ARCE 451 Timber and Masonry Structures Design Laboratory (3)
Design projects utilizing timber and masonry. Relationship of structural detailing to overall structural behavior. Production of structural calculations and drawings. 3 laboratories. Prerequisite: ARCE 304, ARCE 305, ARCE 372 or consent of instructor.

ARCE 452 Concrete Structures Design Laboratory (3)
Design projects utilizing reinforced concrete. Layout of the structure and preliminary design. Production of design calculations and structural drawings. Two-way slab design. 3 laboratories. Prerequisite: ARCE 444 or consent of instructor.

ARCE 453 Senior Project Laboratory (3)
Projects by individuals or teams which involve, but are not limited to, physical modeling and testing of integrated design projects which may include students from other disciplines. 3 laboratories. Prerequisite: ARCE 451 or ARCE 452, ARCE 483.

ARCE 457 Structural CAD for Building Design (2)
Emphasis on the use of computer graphics software to represent a building’s structural system and its individual elements. Miscellaneous course fee may be required—see Class Schedule. 1 lecture, 1 laboratory. Prerequisite: ARCH 113 and CSC 250.

ARCE 470 Selected Advanced Topics (1–3)
Directed group study of selected topics for advanced students. Open to undergraduate and graduate students. Class Schedule will list topic selected. Total credit limited to 6 units. 1–3 lectures. Prerequisite: Consent of instructor.

ARCE 471 Selected Advanced Laboratory (1–3)
Directed group laboratory study of selected topics for advanced students. Open to undergraduate and graduate students. Class Schedule will list topic selected. Total credit limited to 6 units. 1–3 laboratories. Prerequisite: Consent of instructor.

ARCE 480 Senior Seminar (1)
Discussion of selected topics that are of current interest to the structural engineering profession. 1 seminar. Prerequisite: Senior standing.

ARCE 481 Structural Experimental Laboratory (1)
Application of techniques of physical modeling to obtain solutions to structural design problems. Miscellaneous course fee may be required—see Class Schedule. 1 laboratory. Prerequisite: ARCE 444.

ARCE 483 Seismic Analysis and Design (4)
Introduction to dynamic response analysis of building structures with emphasis on earthquake ground motion. Earthquake resistant design of buildings in accordance with building codes. Application of computer programs and physical models for seismic design. Laboratory studies utilizing physical models for studying the behavior of building structures subjected to simulated ground motions. 3 lectures, 1 activity. Prerequisite: ARCE 325, ARCE 372, CSC 331.

ARCE 485 Cooperative Education Experience (6) (CR/NC)
Part-time work experience in business, industry, government, and other areas of student career interest. Positions are paid and usually require relocation and registration in course for two consecutive quarters. Formal report and evaluation by work supervisor required. Total credit limited to 16 units. Credit/No Credit grading only. Prerequisite: Sophomore standing and consent of instructor.

ARCE 490 History of Structures (3)
Tracing developments in structural materials, structural understanding and complete structures from ancient times through the industrial revolution and the present day. 3 lectures. Prerequisite: Junior standing.

ARCE 495 Cooperative Education Experience (12) (CR/NC)
Full-time work experience in business, industry, government, and other areas of student career interest. Positions are paid and usually require relocation and registration in course for two consecutive quarters. Formal report and evaluation by work supervisor required. Total credit limited to 16 units. Credit/No Credit grading only. Prerequisite: Sophomore standing and consent of instructor.

ARCE 504 Finite Element Method for Building Structures (3)
Basic concepts of equilibrium and compatibility. Stiffness and flexibility properties of various types of finite elements. Development and application of displacement and force methods. Elastic stability and dynamic response of buildings to earthquake, wind, and moving loads. Use of finite-element computer programs. 3 lectures. Prerequisite: MATH 242, ARCE 306, or consent of instructor.

ARCE 521 Architectural Structures (3)
Static and dynamic loads, structural equilibrium and stability, structural configurations and systems, response to dynamic
loads, behavior of structures. 2 seminars, 1 activity.  
Prerequisite: Graduate standing in Architecture.

**ARCH 522 Structural Systems (3)**  
Exploration of the relationship between structural systems and architectural form. Understanding of structural stability and structural order is developed through construction of a series of small scale models. Historical perspectives are presented along with the effects of available materials and technology on structural possibilities. 3 seminars. Prerequisite: Graduate standing in Architecture.

**ARCH 523 Seismic Design for Architects (3)**  
Introduction to the earthquake resistant design of buildings. Observed behavior of buildings during earthquakes. Recent developments of seismic design procedures, provisions, and building codes. Influence of architectural form on seismic response. 3 lectures. Prerequisite: Graduate standing in Architecture.

**ARCH—ARCHITECTURE**

**ARCH 101 Survey of Architectural Education and Practice (2) (CR/NC)**  
Exploration of the major paradigms which have guided the development of architectural education and the profession. Survey of the roles of the architects and an introduction to curricula and programs designed to prepare students for careers in architecture. 2 lectures. Credit/No Credit grading only.

**ARCH 106 Materials of Construction (3)**  
Use and application of construction processes and materials. Miscellaneous course fee required—see Class Schedule. 2 lectures, 1 laboratory.

**ARCH 111 Introduction to Drawing and Perspective (3)**  
Basic techniques used in graphic communication. Orthographic and isometric projection. Mechanical perspective, shades and shadows. 3 laboratories.

**ARCH 112 Basic Graphics (3)**  
Drawing as a communication tool in the environmental design fields. Exercises to develop basic skills and speed in the representation of ideas. Use of various drawing media. 3 laboratories. Prerequisite: ARCH 111, or consent of instructor.

**ARCH 113 Graphic Analysis and Communication Skills (3)**  
Further development of freehand graphic communication skills for representation of conceptual ideas analysis, and design concepts. Demonstrates the link between graphics, design process and communications. 3 laboratories. Prerequisite: ARCH 111, ARCH 112.

**ARCH 202 Creative Problem-Solving (3)**  
Techniques for stimulating creative behavior applied to general and environmental problems. Development of problem-solving and decision-making skills and knowledge. 3 lectures.

**ARCH 204 Architectural Theory (3)**  
Theories of architectural design. 3 lectures. Prerequisite: EDES 101.

**ARCH 207 Environmental Control Systems I (4)**  
Theory and application of climate, energy use and comfort as determinants of architectural form. Emphasis on architectural methods of ventilating, cooling, heating, and lighting for envelope-load dominated buildings. 2 lectures, 2 laboratories. Miscellaneous course fee required—see Class Schedule. Prerequisite: PHYS 131, PHYS 132, ARCH 250.

**ARCH 221, 222 Architectural Design Fundamentals (3) (3)**  
Development of knowledge and abilities in the theories, processes, and methods of creative problem solving; basic visual and verbal communication; basic two and three-dimensional design and composition and the analysis of the built environment. 3 laboratories. Prerequisite: EDES 101, ARCH 111, ARCH 113.

**ARCH 231 Architectural Practice (3)**  
Wood construction methods and processes. Construction documents used as communication medium for such methods and processes. 3 laboratories. Prerequisite: ARCH 106 and ARCH 111. Prerequisite or concurrent enrollment in ARCH 250.

**ARCH 240 Additional Architectural Laboratory (1–2)**  
Total credit limited to 4 units, with a maximum of 2 units per quarter. 1 or 2 laboratories.

**ARCH 250 Computer Applications (3) GEB F.1.**  
Introduction to the application of computers in architecture. History of computing and its use in architectural practice, hardware options, operating systems, electronic mail, databases, programming languages, graphics systems, survey and use of selected applications in architecture. Miscellaneous course fee required—see Class Schedule. 2 lectures, 1 laboratory.

**ARCH 251 Architectural Design Fundamentals I (5)**  
Theories, principles, methods and means pertaining to the creation of two- and three-dimensional visual organizations to communicate intended concepts and meanings. 5 laboratories. Prerequisite: ARCH 111, ARCH 112, ARCH 113, EDES 101.

**ARCH 252 Architectural Design Fundamentals II (5)**  
Continuation of the content and issues introduced in ARCH 251 plus the theories, principles, methods and means pertaining to the creation of architectural form, space and organizations and the incorporation of function and light as issues that shape the built environment and support the communication of intended concepts and meanings. 5 laboratories. Prerequisite: ARCH 251.

**ARCH 253 Architectural Design Fundamentals III (5)**  
Continuation of the content and issues introduced in ARCH 251 and ARCH 252 plus the theories, principles, methods and means pertaining to the incorporation of context, structure and climate as issues that shape the built environment and support the communication of intended concepts and meanings. 5 laboratories. Prerequisite: ARCH 251, ARCH 252, ARCH 106.
ARCH 270  Selected Topics (1–3)  
Directed group study of selected topics. Class Schedule will list topic selected. Open to first-, second-, and third-year students. Total credit limited to 6 units. 1 to 3 lectures.

ARCH 302  Principles of Architectural Design (3)  
Basic theory of the art of architecture and its application in architectural design. 3 lectures. Prerequisite: ARCH 204.

ARCH 303  Human Factors for Environmental Designers (3)  
Integrated approach to development of systematic design programs. Developing and interpreting human factors design criteria, performance and satisfaction as a function of environmental factors, determining and assessing user preferences, methods of field observation and analysis. 3 lectures. Prerequisite: Second-year standing in College of Architecture and Environmental Design or consent of instructor.

ARCH 307  Environmental Control Systems II (4)  
Theory and application in the integration of environmental control systems and architectural form. Comprehensive techniques for achieving an architecture of the well-tempered environment. Miscellaneous course fee required—see Class Schedule. 2 lectures, 2 laboratories. Prerequisite: ARCH 207, ARCH 250. Concurrent enrollment required in ARCH 352.

ARCH 310  Architectural Design Methods and Theories (4)  
Analysis of design process, methods of analysis, synthesis, and evaluation in design. Relation between methods used and theories of design. 4 lectures. Prerequisite: ARCH 253.

ARCH 312  Home and Community Design (3)  
GEB F.2. Historical development of the home and city and the effect of location, climate, social and technological factors on homes and cities. Considerations and design methodology; furniture, landscape, and relation of home to community environment. For non-Architecture majors. 3 lectures. Prerequisite: Junior standing.

ARCH 313  Advanced Delineation (2)  
Development of proficiency in architectural presentation. Projects and critiques. 2 laboratories. Prerequisite: ARCH 253.

ARCH 316  California Architecture and the California Dream (3)  
GEB C.3. Development of California Architecture as the symbolic expression of the myth of the California Dream. Focus on tracing California’s unique contribution to architecture and urban patterns in the United States. 3 lectures. Prerequisite: ENGL 114.

ARCH 317  History of Architecture (3)  
GEB C.3. Architecture and urbanism in the Mediterranean Basin, Europe and Asia from prehistory to about AD 900. Cultural and physical conditions which influenced the built environment. 3 lectures. Prerequisite: ENGL 114.

ARCH 318  History of Architecture (3)  
GEB C.3. Architecture and urbanism in the Pre-Columbian Americas, and the developments in the West from the Middle Ages until the end of the Baroque. Cultural and physical conditions which influenced the built environment. 3 lectures. Prerequisite: ENGL 114.

ARCH 319  History of Architecture (3)  
GEB C.3. Architecture and urbanism from Neo-Classicism to the present. Cultural and physical conditions which influenced the built environment. 3 lectures. Prerequisite: ENGL 114.

ARCH 337  Photographic Presentation (2)  
Media presentations in architecture with emphasis on black and white and color print photographic presentations, formats, and techniques applicable to architecture subjects and to design communication. 1 lecture, 1 laboratory. Prerequisite: ARCH 111, ARCH 112, ARCH 113.

ARCH 338  Media Presentations in Architecture (2) (CR/NC)  
Media presentations in architecture with emphasis on photographic color slide presentations, formats and techniques applicable to architectural subjects and to design communication. For students in CAED. Credit/No Credit grading only. 1 lecture, 1 laboratory. Prerequisite: ARCH 111, ARCH 112, ARCH 113.

ARCH 339  Video Presentations in Architecture (2) (CR/NC)  
Media presentations in architecture with emphasis on video format and creative camera and editing techniques as applicable to subjects in architecture and design communication. Open to students in CAED. Credit/No Credit grading only. 1 lecture, 1 laboratory. Prerequisite: ARCH 111, ARCH 112, ARCH 113.

ARCH 341, 342  Architectural Practice (4) (4)  
Construction systems in masonry, steel, and concrete and combinations of these materials. Preparation of outline specifications. Production of design development drawings. 2 lectures, 2 laboratories. Prerequisite: ARCH 231, ARCH 253. Concurrent enrollment required in ARCH 341: ARCH 351; ARCH 342: ARCH 353.

ARCH 350  Computer Applications in Architecture (3)  
Applications of computer systems to large-scale data processing, analysis, optimization and evaluation of design program elements. 2 lectures, 1 activity. Prerequisite: ARCH 250.

ARCH 351  Architectural Design (5)  
Continuation of ARCH 253. Development and exploration of architectural theories, building systems, and design processes involved in creating appropriate architecture on a sensitive site; implications of the site as building form generator. Miscellaneous course fee required—see Class Schedule. 5 laboratories. Prerequisite: ARCE 226, ARCH 231, ARCH 253. Concurrent enrollment required in ARCH 341.

ARCH 352  Architectural Design (5)  
Continuation of ARCH 351. Development and exploration of architectural theories, building systems, and design processes involved in creating appropriate sustainable architecture with an emphasis on ecological and environmental concerns. Miscellaneous course fee required—see Class Schedule. 5 laboratories. Prerequisite: ARCE 226, ARCH 231, ARCH 253. Concurrent enrollment required in ARCH 307.

ARCH 353  Architectural Design (5)  
Continuation of ARCH 352. Development and exploration of architectural theories, building systems, and design processes
involved in creating appropriate architecture with an emphasis on socio-cultural and space planning/life safety concerns. Miscellaneous course fee required—see Class Schedule. 5 laboratories. Prerequisite: ARCE 226, ARCH 231, ARCH 253. Concurrent enrollment required in ARCH 342.

ARCH 357 Computer Graphics in Architecture (4)
Computer-aided drawing methods in architectural practice, focusing on two-dimensional and three-dimensional graphics on micro-computers. Miscellaneous course fee required—see Class Schedule. 2 lectures, 2 laboratories. Prerequisite: ARCH 250.

ARCH 400 Special Problems for Advanced Undergraduates (1–2)
Individual investigation, research, studies, or surveys of selected problems. Total credit limited to 4 units, with a maximum of 2 units per quarter.

ARCH 401 Toward a Barrier-Free Environment (3)
Exploring the interface between the built environment and human behavior. Physical and psychological design determinants. Attitudes towards deviancy, accessible environments and persons with disabilities. Legal, ethical, human factors. 3 lectures. Prerequisite: Junior standing or consent of instructor.

ARCH 407 Environmental Control Systems III (4)
Theory and application of mechanical and electrical systems for comfort. Emphasis on internal-load dominated buildings. Consideration of artificial lighting, H.V.A.C., systems, acoustics, water and waste systems. Miscellaneous course fee required—see Class Schedule. 2 lectures, 2 laboratories. Prerequisite: ARCH 307. Concurrent enrollment required in ARCH 451.

ARCH 411 Climatic Determinants of Building Design (2)
Influence of solar radiation and climatic conditions on siting and design of buildings. Architectural principles and energy conservation. 2 lectures. Prerequisite: PHYS 132, ARCH 307.

ARCH 413 The Built Environment: Issues and Education (3)
Identification of major issues in the design and creation of the built environment. Strategies for developing instructional units related to critical thinking and problem solving in the K-12 school setting. 1 lecture, 2 activities. Prerequisite: Junior standing.

ARCH 420 Seminar in Architectural History (3)
Architectural history, theory and criticism. Specific areas, periods, approaches and the relevance of history on present and future design issues. Class Schedule will list topic selected. 3 seminars. Prerequisite: 4th year or senior standing and ARCH 317, ARCH 318, and ARCH 319.

ARCH 441 Professional Practice (3)
The practice of architecture as it relates to the profession, firm organization and management. An introduction to the process and requirements from graduation to licensed professional. 1 lecture, 2 activities. Prerequisite: ARCH 407 and ARCH 451. Concurrent enrollment required in ARCH 452.

ARCH 442 Professional Practice (3)
Continuation of ARCH 441. The practice of architecture as it relates to the architect’s role and responsibilities for building project development, delivery, and construction administration. Introduction to the architect's legal and ethical relationship to owner, contractor and subcontractors before, during and following the building construction process. 1 lecture, 2 activities. Prerequisite: ARCH 441 and ARCH 452. Concurrent enrollment required in ARCH 453.

ARCH 445 Urban Design in Architecture (3)
Design role of the urban architect. Economic, environmental and technological forces impacting on architectural practice in urban areas. 3 lectures. Prerequisite: ENGL 114.

ARCH 446 The Small Scale Master Builder (4)
Principles of practice as owner-designer-builder, selling or leasing products. Comparison with traditional practice. Potential income, constraints on design decisions, and ethics. Analysis of factors and methods relevant to such practice, including financing, taxes, accounting, market analysis, and development potential. Starting with little or no capital. 4 lectures. Prerequisite: Fourth-year standing.

ARCH 447 Design Regulations (3) (Also listed as CRP 447)
Practical application of fundamental building code requirements and zoning regulations in the design process. Codes and regulations used including city zoning regulations, city parking and driveway standards, the Uniform Building Code, and architectural barrier laws. 3 lectures. Prerequisite: ARCH 342.

ARCH 451 Architectural Design (5)
Continuation of ARCH 351, 352, 353. Problems of increasing architectural complexity involving the comprehensive integration of architectural theory, design processes, and building systems with emphasis placed on multifunctional buildings. Miscellaneous course fee required—see Class Schedule. 5 laboratories. Prerequisite: ARCH 307, ARCH 341, ARCH 342, ARCH 351, ARCH 352, ARCH 353, ARCE 321, ARCE 322, ARCE 323. Concurrent enrollment required in ARCH 407.

ARCH 452 Architectural Design (5)
Continuation of ARCH 451. Problems of increasing architectural complexity involving the comprehensive integration of architectural theory, design processes, and building systems with emphasis placed on multifunctional buildings. Miscellaneous course fee required—see Class Schedule. 5 laboratories. Prerequisite: ARCH 407 and ARCH 451. Concurrent enrollment required in ARCH 441.

ARCH 453 Architectural Design (5)
Continuation of ARCH 452. Problems of increasing architectural complexity involving the comprehensive integration of architectural theory, design processes, and building systems with emphasis placed on multifunctional projects in an urban context. Miscellaneous course fee required—see Class Schedule. 5 laboratories. Prerequisite: ARCH 441 and ARCH 452. Concurrent enrollment required in ARCH 442.
ARCH 455 Human Factors Applications in Architecture (3)
Human factors applications: human factors taxonomy, standardized information system, ergonomic research methods, evaluation procedures, and application strategies. 3 lectures. Prerequisite: ARCH 303 or consent of instructor.

ARCH 460 Advanced Computer Graphics in Architecture (3)
Advanced methods in the application of computer graphics and multi-media techniques in architectural design. Miscellaneous course fee required—see Class Schedule. 2 lectures, 1 activity. Prerequisite: ARCH 250 or equivalent and consent of instructor.

ARCH 461 Advanced Computer-Aided Design in Architecture (3)
Advanced applications of computers in architectural design with emphasis on utilizing intelligent tools in the design process. Miscellaneous course fee required—see Class Schedule. 2 lectures, 1 activity. Prerequisite: ARCH 357 or equivalent and consent of instructor.

ARCH 463 Undergraduate Seminar (2) (CR/NC)
Discussion and lectures on problems of practice in architecture. Professional ethics. Students present organized material on some subject of interest in architecture. 2 seminars. Prerequisite: Fourth-year standing in architecture. Credit/No Credit grading only.

ARCH 470 Selected Advanced Topics (1–3)
Directed group study of selected topics for advanced students. Class Schedule will list topic selected. Total credit limited to 6 units. 1 to 3 lectures. Prerequisite: Consent of instructor.

ARCH 471 Selected Advanced Laboratory (1–3)
Directed group laboratory study of selected topics for advanced students. Open to undergraduate and graduate students. Class Schedule will list topic selected. Total credit limited to 6 units. 1 to 3 laboratories. Prerequisite: Consent of instructor.

ARCH 480 Special Studies in Architecture (1–12)
Special issues and problems through research, field trips, design projects, and other forms of investigation and involvement. Course requirements are determined prior to each individual project through a contractual agreement between students and department. The departmental Off Campus Study Guidelines apply except when superseded by guidelines and practices of the London Study Program of the School of Liberal Arts. Total credit limited to 36 units. Prerequisite: Junior standing.

ARCH 481 Senior Architectural Design Thesis Project (5)
Comprehensive building design and research project in an architectural concentration area. Demonstration of professional competency in integration of architectural theory, principles and practice with creative, organizational and technical abilities in architectural programming, design and design research. Total credit limited to 15 units, with a maximum of 5 units per quarter. Miscellaneous course fee required—see Class Schedule. 5 laboratories. Prerequisite: ARCH 407, ARCH 441, ARCH 442, ARCH 451, ARCH 452, ARCH 453 and fifth year standing.

ARCH 485 Cooperative Education Experience (6) (CR/NC)
Part-time work experience in business, industry, government, and other areas of student career interest. Positions are paid and usually require relocation and registration in course for two consecutive quarters. Formal report and evaluation by work supervisor required. Total credit limited to 16 units. Credit/No Credit grading only. Prerequisite: Sophomore standing and consent of instructor.

ARCH 491 Design Project (2)
Comprehensive architectural design project chosen by the student to challenge technical, creative, and organizational abilities. Project to involve community or field contact. Projects involving other disciplines encouraged. 2 laboratories. Prerequisite: ARCH 407, ARCH 441, ARCH 442, ARCH 451, ARCH 452, ARCH 453 and fifth year standing. Concurrent enrollment required in ARCH 481.

ARCH 495 Cooperative Education Experience (12) (CR/NC)
Full-time work experience in business, industry, government, and other areas of student career interest. Positions are paid and usually require relocation and registration in course for two consecutive quarters. Formal report and evaluation by work supervisor required. Total credit limited to 16 units. Credit/No Credit grading only. Prerequisite: Sophomore standing and consent of instructor.

ARCH 501 Environmental Control Systems (3)
Comparative analysis and evaluation of mechanical and electrical building systems in high-rise and special purpose low-rise buildings. 3 seminars. Prerequisite: ARCH 407.

ARCH 510, 511 Environmental Design Methods (3) (3)
Application of systematic, step-by-step procedures to rational and intuitive judgmental tasks. Methods for formulation, idea production, evaluation, and testing applied to planning, testing, design information systems, communication between designer and client, user participation in design, and other current topics. 511 focuses on specific problem area among topics and may be repeated up to 9 units. 3 lectures. Prerequisite: Graduate standing.

ARCH 513 Natural Architectural Lighting (3)
Perception and awareness of light; natural light as generator of urban spaces and building forms. Principles of design in lighting fundamentals and techniques. 3 lectures. Prerequisite: ARCH 407 or consent of instructor.

ARCH 519 Theory of Architecture (3)
Comparative analysis of the major historic influences which have contributed to the development of architectural design theories. Class Schedule will list topic selected. Total credit limited to 9 units. 1 lecture, 2 seminars. Prerequisite: ARCH 319 or graduate standing.
ARCH 531 Habitability (3)
Habitability standards and concepts significant for architectural design and practice. Behavioral analysis of habitats, facilities and urban systems. Design and development of structures and systems responsive to human needs. Habitability and environmental specifications, human factors, human engineering, behavioral sciences. 3 seminars. Prerequisite: ARCH 303, ARCH 453, or consent of instructor.

ARCH 532 Quantitative Methods in Architecture (3)
Roles of research in environmental design analysis. Approaches to research, hypothesis testing, data banks, and information systems for design. Use of research findings in various decision-making systems. 3 seminars. Prerequisite: Graduate standing.

ARCH 533 Architectural Programming (3)
Information management in the design process. Techniques for gathering, analyzing, and transforming data for use as design information. Variety of approaches to pre-design planning. 3 seminars. Prerequisite: ARCH 453.

ARCH 537 Principles of Development (3)
Theory and application of the architect's role in real estate development. Topics include financing, corporate structuring, feasibilities, market studies, and proposal presentation. Emphasis on the influence of design on the success of the development process. 3 seminars. Prerequisite: Graduate standing in Architecture, or consent of instructor.

ARCH 551 Architectural Design (5)
Professional initiative and responsibility in integrating architectural design theory and practice with fields influencing the total environment. Building types considered as the coordinating factor. Total credit limited to 15 units with no more than 5 units in any one quarter. 5 laboratories. Prerequisite: Graduate standing.

ARCH 561 Advanced Design (3)
Continuation of ARCH 551. Advanced studies integrating architectural design theory and practice with fields influencing the shaping of the total environment. Total credit limited to 9 units. 3 laboratories. Prerequisite: Graduate standing.

ARCH 563 Professional Seminar (2)
Problems and topics in the field of the architectural profession. Seminar drawn upon expertise of visiting professionals in addition to topics presented by regular faculty and students. 2 seminars. Prerequisite: Graduate standing.

ARCH 580 Seminar in Theory of Architecture (3)
Directed group study of selected topics in the theory of architecture for graduate students. Class Schedule will list specific topics selected. Total credit limited to 9 units. 3 seminars. Prerequisite: ARCH 453.

ARCH 598 Master's Design Project (3–6)
Completion of a master project demonstrating in-depth research ability at a graduate level. Total credit limited to 9 units. 3 or 6 laboratories. Prerequisite: Consent of graduate adviser.

ARCH 599 Master's Thesis (3–6)
Completion of a thesis embodying original research in an area of environmental design. Total credit limited to 9 units. Prerequisite: Consent of graduate adviser.

ART

Analysis, history and practice of the art of drawing. Drawing problems progress from simple geometric shapes to more sophisticated subject matter, expanding visual awareness. Lectures on historical methods and the importance of drawing. Development of individual techniques. 1 lecture, 3 activities.

ART 104 Introduction to Art Materials (3)
Manipulation and experimentation with a wide variety of art media and techniques. Evaluation of expressive and design qualities in group and individual projects. 3 activities.

ART 108 Fundamentals of Sculpture (4) GEB C.2.
Studio course in the creative investigation of three-dimensional form through problems in modeling, casting, carving and assembly. Emphasis on expression, aesthetics and history. Miscellaneous course fee required—see Class Schedule. 1 lecture, 3 activities.

ART 111 Introduction to Art (4) GEB C.2.
Designed to acquaint the non-art major with painting, sculpture, drawing, crafts, architecture, and printmaking. Development of vocabulary, analytic skills, and research techniques for the understanding of art objects. 4 lectures.

ART 112 Survey of Western Art (3) GEB C.2.
History of major art movements in western civilization from Greek art to the present. Representative periods of western culture, such as the Classic tradition, the Middle Ages, the Italian Renaissance, the Renaissance in Northern Europe, Baroque and Rococo, Romanticism, Neo-Classicism and Modernism. 3 lectures.

ART 131 2-Dimensional Design Fundamentals (3)
Basic design theory in black, white and greys covering the visual elements and principles in two dimensions. 1 lecture, 2 activities.

ART 132 Beginning Color Theory (3)
Basic design color theory developed through exercises in hue, value and intensity. 1 lecture, 2 activities. Prerequisite: ART 131.

ART 133 Color and Design (3)
Advanced color problems in two-dimensional design theory covering compositional, optical and psychological aspects of visual communication. 1 lecture, 2 activities. Prerequisite: ART 131, ART 132.

ART 134 3-Dimensional Design (3)
Studio course in research and application of principles, elements and criticism of three-dimensional design concepts. Miscellaneous course fee required—see Class Schedule. 1 lecture, 2 laboratories.
ART 135  Introduction to Product Design (3)
Studio course using 3-dimensional forms and materials. Introduction of product design including concept, illustration and assembly methods. Miscellaneous course fee required—see Class Schedule. 3 activities. Prerequisite: ART 134, or consent of instructor.

ART 200  Special Problems for Undergraduates (1–2)
Individual investigation, research, studies or surveys of selected problems. Total credit limited to 4 units, with a maximum of 2 units per quarter. Prerequisite: Consent of instructor.

ART 201  Intermediate Drawing (3)
Development of additional drawing techniques with emphasis on form and composition. 3 activities. Prerequisite: ART 101.

ART 204  Beginning Watercolor (3)
Transparent watercolor painting. Course emphasizes: proper use of watercolor paper, brush techniques, pigment mixing, use of color, use of washes, wet-into-wet, indirect methods, composition and presentation. 3 activities. Prerequisite: ART 101.

ART 211  Art History—Prehistoric through the European Middle Ages (4)
Nature and development of outstanding works of art from ancient cultures in Europe, Egypt and the Eastern Mediterranean. Emphasis upon the study of painting, sculpture and related visual arts that coincide with historical background factors. 4 lectures.

ART 212  Art History—European Renaissance through Baroque Eras (4)
Studies concentrate upon significant visual expressions of the Renaissance and Baroque eras in painting, sculpture and architecture. Relevancy of historical background factors to art expression emphasized. 4 lectures. Prerequisite: ART 211.

ART 213  Art History—European 18th and 19th Century Art (4)
Painting, sculpture and the related visual arts culminating with Romanticism, Neoclassicism, and Realism. Historical factors and artists prominent to art expression of these eras emphasized. 4 lectures. Prerequisite: ART 211 or ART 212.

ART 221  Basic B/W Photography (3)
Fundamental techniques in black and white photography. Mechanics of cameras and equipment, optics, composition, filters, subject content, developing, printing, and mounting. Understanding photographic principles, producing a quality continuous tone print, and print presentation. 35mm camera with manual adjustment capability required. 2 lectures, 1 laboratory.

ART 222  35mm Intermediate B/W Photography (3)
Control of tonal range using 35mm cameras and available daylight illumination. Composition and visual communication. Assignments range from close-ups to architecture. Emphasis on "photographic seeing" and professional quality enlargements. 2 lectures, 1 laboratory. Prerequisite: ART 221.

ART 224  35mm Advanced B/W Photography (3)
Advanced B/W photography using 35mm cameras. Artificial light including studio electronic flash, tungsten studio light, and hand strobe. Professional quality developing and printing. Includes portraiture, close-ups, product, and action. 2 lectures, 1 laboratory. Prerequisite: ART 221, ART 222.

ART 231  Computer Imaging and Design (3)
Introduction to the Macintosh system to acquaint students with operating procedures. Students will learn QuarkXpress, Adobe Illustrator, Aldus Freehand, and Adobe Photoshop for use in their own creative design or photography. Miscellaneous course fee required—see Class Schedule. 2 lectures, 1 laboratory. Prerequisite: ART 133 and CSC 113 or consent of the instructor.

ART 232  Beginning Graphic Design (3)
Basic terminology, studio skills, assembly methods, photographic reproduction processes, and specification for graphic designers. Familiarization with the various services available. 2 lectures, 1 laboratory. Prerequisite: ART 131, ART 132, ART 133.

ART 242  Glassblowing (4)
Studio course in the offhand process of working with glass from a furnace. Overview of glass history. Development of tools and forming processes studied while students develop 3-dimensional projects. Miscellaneous course fee required—see Class Schedule. 2 lectures, 2 activities.

ART 245  Ceramics I (3)
Studio course in basic clay working with emphasis on design quality, hand building, and use of the potter’s wheel. Miscellaneous course fee required—see Class Schedule. 1 lecture, 2 laboratories.

ART 255  Jewelry Design (3)
Studio course in nonferrous metal techniques including cutting, forming, soldering, and forging with emphasis on creative design solutions. Miscellaneous course fee required—see Class Schedule. 3 activities.

ART 301  Advanced Drawing (3)
Development of advanced methods and techniques in the study of form and structure. Emphasis on problem solving. 3 activities. Prerequisite: ART 131 and ART 201.

ART 302  Life Drawing I (3)
Development of methods and techniques in the study of form and structure as it relates to human proportion and anatomy analysis. 3 activities. Prerequisite: ART 201.

ART 303  Life Drawing II (3)
Advanced problems in life drawing. Advanced methods and techniques in the study of the human form as it relates to proportion, anatomy analysis and composition. 3 activities. Prerequisite: ART 302.

ART 304  Advanced Watercolor (3)
Transparent watercolor painting. Design and composition of painting, use of drawing and advanced watercolor techniques. 3 activities. Prerequisite: ART 204.
ART 305 Painting Techniques (3)
Physical characteristics of painting media, creative understanding of pictorial space and color. 3 activities.
Prerequisite: ART 101.

ART 306 Figure Painting (3)
Comparative development of proportion and structure of the human head and figure as it relates to color and value. Mixing of pigment color and its implementation to figure painting. Continued emphasis with figure, its artistic placement in space and pictorial composition. Total credit limited to 6 units. 3 activities. Prerequisite: ART 204, ART 302.

ART 307 Graphic Rendering (3)
Problems in felt-marker rendering techniques relative to various graphic design applications. 2 lectures, 1 laboratory. Prerequisite or concurrent: ART 301 and ART 302.

ART 308 Advanced Sculpture (3)
Advanced studio course in expressive use of form with modeling, casting, carving, and/or assembly. Miscellaneous course fee required—see Class Schedule. 3 activities. Prerequisite: ART 108, or ART 134, or consent of instructor.

ART 310 Art History—American Art (4)
Major historical periods of American art from the colonial period to the present. Special emphasis will be given to the broader notion of American art as a process of developing an identity of the varied historical and sociological forces which have shaped images in American art. 4 lectures. Prerequisite: ART 111, ART 213, or consent of instructor.

ART 311 Art History—Modern Art (4)
History of painting and sculpture from the French Revolution to World War II. Covers such major movements as Neo-Classicism, Romanticism, Impressionism, Post-Impressionism, Fauvism, Cubism, Expressionism, and Dada. 4 lectures. Prerequisite: ART 111, ART 112 or ART 213

ART 312 Art History—Contemporary Art (4)  
History of major art movements and ideologies from Surrealism to the present. Major emphasis will be placed on developments in painting and sculpture after World War II. 4 lectures. Prerequisite: ART 311, a 200-level art history course.

ART 313 Design History (3)
Survey of graphic and product design from Russian avant-garde to the present. Emphasis placed on Constructivism, Streamlining, and development of the Modern Movement in design. 3 lectures. Prerequisite: Any lower division art history course for Art majors; Junior standing for all other students.

ART 314 History of Photography (4)  
GEB C.3.
Photography and significant photographers from the invention of the camera obscura to the present day. Evolution of visual ideas in the medium with regard to changes in technology and society. Relationship to other visual arts and cultural impact. 4 lectures. Prerequisite: Any lower division art history course for Art majors; Junior standing and ART 111 or ART 112 for all other students; or consent of instructor.

ART 320 Fashion Photography (3)
Posing and directing models in fashion photography using 35mm and medium format cameras in black and white. Various studio lighting setups and locations techniques as they apply to advertising and editorial fashion photography. 2 lectures, 1 laboratory. Prerequisite or concurrent: ART 224.

ART 321 Photographic Expression: B/W (4)
Advanced techniques including multiple exposure, series, high contrast and digital manipulation. Emphasis on personal expression and developing style, introduction to symbology, visual source development and the work of contemporary creative photographers. 2 lectures, 2 laboratories. Prerequisite: ART 224 and ART 314.

ART 322 Color Photography I, Negative (3)
Fundamental techniques in color photography. Theory of color, visual concepts, exposing, and processing color negatives, printing from color negatives, finishing and presentation. Studio electronic flash and available light. 2 lectures, 1 laboratory. Prerequisite: ART 224.

ART 323 Color Photography II, Positive (3)
Development of consistent control of 35mm transparency exposure and printing. Introduction to digital manipulation techniques and vocabulary. Theory of color in expression and communication; exploration of both a descriptive approach and interpretive approach; a survey of contemporary color photography. Miscellaneous course fee required—see Class Schedule. 2 lectures, 1 laboratory. Prerequisite: ART 322. Recommended: CSC 113.

ART 325 4x5 Camera Techniques, B/W (3)
Basic techniques using 4x5 view cameras. Architecture, landscapes, portraiture, and other outdoor subjects used to help the student master the use of large format cameras. Other topics include exposure techniques, perspective, and sharpness correction, lighting and composition. Sensitometric approach to B/W film development and print quality emphasized. 2 lectures, 1 laboratory. Prerequisite: ART 323.

ART 326 4x5 Camera/Commercial (3)
Professional techniques with large format cameras. Outdoor and studio photography presented using B/W film and color transparencies. Topics include studio lighting for glass and metal, copying, interiors, and product photography. 2 lectures, 1 laboratory. Prerequisite: ART 325.

ART 327 Portraiture (3)
Studio and environmental portraiture. Emphasis on light ratios/patterns; posing; personality portrayal. Retouching of film and print. 2 lectures, 1 laboratory. Prerequisite: ART 224, ART 325.

ART 329 Editorial and Corporate Photography (3)
Creating, lighting and executing editorial photography. Producing photography for corporate needs, i.e. annual reports, brochures and in-house publications. Emphasis on selecting subject matter, handling lights and color film. 2 lectures, 1 laboratory. Prerequisite: ART 326.

ART 331 Typographic Design (3)
Principles of letterforms and how these principles affect the communication of ideas through graphic design. Analysis of type style, structure, and form. Computer applications are
encouraged for appropriate problems. 3 activities.
Prerequisite: Junior standing. ART majors: ART 135, ART 230
(or concurrent). GRC majors: ART 133.

ART 332 Symbology (3)
Use of symbolism, metaphor and connotative imagery in
graphic design. Exploration of various problem solving
methods for image-making. Computer applications are
encouraged for appropriate problems. 3 activities.
Prerequisite: ART 331, junior standing.

ART 333 Corporate Identity (3)
Design and implementation of corporate logos. Development
of graphic standards manuals for use of identity in diverse
applications. Computer applications are encouraged for
appropriate problems. 3 activities. Prerequisite: ART 332,
junior standing.

ART 336 Exhibition Design/Museum Studies (3)
Theory and applied principles of exhibition design for art
objects in the museum or gallery setting. Class responsible
for planning and installing actual gallery exhibitions. 2 lectures,
1 laboratory. Prerequisite: ART 131, ART 134, or consent of
instructor.

ART 343 Selected Advanced Topics in Glass (4)
Continued exploration into the expressive use of glass as a
creative medium. Topics may include glass casting, glass
blowing, mold making, and kiln work. Studio time is by
arrangement. Miscellaneous course fee required—see Class
Schedule. 2 lectures, 2 activities. Prerequisite: ART 108 or
ART 242, or consent of instructor.

ART 344 Glass Fusing and Forming (3)
Studio course in the creative processes of fusing, forming,
and assembling glass. Introduction to the use of line, color,
and texture related to glass as a transparent or opaque
material. Miscellaneous course fee required—see Class
Schedule. 3 activities. Prerequisite: ART 108 or ART 242 or
consent of instructor.

ART 345 Ceramics II (3)
Studio course in hand, wheel, mold, extruder, jigger, and
press forming skills. Design of single and multiple forms and
kiln firing procedures. Miscellaneous course fee required—see
Class Schedule. 3 activities. Prerequisite: ART 108 or ART
134, or ART 245 or consent of instructor.

ART 346 Ceramics III (3)
Studio use of clay, slip, engobe, glaze, stoneware and raku.
Contemporary craftmaker's skills are developed through use
of historic and industrial techniques. Miscellaneous course
fee required—see Class Schedule. 1 lecture, 2 activities.
Prerequisite: ART 108, or ART 134, or ART 245 or consent
of instructor.

ART 355 Metalsmithing (3)
Studio course investigating intermediate fabrication including
raising, box construction and masonite dye. Exploration of
surface design techniques for nonferrous metals. Emphasis on
creative design solutions to problems. Miscellaneous course
fee required—see Class Schedule. 3 activities. Prerequisite:
ART 108 or ART 255, or consent of instructor.

ART 356 Jewelry Casting (3)
Introduction to casting for the jeweler with emphasis on
creative design solutions to assigned problems. Use of lost
wax techniques including design, wax working, casting and
finishing. Miscellaneous course fee required—see Class
Schedule. 3 activities. Prerequisite: ART 108 or ART 255, or
consent of instructor.

ART 400 Special Problems for Advanced
Undergraduates (1–2)
Individual investigation, research, studies, or surveys of
selected problems. Total credit limited to 4 units, with a
maximum of 2 units per quarter. Prerequisite: Senior standing
and consent of instructor.

ART 408 Illustration (3)
Development of techniques and conceptual skills in
illustration for use in the fields of graphic design and
advertising. Total credit limited to 6 units. For Applied Art
and Design majors only. 3 activities. Prerequisite: ART 204,
ART 302, ART 331.

ART 424 Multimedia Photography (4)
Multimedia presentation, synchronizing color slides, music,
narration, and video. Contemporary, creative photography
 techniques applied. Creative seeing and interpretation that
communicates to the viewer. 2 lectures, 2 laboratories.
Prerequisite: ART 323.

ART 426 Illustration Photography I–B/W (3)
Principles of lighting and design as applied to subjects and
small product studio photography. 35mm and 4x5 cameras
used. Emphasis on creative problem solving, tabletop
composition and lighting to produce quality image. 2
lectures, 1 laboratory. Prerequisite: ART 326 and senior
standing.

ART 427 Illustration Photography II–Color (3)
Applied principles of design and color to produce a
photograph that sells an idea, product, or service. 35mm and
4x5 cameras used. Emphasis on thinking, planning,
interpreting, and presenting an idea photographically. 2
lectures, 1 laboratory. Prerequisite: ART 426 and senior
standing.

ART 428 Commercial Photography (4)
Professional photographic techniques using large and small
format cameras, color and B/W materials. Incorporates
personal style. Emphasis on commercial and illustrative
applications in studio and on location. Portfolio quality
prints. 2 lectures, 2 laboratories. Prerequisite: ART 427 and
senior standing.

ART 430 Advanced Typographic Design (3)
Advanced principles of letterform design and modification
related to the communication of ideas through graphic
design. Advanced analysis of type characteristics. Computer
application to the typographic design processes.
Miscellaneous course fee required—see Class Schedule. 3
activities. Prerequisite: ART 333 and senior standing.

ART 431 Package Design (3)
Graphics for food, beverage and related packaging.
Positioning of products through research into typography,
imagery and color. For Applied Art and Design majors only. Computer applications are encouraged for appropriate problems. 3 activities. Prerequisite: ART 333 and senior standing.

ART 432  Advertising Design (3)
Development of print advertising from concept to marker rendering. Emphasis on art direction, photo direction and copywriting. For Applied Art and Design majors only. Computer applications are encouraged for appropriate problems. 3 activities. Prerequisite: ART 431 and senior standing.

ART 433  Editorial Design (3)
Design of editorial material, printed collateral, magazine layouts and annual reports. For Applied Art and Design majors only. Computer applications are encouraged for appropriate problems. 3 activities. Prerequisite: ART 432 and senior standing.

ART 460  Professional Practices (2)
Professional practices in the art and design field, legal and ethical questions, taxes, contracts, fees and copyrights. Current job opportunities, résumé and portfolio preparation with visiting professionals. For Applied Art and Design majors only. 2 lectures. Prerequisite: Senior standing.

ART 461  Senior Project (3)
Selection and completion of a project under faculty supervision. Minimum of 90 hours time. Results presented in a formal report. Prerequisite: Senior standing and ART 460.

ART 462  Senior Portfolio Project (1)
Preparation of portfolio system for entrance into the professional job market. 1 activity. Prerequisite: Senior standing and ART 461.

ART 463  Undergraduate Seminar (2)
Analysis of selected problems and topics for undergraduates. 2 seminars. Prerequisite: Senior standing.

ART 464  Graphics and Animation Techniques for Microcomputers (3)
Original and available software to investigate graphics generation and realtime animation techniques. Topics include BASIC vs. assembly language, brush painting, page flipping. Color graphics, sound, and music. Educational and commercial applications and marketing. 3 lectures. Prerequisite: CSC 110 or 410 and 207.

ART 465  Contemporary Photography Seminar (2)
Survey of significant photographers and developments in the field since 1950. The interaction between photography and the other visual arts as well as its social impact during this period. Student presentations on selected research topics. Total credit limited to 4 units. 2 seminars. Prerequisite: ART 314.

ART 470  Selected Advanced Topics (1–3)
Directed group study of selected topics for advanced students. Open to undergraduate and graduate students. Class Schedule will list topic selected. Total credit limited to 6 units. 1 to 3 lectures. Prerequisite: Consent of instructor.

ART 471  Selected Advanced Laboratory (1–3)
Directed group laboratory study of selected topics for advanced students. Open to undergraduate and graduate students. Class Schedule will list topic selected. Total credit limited to 6 units. 1 to 3 laboratories. Prerequisite: Consent of instructor.

ART 485  Cooperative Education Experience (6) (CR/NC)
Part-time work experience in business, industry, government, and other areas of student career interest. Positions are paid and usually require relocation and registration in course for two consecutive quarters. Formal report and evaluation by work supervisor required. Total credit limited to 16 units. Credit/No Credit grading only. Prerequisite: Sophomore standing and consent of instructor.

ART 495  Cooperative Education Experience (12) (CR/NC)
Full-time work experience in business, industry, government, and other areas of student career interest. Positions are paid and usually require relocation and registration in course for two consecutive quarters. Formal report and evaluation by work supervisor required. Total credit limited to 16 units. Credit/No Credit grading only. Prerequisite: Sophomore standing and consent of instructor.

ASCI—ANIMAL SCIENCE

ASCI 101  Introduction to the Animal Sciences (2) (CR/NC)
Economic, environmental and societal impact of the livestock, poultry and horse industries. Basic terminology, anatomy, and physical requirements of animals. Career and academic planning. Co-curricular, extra-curricular, and post-graduate opportunities. Required of all first-time students in the Animal Sciences and Industry Department. Credit/No Credit grading only. 2 lectures.

ASCI 141  Market Beef Production (4)
Survey of industry characteristics, breeds, market classes, carcass residues, environmental protection and diet/health issues. Application of management skills, health care and behavior. 3 lectures, 1 laboratory.

ASCI 142  Swine Science (4)
Role of swine in agriculture, consideration of product quality assurance, diet/health issues and animal welfare concerns. Evaluation of brood stock and progeny product, husbandry systems, management skills, feeding systems and health management. 3 lectures, 1 laboratory.

ASCI 143  Systems of Sheep Production (4)
Types of sheep operations and geographic influence on management. The role of sheep in world agriculture. Social concerns including humane care, residues and diet/health issues. Evaluation of products, management skills, health care and behavior. 3 lectures, 1 laboratory.

ASCI 144  Equine Science (3)

ASCI 200  Special Problems for Undergraduates (2–3)
Individual investigation, research, studies, or surveys of selected problems. Total credit limited to 4 units, with a
maximum of 3 units per quarter. Prerequisite: Consent of department head.

ASCI 220  Introductory Animal Nutrition and Feeding (4)
Food nutrients, identification and nutrient quality of feedstuffs and uses for each class of livestock. Ration formulation based on the digestion and utilization of feeds. Economy and least price purchasing based on nutrient content and market value of livestock. 3 lectures and 1 laboratory.

ASCI 226  Livestock Evaluation (3)
Utilization of objective and subjective estimation measures in establishing economic worth of domestic animals of the three meat animal species and horses. 1 lecture, 2 laboratories.

ASCI 231  General Animal Science (3)
Relationship of animal agriculture to society and the economy and their role for human use and consumption. Discussion of nutrition, reproduction and management of beef cattle, sheep, swine and horses. Credit not allowed for Animal Science majors. 3 lectures.

ASCI 244  Applied Horse Practices (2)
History and location of horse unit facilities and breeds maintained. Common knots, proper techniques in safely catching, leading, grooming, and restraining horses. Evaluation of desirable and faulty conformation. Preventive health program. Determining the age of a horse by dentition. Pedigree analysis. 1 lecture, 1 activity. Prerequisite or corequisite: ASCI 144 recommended.

ASCI 260  Preparation of Livestock for Shows and Sales (2)
Techniques, equipment and knowledge necessary in order to properly condition, groom, and present beef cattle or horses for evaluation and merchandising. Total credit limited to 4 units. 2 laboratories.

ASCI 290  Livestock Management Enterprise (2–4) (CR/NC)
Management techniques of the livestock enterprise. Providing health, nutritional and physical care to a representative group of animals. Planning, budgeting and marketing. Instructor approval required. Prerequisites may exist for some enterprises. Total degree credit for 290/490 limited to 9 units. Credit/No Credit grading only. Prerequisite: Consent of instructor.

ASCI 304  Animal Breeding (3)
Application of genetic principles for livestock improvement. Improving production through a study of selection techniques, mating systems, and performance evaluation using current technology. 3 lectures. Prerequisite: BIO 303.

ASCI 311  Commercial Beef Management (3)
Management practices involved in the commercial beef cattle breeding enterprise. Trends and economic considerations relative to California and the U.S. Principles of selection, basic reproductive physiology, breeding systems, range management, nutrition, health programs and marketing phases of the enterprise. 3 lectures. Prerequisite: ASCI 141.

ASCI 312  Swine Management (3)
Management practices involved in commercial and purebred swine enterprises. Methods of production and marketing, performance testing programs and carcass evaluation techniques. Nutritional requirements, rations, feed additives, diseases and parasites, facilities and equipment. 3 lectures. Prerequisite: ASCI 142.

ASCI 313  Sheep Management (3)
Management practices of purebred and commercial sheep operations. Techniques, equipment, feeds, health care products and decision making throughout a production cycle from selection to culling. Exposure to emerging technologies and scientific advancements that will affect the sheep industry. 3 lectures. Prerequisite: ASCI 143.

ASCI 314  Advanced Horse Management (3)
Management practices relative to the training and conditioning of the horse. Investigation of the nutritional, behavioral and physiological parameters required of the horse in work, sport and recreational events. Miscellaneous course fee required—see Class Schedule. 3 lectures. Prerequisite: ASCI 144 and ASCI 244, or consent of instructor.

ASCI 326  Advanced Livestock Evaluation (2)
Application of deductive and inductive logical processes in appraising the relative merit of individual animals within a group sample. Oral expression of the selection rationale. 2 laboratories. Prerequisite: ASCI 226.

ASCI 329  Principles of Range Management (3)
Characteristics, history and multiple uses of rangeland. Principles of range plant physiology and ecology in relation to range condition, trend, utilization and improvement practices. Principles of proper grazing practices and nutrition of livestock. 3 lectures. Prerequisite: One course each in soil science, animal science and botany or crop science.

ASCI 331  Applied Range Management Practices (2)
Basic taxonomy and values of common range plants. Evaluation of range sites, soils, condition, trend and grazing utilization. Application of range technology, improvement and management practices to field situations. 1 lecture, 1 activity. Prerequisite: One course each in soil science, animal science and botany or crop science. ASCI 329 recommended.

ASCI 333  Equine Reproduction (5)
Management of the breeding farm, breeding problems, diseases, study of estrus cycles, servicing the mare, handling stallions. Breeding systems, teasing, embryo transfer, ultrasound pregnancy diagnosis, new developments in breeding technology. Miscellaneous course fee required—see Class Schedule. 4 lectures, 1 laboratory. Prerequisite: ASCI 144, ASCI 244.

ASCI 344  Equine and Human Communication (3)
Behavior of the horse and its relationship with people. Learning, motivation, social behavior and communication with techniques to improve the safety and understanding between people and horses. 3 laboratories. Prerequisites: ASCI 144, ASCI 244, ASCI 260 and consent of instructor.
ASC 345  Equine Behavior Modification (3)
Advanced principles of equine behavior modification for training young horses under saddle. Identifying differences in individual horse's attitudes, techniques to teach horses to respond to various stimuli, management of young equine athletes. 3 laboratories. Prerequisite: ASC 344 or consent of instructor.

ASC 400  Special Problems for Advanced Undergraduates (2–4)
Individual investigation, research, studies, or surveys of selected problems. Total credit limited to 4 units, with a maximum of 4 units per quarter. Prerequisite: Prior consent of department head.

ASC 401  Reproductive Physiology (4)
Reproductive anatomy of male and female farm animals. General endocrinology and systemic physiology. Endocrine system effects on the various aspects of reproduction, such as: gametogenesis, estrus, gestation, parturition, mothering and seasonality. Introduction to reproductive biotechnology and embryo manipulation. 3 lectures, 1 laboratory. Prerequisite: VS 123.

ASC 410  Ultrasonography (1)
Utilization of ultrasound technology for pregnancy diagnosis in sheep, beef cattle, swine and horses and live animal carcass estimation in sheep, beef cattle and swine. 1 laboratory. Prerequisite: FSN 211, ASC 401, VS 123 and senior standing.

ASC 420  Animal Nutrition (3)
Metabolism of proteins, carbohydrates, lipids, minerals, vitamins and water, and the relationship of nutrient utilization to animal production. 3 lectures. Prerequisite: ASC 220 and CHEM 326 (or CHEM 316 and CHEM 317).

ASC 421  Animal Nutrition (Pre-Veterinary and Graduate Students) (3)
Nutrient metabolism and the relationship of nutrient metabolism and utilization to metabolic dysfunctions and food-animal production. 3 lectures. Prerequisite: ASC 220 and CHEM 328 (or CHEM 371 and CHEM 372).

ASC 461  Senior Project (2)
Selection of a project and an ASC 462 adviser, formulation of an outline and a literature review. Projects selected in the student's expected field of employment. Outline and literature review will be presented as part of the ASC 462 final report. Minimum 60 hours. 2 seminars. Prerequisite: Senior standing.

ASC 462  Senior Project (2)
Selection and completion of a project under faculty supervision. Projects typical of problems which graduates must solve in their fields of employment. Project results are presented in a formal report. Minimum 60 hours.

ASC 463  Undergraduate Seminar (2)
Major developments in the chosen field of the student. Discussion of new developments, policies, practices, and procedures. Each individual is responsible for the development and presentation of a topic in the chosen field. 2 seminars.

ASC 470  Selected Advanced Topics (1–3)
Directed group study of selected topics for advanced students. Open to undergraduate and graduate students. Class Schedule will list topic selected. Total credit limited to 6 units. 1 to 3 lectures. Prerequisite: Consent of instructor.

ASC 471  Selected Advanced Laboratory (1–3)
Directed group laboratory study of selected topics for advanced students. Open to undergraduate and graduate students. Class Schedule will list topic selected. Total credit limited to 6 units. 1 to 3 laboratories. Prerequisite: Consent of instructor.

ASC 476  Issues in Animal Agriculture (3)
Exploration of social, political and environmental forces which will affect livestock production in the future. Roles played by advocacy groups and the media in influencing consumer demands and management practices. 3 seminars. Prerequisite: Upper division standing.

ASC 490  Advanced Livestock Management Enterprise (2–4) (CR/NC)
Intensified management of specialized livestock enterprises in all species areas. Application of applied research and progressive husbandry practices employed. Industry contact and visitation encouraged. Specified class prerequisites and consent of instructor required. Total degree credit for 290/490 limited to 9 units. Credit/No Credit grading only. Prerequisite: Specified classes and consent of instructor.

ASC 581  Graduate Seminar in Animal Production (3)
Current findings and research problems in the field and their application to the industry. 3 seminars.

ASME—AGRICULTURAL SYSTEMS MANAGEMENT

ASM 141  Agricultural Machinery Safety (3)
Evaluation of safe tractor and equipment operation. Supervised field operation emphasizing the safe and efficient performance of modern farm and utility-industrial equipment. 2 lectures, 1 laboratory.

ASM 142  Agricultural Power and Machinery Management (4)
Evaluation of agricultural machinery and tractor power performance. Equipment studied includes primary and secondary tillage tools, grain drills, row crop planters, sprayers, grain and forage harvesters, and specialty crop harvesters. Emphasis on management, selection, cost analysis using computers and efficient operation of agricultural machinery. 3 lectures, 1 laboratory. Prerequisite: MATH 116 or equivalent.

ASM 203  Agricultural Systems Analysis (3)
Agricultural Systems Analysis investigates the interrelationships between sub-components in an overall system. Problem solving algorithms, network analysis, project planning techniques, and optimization. 2 lectures, 1 laboratory. Prerequisite: MATH 116 or equivalent.
ASM 324  Principles of Agricultural Electrification (4)
Applications of DC/AC electricity in agriculture. National Electric Code regulations. The wiring of agricultural structures and electrical distribution. Series, parallel and series-parallel circuits, R-L-C circuits, electric motors, electronics. 3 lectures, 1 laboratory. Prerequisite: MATH 119 or MATH 120, PHYS 104.

ASM 325  Agricultural Energy Systems (3)
Use of energy systems in modern agriculture with a focus on the economic and moral dilemmas facing our technological society. 2 lectures, 1 laboratory. Prerequisite: PHYS 104, ASM 142.

ASM 402  Agricultural Materials (3)
Introduction to the physical aspects and properties of a wide variety of materials encountered in the field of agriculture. Physical interactions between agricultural commodities and the machines used in handling. 2 lectures, 1 laboratory. Prerequisite: ASM 325.

ASM 432  Agricultural Buildings (4)
Selection of buildings, storage units, and related equipment for production agriculture. Economics and functionality of various designs and construction materials. Environmental factors affecting crop storage and animal housing. 3 lectures, 1 laboratory. Prerequisite: PHYS 104, ASM 402.

ASM 463  Undergraduate Seminar (1)
Group discussion of current agricultural engineering topics presented by individual members of the class and visitors. Placement opportunities and requirements. 1 seminar.

ASTR–ASTRONOMY AND ASTROPHYSICS

ASTR 101  Introduction to the Solar System (3)  GEB B.1.a.
Descriptive astronomical properties of the Earth, Moon, other planets and their satellites. Comets, asteroids and other members of the Solar System. Theories of the formation of the Solar System. Opportunities for telescope observations of the Moon and planets. Not open to students who have completed or are taking ASTR 301, or PHYS 132. 3 lectures.

ASTR 102  Introduction to Stars and Galaxies (3)  GEB B.1.a.
Descriptive astronomical properties of the Sun, stars, galaxies, and interstellar material. Expanding universe and cosmological models. Opportunities for telescope observations and star identification. Not open to students who have completed or are taking ASTR 301, ASTR 302, or PHYS 132. ASTR 101 is not a prerequisite. 3 lectures.

ASTR 301  The Solar System (3)  GEB B.1.a.
Quantitative and descriptive properties of the Solar System including the physics of the planets, their satellites, comets and interplanetary media. Possible origins of the Solar System. Not open to students who have completed ASTR 101. 3 lectures. Prerequisite: PHYS 132 or PHYS 123.

ASTR 302  Stars and Galaxies (3)  GEB B.1.a.
Quantitative and descriptive properties of the stars, galaxies and interstellar media; including stellar structure and evolution, structure and make-up of galaxies and cosmological models. Not open to students who have completed ASTR 102. 3 lectures. Prerequisite: PHYS 132 or PHYS 123. ASTR 301 is not a prerequisite.

ASTR 303  Relativity and Cosmology (3)  GEB B.1.a.
Introduction to the basic ideas of Einstein’s theories of relativity and cosmology. The structure and evolution of the universe. The principle of relativity, the speed of light, gravity and the equivalence principle. Curved spacetime, black holes, the expanding universe, the Big Bang, and nucleosynthesis. 3 lectures. ASTR 302 is not a prerequisite. Prerequisite: PHYS 122 or PHYS 132.

BACT–BACTERIOLOGY

BACT 221  General Bacteriology (4)  GEB B.1.b.
Morphology, metabolism, classification and identification; bacteriology of air, soil, water, and foods with applications to industry, agriculture, medicine, and public health. 2 lectures, 2 laboratories. Prerequisite: One quarter of chemistry.

BACT 222  General Microbiology (5)  GEB B.1.b.
Genetics and ecology of microorganisms. Host-parasite relationships, mechanisms of genetic transfer in bacteria, and physiologic and ecologic aspects of various microbial groups will be emphasized. 3 lectures, 2 laboratories. Prerequisite: BACT 221.

BACT 322  Dairy Microbiology (4)  GEB B.1.b.
Methods used in the isolation, identification and enumeration of microorganisms important to the dairy industry, with emphasis on those instrumental in dairy fermentations and ripening processes, those used as sanitary indicators, and on major spoilage organisms. 2 lectures, 2 laboratories. Prerequisite: BACT 221 or BACT 224.

BACT 333  Industrial Microbiology (4)  GEB B.1.b.
Microbial biotechnology in producing pharmaceuticals, food additives, and industrial chemicals. Consideration of selected large-scale processes for producing primary and secondary metabolites. 2 lectures, 2 laboratories. Prerequisite: BACT 221 or BACT 224, CHEM 326 or equivalent.

BACT 342  Sanitary Microbiology (4)  GEB B.1.b.
Principles of disease prevention and control. Water-, food-, and air-borne microbial contaminations and epidemiology of ensuing diseases. Laboratory techniques in detection and control of wastes and disease-causing microorganisms. 2 lectures, 2 laboratories. Prerequisite: BACT 221 or BACT 224.

BACT 402  General Virology (3)
Virus-host interactions. Structure and function of viruses as obligate intracellular parasites of microbes, plants, and animals. Epidemiology, pathogenesis, prophylaxis, chemotherapy, and manipulation of viruses which parasitize humans. 3 lectures. Prerequisite: BACT 225 and CHEM 328 or equivalent. Recommended: ZOO 426.

BACT 403  General Virology Laboratory (2)
Methods of culture, characterization and identification of viruses, with emphasis on viruses parasitic in microorganisms, humans, and animals. 2 laboratories.
Prerequisite or concurrent: BACT 402 and consent of instructor.

**BACT 421 Food Microbiology (4)**
Physiological activities of microorganisms involved in the preparation, preservation, deterioration and toxicity of foods and related products. 2 lectures, 2 laboratories. Prerequisite: BACT 221 or BACT 224. Recommended: CHEM 326.

**BACT 423 Medical Microbiology (5)**

**BACT 424 Bacterial Cytology and Physiology (5)**
Cellular structure and life processes of bacteria; chemical composition, growth and metabolism. General biological and evolutionary considerations. 3 lectures, 2 laboratories. Prerequisite: BACT 225 and CHEM 328.

**BACT 430 Medical Mycology (4)**
Morphology, physiology, infectivity, and immunogenicity of fungi pathogenic for man and other mammals. Host-parasite interactions. Demonstration and isolation of pathogenic fungi from clinical material. 2 lectures, 2 laboratories. Prerequisite: BIO 152, BIO 153, and BACT 423.

**BIO–BIOLOGY**

**BIO 100 Orientation to Biological Sciences (1) (CR/NC)**
Career opportunities in the biological sciences, designing a career goal and a survey of departmental facilities and procedures related to research, study and graduation. Credit/No Credit grading only. 1 lecture.

**BIO 101 General Biology (3)**
Principles of cellular biology, heredity, ecology, and evolution, with emphasis on their relationship to human affairs. Not open for credit to students who have completed BIO 151 or BOT 121 or ZOO 131. 3 lectures.

**BIO 105 General Biology Laboratory (1)**
Observations and experiences involving basic principles in the biological sciences. Emphasis on the diversity of living systems. Cell structure and function. Genetics and ecological relationships. 1 laboratory. Concurrent or previous enrollment in BIO 101.

**BIO 127 Natural History: Animal Adaptations (3)**
Interpretation of structural and functional adaptations of animals; emphasis on phenomena readily observed in the field. Laboratory exercises emphasize insects as examples. 2 lectures, 1 laboratory.

**BIO 128 Natural History: Animal Communities (3)**
Examination of local biotic communities, emphasizing identification and natural history of the animals which inhabit them. Field experience in local communities. 2 lectures, 1 laboratory, 2 Saturday field trips. Recommended: BIO 127.

**BIO 129 Natural History: Plant Communities (3)**
Principles of field biology and ecology; laboratory and field study of land and freshwater plant communities, emphasizing identification of plants inhabiting them. 1 lecture, 2 laboratories, Saturday field trips. Recommended: BIO 128.

**BIO 151 Introduction to Biology (5)**
Fundamental principles of biology with emphasis on the physical and chemical basis of life; cytology; bioenergetics; storage; processing and expression of genetic information; ecology; evolution. 3 lectures, 2 laboratories. Recommended prerequisite: Concurrent or previous enrollment in college chemistry course.

**BIO 152 Biology of Plants and Fungi (5)**
Structure, ecology, reproduction, and evolution of fungi, cyanobacteria, algae, and plants. 3 lectures, 2 laboratories. Prerequisite: BIO 151.

**BIO 153 Biology of Animals (5)**
Survey of the protist and animal kingdoms; fundamentals of animal form and function. 3 lectures, 2 laboratories. Prerequisite: BIO 151.

**BIO 205 Traces Through Time (3) (Also listed as PSC 205)**
Survey of evidence supporting evolution including origin of the universe, radiometric dating, structure of Earth and plate tectonics. Evolutionary evidence from chemistry, biology, fossils, and the geographical distribution of life. Fundamental differences between science and creationism will be explored. A student using this course for GEB credit also must take at least one other course in Area B.1.b and at least one other course in Area B.1.a. 3 lectures.

**BIO 220 Physiology and Biological Adaptation (4)**
Physiological principles with integration of principles of adaptation of life processes among living organisms. Not open for credit to students who have completed ZOO 131. 4 lectures. Prerequisite: Completion or simultaneous enrollment in college level chemistry.

**BIO 253 Orientation to the Health Professions (1) (CR/NC)**
Participation in hospital activities and mental health services. Intended for medically oriented students. Total credit limited to 6 units with a maximum of 1 unit per quarter. Credit/No Credit grading only. 1 activity. Prerequisite: Instructor’s consent and one quarter of college chemistry and BIO 153 or ZOO 131.

**BIO 300 Biology of Cancer (2)**

**BIO 301 Human Ecology (3)**
Examination of the ways in which humans are dependent on their environment, their ability to modify it, and the results of such modification. 3 lectures. Prerequisite: One quarter of biological science.
BIO 302 Human Genetics (3)  GEB B.1.b.
Basic principles of human inheritance. Transmission of genetic traits, chromosomal anomalies of humans, gene action, mutations and mutagenic agents, eugenics, and principles of genetic counseling. Not for Biology credit for Biological Sciences majors. 3 lectures. Prerequisite: One course in college biology (preferably BIO 101, BIO 151, or ZOO 131).

BIO 303 Genetics (3)  GEB B.1.b.
Principles of heredity and variation. 3 lectures. Prerequisite: One quarter of college biology and one quarter of college mathematics. Recommended: STAT 211.

BIO 304 Molecular Genetics (3)  GEB B.1.b.
Introduction to the structures, functions, and regulatory mechanisms of nucleic acids in biological systems. 3 lectures. Prerequisite: One quarter of college biology. Recommended: BIO 303 and one course in biochemistry.

BIO 306 Applications of Biological Concepts (4)
Applications of basic biological concepts with special reference to how these concepts can be presented and developed in elementary schools. Emphasis is on hands-on activities, problem solving and computer assisted instruction modules in biology. 3 lectures, 1 laboratory. Prerequisite: BIO 101 and BIO 105, or equivalent.

BIO 311 Radiation Biology (3)  GEB B.1.b.
Review of production and characteristics of non-ionizing and ionizing radiation; interaction and effect of radiation on living cells, tissues, organs, and organisms; introduction to use of radioisotopes; radiation protection and dosimetry; impact of nuclear energy on the biological world. 3 lectures. Prerequisite: CHEM 122 or CHEM 128 and one of the following: BIO 101, BIO 151, BOT 121, ZOO 131.

BIO 321 Biological Instrumentation (3)
Theory and operation of instruments commonly used in biological investigation. 1 lecture, 2 laboratories. Prerequisite: BIO 151, BOT 121 or ZOO 131.

BIO 322 Introduction to Electron Microscopy (2)
Introduction to principles and theory of scanning and transmission electron microscopy including instruments utilized in study of biological and nonbiological specimens. 1 lecture, 1 activity. Prerequisite: BIO 151, BOT 121 or ZOO 131 or consent of instructor.

BIO 323 Scanning Electron Microscopy Laboratory (1)
Techniques of using the scanning electron microscope including preparing, examining and interpreting biological and nonbiological materials. 1 laboratory. Prerequisite or concurrent enrollment in: BIO 322.

BIO 324 Transmission Electron Microscopy Laboratory (2)
Applications of transmission electron microscopy including in-depth training in specimen preparation and use of the microscope. Design of experiments and interpretation of results will be included in laboratory. 2 laboratories. Prerequisite or concurrent enrollment in: BIO 322.

BIO 325 General Ecology (4)  GEB B.1.b.
Interactions between living organisms and their environment in terrestrial and aquatic habitats. 3 lectures, 1 laboratory. Prerequisite: BIO 152 and BIO 153.

BIO 328 Marine Biology (4)  GEB B.1.b.
Biological and environmental studies of marine organisms, with emphasis on their economic importance. 2 lectures, 2 laboratories. Prerequisite: BIO 152 or BIO 153, or consent of instructor.

BIO 330 Biology of Aging (3)  GEB B.1.b.
Theories of aging, the biological principles involved, and the current status of research in the field. 3 lectures. Prerequisite: College-level course in biology. Recommended: An introductory course in chemistry.

BIO 334 Limnology (3)  GEB B.1.b.
Biological, physical, and chemical dynamics of freshwater ecosystems. 2 lectures, 1 laboratory. Prerequisite: BIO 325. Recommended: One college level course in chemistry.

BIO 342 Computer Applications in Biology (3)
Applications of computers and data processing technology to the understanding and solving of specific problems in biology. 2 lectures, 1 laboratory. Prerequisite: One college level course in biological science and one course in computer science.

BIO 375 Molecular Biology Laboratory (2) (Also listed as CHEM 375)  GEB B.1.b.
Techniques used in molecular biology and biotechnology, plasmid DNA extraction, agarose gel electrophoresis, restriction endonuclease mapping, transduction, transformation, and gene cloning. 2 laboratories. Prerequisite: BACT 221 or BACT 224 and BIO 304 or CHEM 373.

BIO 400 Special Problems for Advanced Undergraduates (1–2)
Individual investigation, research, studies, or surveys of selected problems. Total credit limited to 4 units, with a maximum of 2 units per quarter. Prerequisite: Consent of department chair.

BIO 414 Evolution (3)
Scientific evaluation of the theories, mechanisms, and evidences concerning biological evolution. 3 lectures. Prerequisite: BIO 303.

BIO 415 Biogeography (3)
Plant and animal distribution patterns in relation to past and present physical and biotic factors; continent by continent survey of biogeography with major emphasis on North America. 3 lectures. Prerequisite: BIO 325.

BIO 423 Cell Biology (4)
Detailed study of the structure and function of animal and plant cells. 3 lectures, 1 laboratory. Prerequisite: BIO 152 and BIO 153 or ZOO 131 and BOT 121 and organic chemistry or biochemistry.

BIO 424 Organizing and Teaching Biological Sciences (3)
Objectives, content, techniques, material, and recent trends of successful instruction in secondary school biology. 3 lectures. Prerequisite: Consent of instructor.
BIO 426  Cytogenetics (4)
Cytological basis of genetics. Correlation between genetic principles and chromosome behavior by studying mitotic and meiotic cells. Cytological study of hybrids, polyploids and chromosomal aberrations in plants and animals. 3 lectures, 1 laboratory. Prerequisite: BIO 303.

BIO 431  Physiology I: General (4)
Functioning, control, and integration of physiological phenomena at various levels from cell to organism. 2 lectures, 2 laboratories. Prerequisite: CHEM 326; BIO 152 or BIO 153.

BIO 437  Marine Resources (3)
Resource status of present and potential biological marine resources of the sea. Identification, life history, ecology, culture and economics of pertinent organisms. 3 lectures. Prerequisite: BIO 152 and ZOO 336.

BIO 442  Biometry (4)
Design of biological experiments with emphasis on sampling methods, data collection, mensuration, and analysis of field and laboratory data. 3 lectures, 1 recitation. Prerequisite: One year of biology, STAT 212 or STAT 321 and completion of computer literacy requirement.

BIO 461, 462  Senior Project (3) (2)
Projects are selected from typical problems which graduates may meet in areas of their future employment. Results are presented in written reports. Minimum 150 hours total time.

BIO 463  Undergraduate Seminar (2)
Study and discussion of recent developments in the field of biology. 2 seminars. Prerequisite: Senior standing.

BIO 470  Selected Advanced Topics (1–3)
Directed group study of selected topics for advanced students. Open to undergraduate and graduate students. Class Schedule will list topic selected. Total credit limited to 6 units. 1 to 3 lectures. Prerequisite: Consent of instructor.

BIO 471  Selected Advanced Laboratory (1–2)
Directed group laboratory study of selected topics for advanced students. Open to undergraduate and graduate students. Class Schedule will list topics selected. Total credit limited to 4 units. 1 to 2 laboratories. Prerequisite: Consent of instructor.

BIO 475  Tissue Culture Techniques (4) (Also listed as CHEM 475)
Introduction to the principles and methods of tissue culture with emphasis on the manipulation and study of animal cells. 2 lectures, 2 laboratories. Prerequisite: BACT 221 or BACT 224, BIO 303 and CHEM 328 or CHEM 371.

BIO 485  Cooperative Education Experience (6) (CR/NC)
Part-time work experience in business, industry, government, and other areas of student career interest. Positions are paid and usually require relocation and registration in course for two consecutive quarters. Formal report and evaluation by work supervisor required. Total credit limited to 16 units. Credit/No Credit grading only. Prerequisite: Sophomore standing and consent of instructor.

BIO 495  Cooperative Education Experience (12) (CR/NC)
Full-time work experience in business, industry, government, and other areas of student career interest. Positions are paid and usually require relocation and registration in course for two consecutive quarters. Formal report and evaluation by work supervisor required. Total credit limited to 16 units. Credit/No Credit grading only. Prerequisite: Sophomore standing and consent of instructor.

BIO 500  Individual Study (1–3)
Advanced study planned and completed with the approval of and under the direction of a member of the department faculty. A written scholarly presentation of the results of each BIO 500 project must be included in the graduate student's departmental file. Not open for credit to students in the thesis program. Total credit limited to 4 units. Prerequisite: Graduate standing and/or consent of instructor.

BIO 501  Cellular Biology (3)
Consideration of recent studies on the energetics, synthesis, regulation, genetics, transport, movements, reproduction, and differentiation of cells. 2 seminars, 1 activity. Prerequisite: Graduate standing and/or consent of instructor.

BIO 502  Biology of Organisms (3)
Consideration of recent advances in the knowledge of organisms; their morphology, systems of maintenance, organization and integration, responsiveness and behavior, development and reproductive processes. 2 seminars, 1 activity. Prerequisite: Graduate standing and/or consent of instructor.

BIO 503  Population Biology (3)
Consideration of current theory and practice in evolution, genetics, ecology and systematics of organisms. 2 seminars, 1 activity. Prerequisite: Graduate standing and/or consent of instructor.

BIO 515  History of Biology (3)
Analysis of historical attempts to solve biological problems. 3 seminars. Prerequisite: Graduate standing and/or consent of instructor.

BIO 524  Developmental Biology (3)
Developmental phenomena of higher and lower plants, vertebrate and invertebrate animals at the molecular, cellular, histological and organ levels. Each quarter will emphasize a different biological description. Total credit limited to 9 units, with a maximum of 3 units per quarter. 2 seminars, 1 laboratory. Prerequisite: Graduate standing and/or consent of instructor.

BIO 531  Theory and Prediction in Ecology (2)
Directed group study and lectures on selected topics in ecology. Emphasis on an in-depth study of a restricted topic. 2 seminars. Prerequisite: Graduate standing and/or consent of instructor.

BIO 542  Multivariate Biometry (4)
Design of biological experiments involving multivariate observations. Experimental design, sampling, computer analysis, and interpretation of results. 3 seminars, 1 laboratory. Prerequisite: STAT 313, BIO 442.
BIO 543  Morphometrics (3)
Biological phenomena from problem definition and field
collection of data through multivariate analysis of data and
presentation of results. 2 seminars, 1 laboratory, 2–4
weekend field trips. Prerequisite: BIO 542.

BIO 570  Selected Topics in Biology (1–3)
Directed group study of selected topics for graduate students.
Class Schedule will list topics for selection. Total credit
limited to 9 units. 1 to 3 seminars. Prerequisite: Graduate
standing and/or consent of instructor.

BIO 585  Cooperative Education Experience (6) (CR/NC)
Advanced study analysis and part-time work experience in
student's career field; current innovations, practices, and
problems in administration, supervision, and organization of
business, industry, and government. Must have demonstrated
ability to do independent work and research in career field.
Total credit limited to 9 units. Credit/No Credit grading only.
Prerequisite: Graduate standing and consent of instructor.

BIO 590  Seminar in Biology (1)
Problems and topics in advanced biology selected according
to the interest and needs of the students enrolled. Total credit
limited to 5 units. 1 two-hour seminar. Prerequisite: Graduate
standing and/or consent of instructor.

BIO 595  Cooperative Education Experience (12) (CR/NC)
Advanced study analysis and full-time work experience in
student's career field; current innovations, practices, and
problems in administration, supervision, and organization of
business, industry, and government. Must have demonstrated
ability to do independent work and research in career field.
Total credit limited to 9 units. Credit/No Credit grading only.
Prerequisite: Graduate standing and consent of instructor.

BIO 599  Thesis (3)
Individual research under the general supervision of the
faculty, leading to a graduate thesis of suitable quality. Total
credit limited to 9 units. Prerequisite: Graduate standing,
consent of instructor, and consent of thesis committee.