AERO–AEROSPACE ENGINEERING

AERO 102 General Aviation (4)
Fundamentals of flight aerodynamics and principles. Introduction to power systems, instrumentation, flight planning, modern air navigation, weather data interpretation, flight computer uses, meteorology. Hands-on cockpit/taxi familiarization. Private pilot's examination preparation. Not a technical elective for engineering students. Field trip may be required. 4 lectures.

AERO 103 Instrument Aviation (4)
Introduction to advanced aircraft instrumentation, flight planning, interpretation of weather data, and meteorology. Instrument navigation, uses of flight computer, subjects covered in instrument pilot's examination. Not acceptable as technical elective to engineering students. 4 lectures. Prerequisite: Private pilot certification.

AERO 121 Aerospace Fundamentals (2)
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 lecture, 1 laboratory.

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

AERO 210 History of Aviation (4)
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. 4 lectures.

AERO 215 Introduction to Aerospace Design (2)
Introduction to problem solving techniques and team-centered design projects in aerospace engineering. Primary emphasis on the solution of design problems in aerospace engineering using computers. 2 laboratories. Prerequisite: AERO 121, MATH 143. Recommended: CSC 111, IME 144.

AERO 240 Additional Engineering Laboratory (1–4) (CR/NC)
Total credit limited to four units. Credit/No Credit grading. 1-4 laboratories.

AERO 300 Aerospace Engineering Analysis (5)
Analytical methods for aerospace engineering problems. Topics include vector calculus, linear algebra, differential equations, Laplace transforms and Fourier series. Computer tools and numerical methods as applied to problems in aerodynamics, structures, stability and control and astronautics. 5 lectures. Prerequisite: PHYS 133, ME 211. Corequisite: MATH 244.

AERO 301, 302, 303 Aerothermodynamics I, II, III (4) (4) (4)
Properties and characteristics of fluids, fluid statics and dynamics, the thermodynamic relations, laminar and turbulent flows, subsonic and supersonic flows as applied to flight vehicles. Introduction to heat transfer. 4 lectures, fall, winter and spring. Prerequisite: ME 211, AERO 300.

AERO 304 Experimental Aerothermodynamics (2)
Laboratory experiments verify the momentum and energy equations. Fan performance, boundary layer measurements, diffuser performance, and induction pump performance experiments are evaluated. 1 lecture, 1 laboratory. Prerequisite: ENGL 149. Concurrent: AERO 302.

AERO 306 Aerodynamics and Flight Performance (4)

AERO 307 Experimental Aerodynamics (2)
Wind tunnel testing of basic aerodynamic properties of airfoils, finite wings, aircraft or spacecraft models, and vehicle flight performance. Emphasis on both static and dynamic responses of aircraft. Various measurement techniques, data reduction schemes, and analysis methods. 2 laboratories. Prerequisite: AERO 302, AERO 306, ENGL 149.

AERO 310 Air and Space (4)
(Also listed as HNRS 310)
GE Area F
Technological innovations that have led to modern aircraft and spacecraft as viewed from an historical perspective. Development of aerodynamics, propulsion systems, light-weight structures, and control systems. How aviation has affected, and been affected by, history. Impact of aviation on society, including civil and military aircraft/spacecraft. Federal regulation of aviation, including air traffic control and airlines. Future developments in air and space technology. 4 lectures. Prerequisite: Completion of GE Area B and junior standing.

AERO 320 Fundamentals of Guidance and Control (4)
Introduction to state-space and transfer function models for aircraft, spacecraft, missiles, and helicopters. Elementary classical and modern analysis techniques using computers. 4 lectures. Prerequisite: AERO 215, AERO 300. Concurrent: ME 212.

AERO 331 Aerospace Structural Analysis I (4)

AERO 360 Creative Problem Solving in Engineering Design (2)
The creative problem solving process for an engineering design team. How to explore context and causes as part of defining a design problem; the principles of brainstorming, synthesis, and judgment. Role of iteration, implementation, and communication. Importance of a diverse view, including: customers, products, processes, systems, ethics, and professional responsibility. Team-based applications to case studies and real-world engineering design problems. 2 laboratories. Prerequisite: PSY 350.

AERO 400 Special Problems for Advanced Undergraduates (1–4)
Individual investigation, research, studies, or surveys of selected problems. Total credit limited to 8 units.

AERO 401 Propulsion Systems (4)
Power plant types, components, characteristics, and requirements. Principles of thrust and energy utilization. Thermodynamic processes and performance of turboprop, turbo shaft, turbofan, turbojet, ramjet, and rocket engines. 3 lectures, 1 laboratory. Prerequisite: AERO 303, AERO 306, CHEM 124.

AERO 405 Supersonic and Hypersonic Aerodynamics (4)
Review of gas dynamics, shock-wave and boundary-layer interaction, aerodynamic design. 2-dimensional supersonic flows around thin airfoil; finite wing in supersonic flow. Local surface inclination methods for high-speed flight, boundary-layer and aerodynamic heating, viscous interactions. 4 lectures. Prerequisite: AERO 303, AERO 306.

AERO 407 Reentry Aerodynamics (4)

AERO 409 Flight Test (4)
Overview of flight tests, test equations, and supporting facilities. Principles of team-centered flight testing with applications to performance, stability and control, and avionics systems testing. Test planning, instrumentation, data analysis and reports. 2 lectures, 2 laboratories. Prerequisite: AERO 306. Concurrent: AERO 320.
AERO 416 Principles of Rotary Wing Flight (4)

AERO 419 Simulation of Aerospace Vehicles and Systems (4)
Overview of flight simulators, aerospace avionics systems, and supporting facilities including simulation equations for flight mechanics and land navigation. Team-centered projects, reports, and presentations are emphasized with a strong focus on computer simulation of piloted flight. 2 lectures, 2 laboratories. Prerequisite: AERO 420.

AERO 420 Stability and Control of Aerospace Vehicles (4)
Stability and control derivatives, reference frames, steady-state static analysis and perturbed dynamic analysis for aircraft and spacecraft. Transfer function, state-space, and modal representations of system dynamics in response to control inputs. Design guidelines and introduction to augmentation systems. 4 lectures. Prerequisite: AERO 306, AERO 320, and ME 212.

AERO 431 Aerospace Structural Analysis II (4)
Basic concepts and governing equations with applications to typical aerospace structures. Concepts studied include analysis of aircraft and aerospace structures; airworthiness and airframe loads; stress analysis of aircraft components; structural constraints; elementary aeroelasticity; introduction to modern fatigue and fracture mechanics analysis; and introduction to composite structures analysis. 4 lectures. Prerequisite: AERO 331.

AERO 432 Advanced Composite Structures Analysis (4)

AERO 433 Experimental Stress Analysis (1)
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 331, AERO 431.

AERO 435 Aerospace Numerical Analysis (4)

AERO 443, 444, 445 Aircraft Design I, II, III (2) (4) (4)
Preliminary layout of a typical aircraft vehicle using design and calculation techniques developed in previous aerospace engineering courses. Design of a flight vehicle, including its structures and systems. Preparation of necessary drawings and a report. AERO 443: 2 laboratories. AERO 444 and AERO 445: 2 lectures, 2 laboratories. Prerequisite: Senior standing. AERO 443: 2 laboratories. AERO 444 and AERO 445: 2 lectures, 2 laboratories. Prerequisite: Senior standing. AERO 443, 444, 445: 2 lectures, 2 laboratories. Prerequisite: Senior standing. ME 144, AERO 215, AERO 303, AERO 306, AERO 331. Concurrent: AERO 401, AERO 405, AERO 420, AERO 431. Open to students enrolled in the multidisciplinary design minor.

AERO 446 Introduction to Space Systems (4)
Basic satellite types and their applications. Major subsystems of a satellite system. Space environment, propulsion system, power system, structural design, spacecraft dynamics and attitude control, orbit mechanics, thermal control, communications, and ground segments. Spacecraft integration and testing. May also be available to offsite locations (Distance Education). 4 lectures. Prerequisite: ME 212, graduate standing or consent of instructor. Prerequisite or concurrent: AERO 320, EE 321.

AERO 447, 448, 449 Spacecraft Design I, II, III (2) (4) (4)
Preliminary layout of typical space vehicle using design and calculation techniques developed in previous aerospace 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: ME 144, AERO 215, AERO 303, AERO 331, senior standing. Concurrent: AERO 401, AERO 420, AERO 431, AERO 451. Open to students enrolled in the multidisciplinary design minor.

AERO 450 Introduction to Aerospace Systems Engineering (4)
Aerospace systems and subsystems. Systems integration. Development of system requirements. Analysis, modeling and simulation of complex systems. Project management. Cost analysis. Optimization and trade studies. 4 lectures. Prerequisite: Senior standing or consent of instructor.

AERO 451 Spaceflight Dynamics I (4)

AERO 452 Spaceflight Dynamics II (4)
Orbital motion, perturbing forces. Asphericity of the earth, aerodynamic drag, third-body tidal forces, etc. Enke and Cowell solution techniques. Restricted 3-body problem. Satellite attitude dynamics, rigid body-symmetric and asymmetric semirigid bodies. Attitude control, spinning/fixed gravity gradient. 4 lectures. Prerequisite: AERO 451.

AERO 461, 462 Senior Project I, II (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 463, 464 Senior Project Laboratory I, II (2) (3)
Selection and completion of a project by individuals or team which is typical of problems which graduates must solve in their fields of employment. Project involves, but is not limited to, physical modeling and testing of integrated design and may include students from other disciplines. Formulation of outline, literature review, and project schedule. AERO 463: 2 laboratories. AERO 464: 3 laboratories. Prerequisite: Senior standing. Note: although AERO 463, 464 substitute for AERO 461, 462, students may not use repeat credit for the purpose of increasing GPA.

AERO 470 Selected Advanced Topics (1–4)
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 8 units. 1 to 4 lectures. Prerequisite: Consent of instructor.

AERO 471 Selected Advanced Laboratory (1–4)
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 8 units. 1 to 4 laboratories. Prerequisite: Consent of instructor.

AERO 493 Cooperative Education Experience (2) (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. Credit/No Credit grading only. Total credit limited to 6 units. Prerequisite: Sophomore standing and consent of instructor.

AERO 494 Cooperative Education Experience (6) (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. Credit/No Credit grading only. Total credit limited to 18 units. 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. A more fully developed formal report and evaluation by work supervisor required. Credit/No Credit grading only. Total credit limited to 24 units. Prerequisite: Sophomore standing and consent of instructor.

AERO 500 Individual Study (1–4)
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. Total credit limited to 12 units. Prerequisite: Consent of department head, graduate advisor and supervising faculty member.

AERO 510 Aerospace Systems Engineering I (4)
Project management. Scheduling and budgeting. Department of Defense acquisition development cycle. Queuing theory. Process control and life-cycle cost analysis. Contracts and negotiation. May also be available to offsite locations (Distance Education). 4 lectures. Prerequisite: AERO 450. Graduate standing or consent of instructor.

AERO 511 Aerospace Systems Engineering II (4)
Risk management. Design strategies to meet system/misson requirements. Design for supportability, manufacturability, reliability, etc. Quality function development and quality control concepts. Quality requirements in the aerospace industry. May also be available to offsite locations (Distance Education). 4 lectures. Prerequisite: AERO 450, Graduate standing or consent of instructor.

AERO 512 Aerospace Vehicle Software Applications (4)
Computer system requirements for aerospace vehicles. Typical aerospace vehicle computer architectures. Software testing, verification and validation. Vehicle automation systems. Risks and benefits of vehicle autonomous operations. Integration of software with vehicle subsystems. Software development cost/schedule estimation. May also be available to offsite locations (Distance Education). 4 lectures. Prerequisite: AERO 450, Graduate standing or consent of instructor.

AERO 515 Continuum Mechanics (4)
Vectors and tensors stress analysis. Analysis of deformation. Velocity fields and compatibility conditions. Constitutive equations. Isotropy. Mechanical properties of real fluids and solids. Field equations and boundary conditions in fluid mechanics problems and applications in elasticity. Active remodeling of structures. Distance Learning Lab fee may be required—see Class Schedule. 4 seminars. Prerequisite: Graduate standing or consent of instructor.

AERO 519 Fundamentals of Vehicle Dynamics and Control (4)
Fundamentals of particle and rigid body dynamics as they apply to aerospace vehicles. Kinematic variables and coordinate transformations. Attitude dynamics. Fundamentals of feedback control and its application to aerospace systems. Stability analysis. Numerical simulation. May also be available to offsite locations (Distance Education). 4 lectures. Prerequisite: Graduate standing or consent of instructor. Not open to students with credit in AERO 451 and AERO 452.

AERO 520 Applied Airplane Aerodynamics (4)
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. Panel methods. Boundary-layer effects on aerodynamics. Viscous flow. Distance Learning Lab fee may be required—see Class Schedule. 4 seminars. Prerequisite: AERO 306, MATH 502, graduate standing or consent of instructor.

AERO 521 Missile and Launch Vehicle Aerodynamics (4)
The aerodynamics of missile configurations in subsonic, transonic, supersonic, and hypersonic flows. Slender bodies and wings at high angles of attack. Asymmetric flow separation and vortex shedding. Wing-body interactions. Control effectiveness. Drag prediction methods and aerodynamic heating. The impact of low observability on aerodynamic design. Missile configuration design. Distance Learning Lab fee may be required—see Class Schedule. 4 lectures. Prerequisite: AERO 405, graduate standing, or consent of instructor.

AERO 522 Boundary-Layer Theory (4)
Concept of boundary-layer. Boundary-layer equations, similarity transformation, integral and differential methods for steady, two-dimensional laminar and turbulent boundary layers. Distance Learning Lab fee may be required—see Class Schedule. 4 lectures. Prerequisite: AERO 302, graduate standing or consent of instructor. Concurrent: MATH 501.

AERO 523 Turbulence (4)
Flow physics of turbulence. Turbulence scales and structures. Reynolds equations. Vorticity dynamics. Energy production, convection, and dissipation. Similarity rules and turbulence modeling for jets, wakes, mixing and boundary layers. Effect of turbulence on noise, combustion, heat transfer, and flow control. Distance Learning Lab fee may be required—see Class Schedule. 4 lectures. Prerequisite: AERO 302, graduate standing or consent of instructor.

AERO 524 Low Gravity Fluid Dynamics and Heat Transfer (4)
Low gravity environment. Mass, momentum and energy transport equations. Free and forced convections. Materials processing. Two-phase flows. Combustion and flame propagation. Turbulence. Fluid management in space. Students are expected to do self-study and make a presentation for the seminar. Distance Learning Lab fee may be required—see Class Schedule. 3 lectures, 1 seminar. Prerequisite: AERO 301, AERO 302, and AERO 303, graduate standing or consent of instructor.

AERO 525 Computational Fluid Dynamics (4)
Classification of partial differential equations. Numerical methods applicable to the solution of elliptic, parabolic, and hyperbolic partial differential equations. Consideration of accuracy and stability of numerical methods. Application to the fundamental equations of fluid dynamics, grid generation, turbulence modeling. Distance Learning Lab fee may be required—see Class Schedule. 4 lectures. Prerequisite: AERO 303, CSC 340, graduate standing or consent of instructor.

AERO 526 Spacecraft Thermal/Fluid Control (4)
Satellite thermal/fluid control hardware. Governing equations for flow and heat transfer. Surface tension and liquid/vapor interface. Heat transfer by free convection, forced convection and radiation in low-gravity environment. Heat pipes. Capillary-pumped loops. Cryogenic systems. Fluid management in space. May also be available to offsite locations (Distance Education). 4 lectures. Prerequisite: AERO 301, AERO 302, and AERO 303, or graduate standing.

AERO 530 Inelastic Structural Analysis (4)
Inelastic stress analysis. Yield criteria. Strain hardening. Plastic straining and bending. Elastic-plastic problems. Plastic instability. Slip-line fields for plains. Plastic strain problems and analysis and introduction to viscoplasticity. Distance Learning Lab fee may be required—see Class Schedule. 4 seminars. Prerequisite: Graduate standing or consent of instructor.

AERO 532 Advanced Aerospace Composite Design (4)
Behavior of composite materials. Bending, buckling, and vibration of laminated plates. Fatigue and fracture mechanics analysis of composite structures. Optimum design of composite pressure vessels. 2 seminars, 2 laboratories. Prerequisite: Graduate standing or consent of instructor.

AERO 534 Aerospace Structural Dynamics Analysis (4)
Fundamentals of structural dynamics and aeroelasticity of flight vehicles. Undamped and damped, free and forced vibration of a single and multi degree-of-freedom linear systems. Finite elements and vibrational analysis. Distance Learning Lab fee may be required—see Class Schedule. 4 seminars. Prerequisite: Graduate standing or consent of instructor.

AERO 535 Advanced Aerospace Structural Analysis (4)
Distance Learning Lab fee may be required—see Class Schedule. 4 seminars. Prerequisite: Graduate standing or consent of instructor.

AERO 540 Elements of Rocket Propulsion (4)
Thrust and impulse equations, propellant composition and mixture ratios, nozzle expansion ratios, solid and liquid propellant combustion, internal ballistics, thermo-chemical computations, chemical kinetics, and combustion instability, nozzle design and exhaust plumes. Distance Learning Lab fee may be required—see Class Schedule. 4 seminars. Prerequisite: AERO 303, AERO 401, graduate standing or consent of instructor.

AERO 541 Air Breathing Propulsion (4)
Aerothermodynamics of propulsion systems, power plant selection and design, on-off design performance, component characterization, component design, component matching, optimization, and introduction to power plant and airframe integration systems for aircraft. Distance Learning Lab fee may be required—see Class Schedule. 4 seminars. Prerequisite: AERO 401 or ME 443, graduate standing or consent of instructor.

AERO 545 Analysis and Design of Flight Control Systems (4)
Principles of flight control design and the application of the Cooper-Harper test and evaluation tool to modern aerospace vehicles. Human factors, issues, and automation, case study of the space shuttle. Distance Learning Lab fee may be required—see Class Schedule. 3 lectures, 1 laboratory. Prerequisite: AERO 420 or ME 422, graduate standing or consent of instructor.

AERO 546 Global Positioning Satellite Navigation Systems (4)
Principles of Global Positioning Satellite navigation systems. Kalman filter design and application to integrated navigation and guidance systems. Statistical evaluation and test methods in aerospace. Interactive computer simulations. Distance Learning Lab fee may be required—see Class Schedule. 3 lectures, 1 laboratory. Prerequisite: AERO 420, graduate standing or consent of instructor.

AERO 550 Advanced Control of Spacecraft and Aircraft (4)
Model following and digital control of aerospace craft, including dynamic estimation of vehicle states using Kalman filters and adaptive compensation. Team-centered projects involving optimal attitude control in deep space, hovering vehicles, and aeroelastic systems. Survey of non-linear, fuzzy, and neural net controllers for aerospace applications. 2 lectures, 2 laboratories. Prerequisite: AERO 550.

AERO 551 Piloted Flying Qualities of Aerospace Vehicles (4)
Flying qualities prediction from flight test data and reduced-order analytical models of vehicles, systems, and human pilots. Application of the Cooper-Harper flight test scale to fly-by-wire aircraft, the space shuttle, and remotely controlled vehicles include rotorcraft. Team-centered projects, reports, and presentations are required. 2 lectures, 2 laboratories. Prerequisite: AERO 420.

AERO 552 Spacecraft Dynamics and Control (4)
Orbit determination and control. Orbit maneuvering and rendezvous. Attitude control of rigid spacecraft via reaction wheels, control moment gyros and thrusters. Modeling, analysis and control of flexible spacecraft. Distance Learning Lab fee may be required—see Class Schedule. 4 lectures. Prerequisite: AERO 420, AERO 452, graduate standing or consent of instructor.

AERO 553 Vehicle Integration and Testing (2)
Space vehicle integration requirements and procedures. Clean room requirements and operations. Quality control and inspection. Qualification and acceptance testing requirements. Test equipment. Vibration and shock testing. Space environment and thermal-vac testing. Development of test procedures. May also be available to offsite locations (Distance Education). 1 lecture, 1 laboratory. Prerequisite: AERO 446, AERO 450 recommended. Graduate standing or consent of instructor.

AERO 554 Space Operations (2)
Launch operations and vehicle integration with launch vehicle. In-orbit operations and maneuvers. Spacecraft tracking. Telemetry and command. Ground systems. Failure detection and identification. Emergency operations. May also be available to offsite locations (Distance Education). 1 lecture, 1 laboratory. Prerequisite: AERO 446, AERO 450 recommended. Graduate standing or consent of instructor.

AERO 555 Advanced Topics in Aircraft Design (4)
Application of advanced analytic engineering methods to aircraft design problems. Analysis and synthesis of advanced topics related to design of aircraft. Distance Learning Lab fee may be required—see Class Schedule. 4 lectures. Prerequisite: AERO 522, AERO 530 and AERO 550, graduate standing or consent of instructor. Concurrent: AERO 520.

AERO 556 Advanced Topics in Spacecraft Design (4)
Application of advanced engineering tools to the design of space vehicles. System architecture and mission design. Concept of operations. Requirements development and flow down. System and subsystems trade studies and preliminary design. May also be available to offsite locations (Distance Education). 4 lectures. Prerequisite: AERO 450, AERO 446, graduate standing or consent of instructor.

AERO 557 Launch Vehicle and Missile Design (4)
Basic launch vehicle/missile types. Launch vehicle subsystems and their interactions. Vehicle requirements development and flow down. Payload accommodations. System and subsystems trade studies and preliminary design. May also be available to offsite locations (Distance Education). 4 lectures. Prerequisite: AERO 401, AERO 450, AERO 446, graduate standing or consent of instructor.

AERO 558 Selected Advanced Topics (4)
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 8 units. Distance Learning Lab fee may be required—see Class Schedule. 4 lectures. Prerequisite: Graduate standing or consent of instructor.

AERO 559 Selected Advanced Laboratory (1–4)
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 8 units. 1-4 laboratories. Prerequisite: Graduate standing or consent of instructor.

AERO 561 Space Manufacturing and Fabrication (1)
Selected topics for assembling aircraft and aircraft components, including empennage, wing fuselage, engine, flight controls, avionics, finishing work, and flight testing. Open to undergraduate and graduate students. Class Schedule will list topic selected. Total credit limited to 8 units. 1 laboratory. Prerequisite: Junior standing and consent of instructor.

AERO 562 Space Operations (2)
Launch operations and vehicle integration with launch vehicle. In-orbit operations and maneuvers. Spacecraft tracking. Telemetry and command. Ground systems. Failure detection and identification. Emergency operations. May also be available to offsite locations (Distance Education). 1 lecture, 1 laboratory. Prerequisite: AERO 446, AERO 450 recommended. Graduate standing or consent of instructor.

AERO 563 Advanced Topics in Aircraft Design (4)
Application of advanced analytic engineering methods to aircraft design problems. Analysis and synthesis of advanced topics related to design of aircraft. Distance Learning Lab fee may be required—see Class Schedule. 4 lectures. Prerequisite: AERO 522, AERO 530 and AERO 550, graduate standing or consent of instructor. Concurrent: AERO 520.

AERO 564 Advanced Topics in Spacecraft Design (4)
Application of advanced engineering tools to the design of space vehicles. System architecture and mission design. Concept of operations. Requirements development and flow down. System and subsystems trade studies and preliminary design. May also be available to offsite locations (Distance Education). 4 lectures. Prerequisite: AERO 450, AERO 446, graduate standing or consent of instructor.

AERO 565 Advanced Topics in Aircraft Design (4)
Application of advanced analytic engineering methods to aircraft design problems. Analysis and synthesis of advanced topics related to design of aircraft. Distance Learning Lab fee may be required—see Class Schedule. 4 lectures. Prerequisite: AERO 522, AERO 530 and AERO 550, graduate standing or consent of instructor. Concurrent: AERO 520.

AERO 566 Advanced Topics in Spacecraft Design (4)
Application of advanced engineering tools to the design of space vehicles. System architecture and mission design. Concept of operations. Requirements development and flow down. System and subsystems trade studies and preliminary design. May also be available to offsite locations (Distance Education). 4 lectures. Prerequisite: AERO 450, AERO 446, graduate standing or consent of instructor.

AERO 567 Launch Vehicle and Missile Design (4)
Basic launch vehicle/missile types. Launch vehicle subsystems and their interactions. Vehicle requirements development and flow down. Payload accommodations. System and subsystems trade studies and preliminary design. May also be available to offsite locations (Distance Education). 4 lectures. Prerequisite: AERO 401, AERO 450, AERO 446, graduate standing or consent of instructor.

AERO 568 Selected Advanced Topics (4)
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 8 units. Distance Learning Lab fee may be required—see Class Schedule. 4 lectures. Prerequisite: Graduate standing or consent of instructor.

AERO 569 Selected Advanced Laboratory (1–4)
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 8 units. 1-4 laboratories. Prerequisite: Graduate standing or consent of instructor.

AERO 570 Topics in Aircraft Manufacturing and Fabrication (1)
Selected topics for assembling aircraft and aircraft components, including empennage, wing fuselage, engine, flight controls, avionics, finishing work, and flight testing. Open to undergraduate and graduate students. Class Schedule will list topic selected. Total credit limited to 8 units. 1 laboratory. Prerequisite: Junior standing and consent of instructor.

AERO 571 Cooperative Education Experience (2) (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. Credit/No Credit grading only. Prerequisite: Graduate standing and consent of instructor.

AERO 572 Cooperative Education Experience (6) (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. Credit/No Credit grading only. Prerequisite: Graduate standing and consent of instructor.

AERO 573 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
AG—AGRICULTURE  see new courses

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 250  Computer Application to Agriculture (3)
Microcomputers and commercial software used in agricultural industries. Word processing, spreadsheets, data base management programs, and programs applied to agriculturally oriented problems. 3 lectures.

AG 301  Agriculture and American Life (4)
Overview of agriculture and effect on American life; wise use of natural resources; animal and plant production; role of machines, labor, and chemicals in producing food and fiber; processing and marketing of commodities; nature of farm life; leadership development in agriculture. Not open to students with majors in agriculture. 4 lectures. Prerequisite: Junior standing.

AG 315  Organic Agriculture (4)
Origins, application, regulation and technology of organic agriculture. Theoretical and practical issues surrounding organic agriculture from a cross-disciplinary perspective. Topics include the history of the organic movement; current regulation and certification; and field management practices and technologies. Features industry guest lecturers. 3 lectures, 1 activity. Prerequisite: Junior standing and completion of GE Area B.

(Also listed as HUM 330)
Scientific investigation of the natural features of the Cal Poly landscape and their transformations by land management technology. Analysis of the environmental, economic, social, and political effects of agricultural, resource extraction and construction technology on that landscape. Emphasis on the educational, land-use and long term planning issues of technology presented by this case study. 4 lectures. Prerequisite: Completion of GE Areas A and B, and 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. Prerequisite: Consent of internship instructor.

AG 350  The Global Environment (4)
(Also listed as BUS/EDES/ENGR/HUM/SCM 350)
Interdisciplinary investigation of how human activities impact the Earth’s environment on a global scale. Examination of population, resource use, climate change, and biodiversity from scientific/technical and social/economic/historical/political perspectives. Use of remote sensing maps. Sustainable solutions. 3 lectures, 1 activity. Prerequisite: Completion of GE Areas A and B and junior standing.

AG 360  Holistic Management (4)
Application of holistic management, a goal-oriented, value-driven framework for making decisions that are ecologically, economically, and socially sound. Impact of technology and other tools on ecosystem processes. Holistic approach to management, especially of land-based resources, aimed toward greater biodiversity and sustainability. 3 lectures, 1 laboratory. Prerequisite: Completion of GE Area B, and junior standing. Not open to students with credit in AG 450.

AG 439  Internship in Integrated Ranch Operations (6–12) (CR/NC)
Work experience in all activities/projects associated with the production of crops, livestock and timber at Swanton Pacific Ranch. Students will be responsible for all activities associated with ranch operation including supervising. For students working and living at Swanton Pacific Ranch. Credit/No Credit grading only. Total credit limited to 18 units. Prerequisite: Senior or graduate standing and consent of instructor.

AG 450  Applied Holistic Management (4)
Application of holistic management, a goal-oriented, value-driven framework for making decisions that are ecologically, economically, and socially sound. Impact of technology and other tools on ecosystem processes. Holistic approach to management, especially of land-based resources, aimed toward greater biodiversity and sustainability. 3 lectures, 1 laboratory. Prerequisite: Any life science course, and junior standing. Not open to students with credit in AG 360.

AG 452  Issues Affecting California Agriculture (4)
Interactive seminars with speakers from government and industry covering policy and regulations affecting California agriculture. Students develop an understanding of agricultural policy and work in teams to develop a public presentation and position paper on a significant issue. Field trip to Sacramento required. 4 seminars. Prerequisite: Completion of GE Area D2 (ECON 201 or ECON 222 recommended), and junior standing.

AG 455  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 (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 500  Individual Study (1–6)
Advanced independent study planned and completed under the direction of a member of the college faculty. Total credit limited to 6 units. Prerequisite: Consent of department head, graduate advisor 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 advisor before the internship commences. Degree credit limited to 6 units. Prerequisite: Consent of internship instructor.

AG 581  Graduate Seminar (1) (CR/NC)
Advanced topics in agriculture and natural resources. Group study of current research and industry trends. Invited speakers covering a variety of topics. Total credit limited to 3 units. 1 hour seminar. Prerequisite: Graduate standing or consent of 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 agriculture, supervising, and organizing 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 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

AGB 101 Introduction to Agribusiness (4)
Orientation to the agribusiness sector of agriculture. An overview of the breadth, size, scope and management aspects of the agricultural business complex. 4 lectures.

AGB 105 Economic Calculus Laboratory (1) (CR/NC)
Facilitated study and discussion of theory, problems and application of calculus in economics. Credit/No Credit grading only. 1 activity. Corequisite: Concurrent enrollment in AGB 313.

AGB 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 202 Sales, Communication and Leadership in Agribusiness (4)
Self management, communication, and interpersonal skills necessary in developing managerial abilities, leadership qualities, and facilitating teamwork within the agribusiness sector. Industry opportunities ranging from input and output products and services along with government and special interest groups will be surveyed. 4 lectures. Prerequisite: AGB 101.

AGB 212 Agricultural Economics (4)
Theoretical development of factors affecting demand and supply for food and fiber and for agricultural inputs. Methods of selecting optimal levels of agricultural production and consumption variables. Evaluation of market structure and price formulation for agricultural products and resources. 4 lectures.

AGB 301 Food and Fiber Marketing (4)
Food and fiber marketing, examining commodity, industrial, and consumer product marketing from a managerial viewpoint. Global perspective in understanding consumer needs and developing the knowledge of economic, political, social and environmental factors that affect food and fiber marketing systems. 4 lectures. Prerequisite: AGB 212/ECON 201.

AGB 302 Agricultural Associations and Cooperatives (4)
Purpose, kinds, organization and management of agricultural cooperatives. Evaluating cooperative performance. Emphasis on California cooperatives, international agricultural cooperatives, and strategic alliances. One-day field trip visiting agricultural cooperatives included. 4 lectures. Prerequisite: AGB 301.

AGB 303 Introduction to the Horse Racing Industry (4)
Descriptive analysis of horse racing industry: breeding farms, race tracks, trade associations, training issues, and auction sales. Industry structure, economic flows, contributions to state and local taxes, and racing law. Cultural influences of racing in Europe, Australasia, and Latin America. 4 lectures. Prerequisite: Junior standing.

AGB 310 Agribusiness Credit and Finance (4)
Financing California’s agricultural industry. Sources of credit and types of loans used by agribusinesses. Costs of credit. Financial analysis of agricultural borrowers. Future and present value techniques used in evaluating agricultural investments. Agricultural financial management. Financial capital markets and leasing. 4 lectures. Prerequisite: One quarter of accounting or AGB 321.

AGB 312 Agricultural Policy (4)
Agricultural policy objectives and formulation, resource allocation and production adjustments. Survey of State and Federal agricultural policies as they influence the planning and practices of agribusiness. 4 lectures. Prerequisite: AGB 212; ECON 222.

AGB 313 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 221.

AGB 314 Fair and Fair Facility Management (4)
Fundamentals of the year round operation of a fair facility to include rental opportunities, master planning, and maintenance. Principles and procedures in planning, organizing, operating, and evaluating a fair. One day field trip required. 4 lectures. Prerequisite: Upper division standing.

AGB 315 Land Economics (4)
Economics of agricultural and rural land use. Incorporates production economics with welfare theory to explore society's implicit and explicit land use decisions and problems in California, the West and nationwide. Incorporates land use planning and its implicit economic content. 4 lectures. Prerequisite: AGB 313.

AGB 317 Agriculture–Consumer Relationships (2)
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. 2 seminars. Prerequisite: Upper division standing.

AGB 318 Global Agricultural Marketing and Trade (4)
Analysis of international marketing opportunities for agricultural products. Strategies for enhancing the performance of U.S. agricultural exports/imports. Impact of government trade policies and regulations, distribution systems, and the changing consumer. 4 lectures. Prerequisite: AGB 301, 312.

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: AGB 212/ECON 201.

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 212 and BUS 212 or AGB 321.

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 BUS 212.

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.

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AGB 326 Rural Property (4)  
Methods of rural appraisal, including farms, ranches and other rural properties, use of county records, appraisal practice on different types of rural properties, discussions with professional appraisers. 3 lectures, 1 activity. Prerequisite: AGB 310.

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: BUS 212.

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 339 Internship in Agribusiness (1-12) (CR/NC)  
Selected students will spend up to 12 weeks with an approved agricultural firm engaged in production or related agribusiness. Time will be spent applying and developing agribusiness functional and managerial skills and abilities. One unit of credit may be allowed for each full week of completed and reported internship. Degree credit limited to 6 units. Credit/No Credit grading only. Prerequisite: Consent of internship instructor.

AGB 360 Agribusiness Information Technology (4)  
Use of information technologies and advanced computer applications in agribusiness decision-making. Information search and retrieval technologies. Computer languages and programs developed as tools to assist in agribusiness problem-solving. 4 lectures. Prerequisite: AGB 212/ECON 201.

AGB 370 World Food Economy (4)  
International agricultural production, economics, and distribution. Comparative and competitive advantage in world agriculture. Food security issues and regional analysis of agriculture policies. The future of agriculture from a global perspective. 4 lectures. Prerequisite: AGB 312 and AGB 313.

AGB 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 or instructor.

AGB 401 Managing Cultural Diversity in Agricultural Labor Relations (4)  
USCP  
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 (4)  
Agricultural marketing research data collection and analysis. Emphasis on food sector market segmentation, product positioning, new product testing, sales forecasting, and marketing plan development through secondary and primary data sources. Experimental research design and implementation. 4 lectures. Prerequisite: STAT 221, AGB 301, AGB 318.

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 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: BUS 212, 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 Seminar in U.S./World Agricultural Trade Issues (2)  
Comparative analysis of agricultural infrastructures and trade policies of major U.S. trading partners within specific world regions (e.g., Latin America, Asia Pacific, Europe, etc.). Particular emphasis on cultural and geo-political influences on the development of world agricultural policies. Class Schedule will list topic selected. 2 seminars. Prerequisite: AGB 318.

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. 4 lectures. Prerequisite: AGB 313, STAT 221.

AGB 422 Logistics in Global Agribusiness (4)  
Scope and elements of the agribusiness logistics system including supply and distribution channels, transportation, inventory, warehousing, packaging, and order processing. 4 lectures. Prerequisite: AGB 318, STAT 221.

AGB 427 Agricultural Estate Planning (2)  
Principles of estate planning with special emphasis on needs of owners of closely held farming businesses. How wills, property ownership, gifts, trusts and continuation agreements affect estate plans. 2 seminars. Prerequisite: Upper division standing.

AGB 433 Agricultural Price Analysis (4)  
Application of statistical tools for price analysis. Emphasis on price making process for specific agricultural commodities. Utilization of USDA and CDFA market price reports and production estimate data in price forecasting and analysis. 2 two-hour lectures. Prerequisite: STAT 221 and AGB 313.

AGB 435 Linear Programming in Agriculture (4)  
Application of linear programming to decision making by contemporary farm businesses. Solutions by graphical and mathematical models including appropriate computer software. Economic interpretation of solutions. Applications for multi-product, multi-function farms. Includes introduction to goal and risk programming, transportation models, and multi-period programming. 4 lectures. Prerequisite: AGB 313.

AGB 440 Field Studies in Agribusiness (2)  
Visitation to selected agribusinesses. Organization, operation, services and problems considered. Prerequisite: Senior standing or consent of instructor. Can only be taken once for credit in the major.

AGB 442 Agricultural Policy Resolution (4)  
Local, state, national, and international agricultural policy issues. Extensive research on one or two policy issues. Work with various policy groups at the local and state level to assist in analyzing a policy issue, and observe how the analysis is used to develop possible consensus among the different stakeholders to be affected by the policy. Review of entire process upon completion. 4 lectures. Prerequisite: AGB 412.
AGB 443  Branded Wine Marketing (4)
Wine pricing as it relates to quality, packaging, and service. Distribution
options with emphasis on the three tier system, promotional strategies,
including public relations, mass media advertising, personal selling, and
direct marketing. Domestic and international marketplaces. 4 lectures.
Prerequisite: AGB 301 or BUS 346 or consent of instructor.

AGB 444  Wine Compliance and Market Analysis (4)
Legal aspects of wine marketing with emphasis on Federal (BATF)
requirements. Application of statistical theory to the collection, interpre-
tation, and forecasting of wine and grape industry data with emphasis on
production and sales. Introduction to standard accounting ratios. 3 lectures,
1 activity. Prerequisite: STAT 221 or STAT 252 or equivalent.

AGB 445  Produce Marketing (2)
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. Prerequisite: Senior standing and AGB 301.

AGB 446  Wine Market Analysis (2)
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.
Prerequisite: AGB 301 or consent of instructor.

AGB 447  Wine Distribution and Pricing (2)
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. Prerequisite: AGB 301 or
consent of instructor.

AGB 448  Governmental Wine Regulations and Compliance (2)
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.
Prerequisite: Consent of instructor.

AGB 449  Wine Promotion and Packaging (2)
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.
Prerequisite: AGB 446 or consent of instructor.

AGB 450  Agribusiness Strategy Formulation (4)
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. Prerequisite:
Senior standing and AGB 323.

AGB 451  Strategy and Cases in International Agribusiness (4)
Exploration of environment, opportunities, and strategic challenges in the
rapidly changing global food and fiber system. Developing coordination
and control, challenges of worldwide management of functional areas of
agribusiness. Focus is practical and managerial through extensive use of
case studies. 4 lectures. Prerequisite: Senior standing, AGB 318, AGB 323.

AGB 455  Advanced Fair Management Seminar (2)
Advanced studies in fair management with emphasis on budgets, contracts, 
entertainment, carnivals, exhibit programs, crowd control, master planning
maintenance. 2 seminars. Prerequisite: AGB 314.

AGB 456  Crop Management Problems (4)
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. 4
lectures. Prerequisite: AGB 322 and senior status.

AGB 457  Livestock Management Problems (4)
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. 4 lectures.
Prerequisite: AGB 322 and senior status.

AGB 458  Dairy Management Problems (4)
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. 4 lectures. Prerequisite: AGB 322 and
senior status.

AGB 460  Research Methodology in Agribusiness (2)
Empirical application of the scientific method as it relates to the design and
development of Senior Project. Research plan is developed. First quarter of
Senior Project. 2 seminars. Prerequisite: Senior standing and AGB 313.

AGB 461  Senior Project (2)
Completion of a project under faculty supervision. Research topics or
projects typical of problems which graduates must solve in the agricultural,
food and fiber industries. Project results are presented in a formal report.
Minimum 60 hours total time. Prerequisite: Senior standing and AGB 460.

AGB 463  Senior Seminar (2)
Individual or group presentation for discussion of subjects and problems
within the agribusiness field. Class Schedule will list topic selected. Total
credit limited to 4 units. 2 seminars. Prerequisite: Senior standing.

AGB 485  Cooperative Education Experience in Agribusiness (6)
Part-time work experience with an approved Agribusiness firm engaged in
production or related business, industry or governmental agency. 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. Degree credit limited to 6 units.
Credit/No Credit grading only. Prerequisite: Sophomore standing and
consent of instructor.

AGB 495  Cooperative Education Experience in Agribusiness (12)
(CR/NC)
Full time work experience with an approved Agribusiness firm engaged in
production or related business, industry or governmental agency. 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. Degree credit limited to 6 units.
Credit/No Credit grading only. Prerequisite: Sophomore standing and
consent of instructor.

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

AGB 510  International Development and Agribusiness (4)
Integration of agricultural development economics, developing economies,
markets, and agribusiness with social and institutional limitations. 4
seminars. For students in MS in Agriculture Program/Specialization in
Agribusiness. Prerequisite: Graduate standing or consent of instructor.

AGB 514  Agribusiness Managerial Leadership and Communication
(4)
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.

AGB 539  Graduate Internship in Agribusiness (1–9)
Application of theory to the solution of problems of agricultural production
or related business in the field of Agribusiness. Analyze
specific management problems and perform general management assignments detailed in a contract between the student, the firm or organization, and the faculty advisor before the internship commences. Degree credit limited to 6 units. Prerequisite: Consent of internship 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 Food System Marketing (4)
Major issues facing the food system marketer. Vertical and horizontal linkages, pricing in agricultural markets, management of price risk through futures markets and hedging, and public policy and consumer impacts on the system. Student involvement through case studies simulations, and presentations. 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 Agribusiness Trade: Cases and Theory (4)
Changing agricultural trade dynamics in a world economy. Evaluation of firm and government policy strategies in interacting with and expanding markets for agricultural trade. Emphasis on environmental and sustainable trade issues. 4 seminars. Prerequisite: Graduate standing or consent of instructor.

AGB 570 Selected Topics in Agribusiness (1–4)
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 12 units. 1 to 4 seminars. Prerequisite: Graduate standing or consent of instructor.

AGB 571 Selected Advanced Laboratory in Agribusiness (1–4)
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 8 units. 1–4 laboratories. Prerequisite: Consent of instructor.

AGB 585 Cooperative Education Experience in Agribusiness (6) (CR/NC)
Advanced study, analysis and part-time work experience in the 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.

AGB 595 Cooperative Education Experience in Agribusiness (12) (CR/NC)
Advanced study, analysis and full-time work experience in the 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.

AGB 599 Thesis in Agribusiness (1–9)
Systematic research of a significant problem in Agribusiness. 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.

AGC–AGRICULTURAL COMMUNICATION

AGC 200 Special Problems in Agricultural Communication (1–4)
Individual investigation, research, studies or surveys of selected problems in Agricultural Communication/Agricultural Education. Total credit limited to 8 units, with a maximum of 4 units per quarter. Prerequisite: Consent of department head.

AGC 339 Internship in Agricultural Communication (1–12) (CR/NC)
Selected Agricultural Communication 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. Degree credit limited to 6 units. Credit/No Credit grading only. Prerequisite: Consent of internship instructor.

AGC 400 Advanced Special Problems in Agricultural Communication (1–4)
Individual investigation, research, studies or surveys of selected problems in Agricultural Communication/Agricultural Education. Total credit limited to 8 units, with a maximum of 4 units per quarter. Prerequisite: Consent of department head.

AGC 407 Agricultural Publications (4)
Integration of writing, editing, and layout skills in producing agricultural publications. Emphasis on using computer applications in desktop publishing. Total credit limited to 9 units; may be in same term. 2 lectures, 2 activities. Prerequisite: AG 250, CSC 113, or JOUR 205.

AGC 426 Presentation Methods in Agricultural Communication (4)
Development, delivery and evaluation of effective means of communication by use of a variety of presentation methods and the use of technology for effective communication. 2 lectures, 1 activity, 2 activities. Prerequisite: SCOM 101.

AGC 461 Senior Project I (1)
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 30 hours total time. Prerequisite: AGED 460.

AGC 462 Senior Project II (1)
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 30 hours total time. Prerequisite: AGED 461 or consent of instructor.

AGC 470 Selected Advanced Topics (1–4)
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 8 units. 1 to 4 lectures. Prerequisite: Consent of instructor.

AGC 471 Selected Advanced Laboratory (1–4)
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 8 units. 1–4 laboratories. Prerequisite: Consent of instructor.

AGC 500 Individual Study in Agricultural Communication (1–3)
Advanced independent study planned and completed under the direction of a member of the Agricultural Education and Communication faculty. Total credit limited to 6 units. Prerequisite: Consent of department head, graduate advisor and supervising faculty member.
AGC 539 Graduate Internship in Agricultural Communication (1–9)
Application of theory to the solution of problems of agricultural production or related business in the field of Agricultural Communication. Analyze specific management problems and perform general management assignments detailed in a contract between the student, the firm or organization, and the faculty advisor before the internship commences. Degree credit limited to 6 units. Prerequisite: Consent of internship instructor.

AGC 570 Selected Topics in Agricultural Communication (1–4)
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 12 units. 1 to 4 seminars. Prerequisite: Graduate standing or consent of instructor.

AGC 571 Selected Advanced Laboratory in Agricultural Communication (1–4)
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 8 units. 1–4 laboratories. Prerequisite: Consent of instructor.

AGC 580 Special Problems in Agricultural Communication (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.

AGC 581 Graduate Seminar in Agricultural Communication (3)
Group study of selected developments, trends and issues in the field of Agricultural Communication. 3 seminars. Prerequisite: Graduate standing or consent of instructor.

AGED–AGRICULTURAL EDUCATION

AGED 102 Personal Assessment (2) (CR/NC)
Designed to increase the student's academic, career, and personal self-assessment as it relates to the educational process. Study skill methods, campus academic regulations, available resources and issues that face many university students. Credit/no credit grading only. 2 activities.

AGED 200 Special Problems in Agricultural Education (1–4)
Individual investigation, research, studies or surveys of selected problems in Agricultural Communication/Agricultural Education. Total credit limited to 8 units, with a maximum of 4 units per quarter. Prerequisite: Consent of department head.

AGED 202 Introduction to Agricultural Education and Communication (2)
Overview of agricultural education career pathways 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 agricultural communication or international agriculture. 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 supervised work. Prerequisite: AGED 202.

AGED 339 Internship in Agricultural Education (1–12) (CR/NC)
Selected Agricultural Education 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. Degree credit limited to 6 units. Credit/No Credit grading only. Prerequisite: Consent of internship instructor.

AGED 400 Advanced Special Problems in Agricultural Education (1–4)
Individual investigation, research, studies or surveys of selected problems in Agricultural Communication/Agricultural Education. Total credit limited to 8 units, with a maximum of 4 units per quarter. Prerequisite: Consent of department head.

AGED 404 Agricultural Leadership (3)
Emphasis upon equipping current and prospective leaders in agriculture with the background and skills to achieve their potential. Class members will assess their status as leaders and identify means to improve their effectiveness. Focus on the theoretical underpinnings of human motivation, personal leadership, and organizational development. 2 lectures, 1 activity. 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 digital technology, TI network systems and software applicable to vocational agriculture. Will be Level I certified, which is required for teaching credential candidates. Prerequisite: AG 250 or CSC 110 and consent of instructor.

AGED 422 Organizing and Teaching K-6 Standards (4)
Objectives, content, techniques, materials, and recent trends of successful application of agricultural literacy and awareness to K-6 grade level standards. Ongoing projects, individual and group, allow for exploration and understanding of agriculture as a theme to teach all of the content areas, as well as assist in understanding the educational standards accompanying each lesson. 4 lectures. Prerequisite: Liberal StudiesPreservice candidate.

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 438 Instructional Processes in Agricultural Education (4)
Principles of specific agricultural teaching methods and developmentally appropriate pedagogy. Daily and unit lesson plans that adopt content, teaching methods, and assessment for English Learners and students with special needs. Class demonstrations in teaching procedures, analysis, assessment and reflection. 2 lectures, 2 activities. Prerequisite: AGED 330, EDUC 412, EDUC 414 and EDUC 416 or consent of instructor.

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 460 Research Methodology in Agricultural Education and Communication (1)
Introduction of the research process and topic selection as it relates to the design and development of the senior project within the Agricultural Sciences major. 1 lecture. Prerequisite: Junior standing.

AGED 461 Senior Project I (1)
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 30 hours total time. Prerequisite: AGED 460.

AGED 462 Senior Project II (1)
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 30 hours total time. Prerequisite: AGED 461 or consent of instructor.

AGED 470 Selected Advanced Topics (1–4)
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 8 units. 1 to 4 lectures. Prerequisite: Consent of instructor.

AGED 471 Selected Advanced Laboratory (1–4)
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 8 units. 1–4 laboratories. Prerequisite: Consent of instructor.

AGED 481 Developing Digital Presentations for Instruction in Agricultural Education (1)
Directed group study and individualized projects in the design and development of digital presentations in technical agriculture for use in teaching and program public relations. Total credit limited to 3 units. 1 laboratory. Prerequisite: admission to credential program.

AGED 482 Teaching Resources and Curriculum Design (1)
Traditional academic and student-centered approaches to gaining resources and curriculum design. Methods of using, and the development of the knowledge and skills related to planning, implementation and assessing the high school agriculture curriculum. Organization and management and their relationship to education effectiveness and productivity. 1 lecture. Prerequisite: student teacher candidate.

AGED 500 Individual Study in Agricultural Education (1–3)
Advanced independent study planned and completed under the direction of a member of the Agricultural Education and Communication faculty. Total credit limited to 6 units. Prerequisite: Consent of department head, graduate advisor and supervising faculty member.

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 530 Developing FFA and Supervised Agricultural Experience Programs in Secondary Education (3)
Integrating FFA and supervised agricultural experience programs into the curriculum. Career development event implementation; record book usage; officer and committee training; recruitment; retention; retreat and leadership training. Current national and state initiatives and experiential learning opportunities in the workplace and entrepreneurial settings. Prerequisite: senior or graduate standing. Not open to students with credit in AGED 530. 3 lectures.

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

AGED 570 Selected Topics in Agricultural Education (1–4)
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 12 units. 1 to 4 seminars. Prerequisite: Graduate standing or consent of instructor.

AGED 571 Selected Advanced Laboratory in Agricultural Education (1–4)
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 8 units. 1–4 laboratories. Prerequisite: Consent of instructor.

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.

AGED 581 Graduate Seminar in Agricultural Education (3)
Group study of selected developments, trends and issues in the field of Agricultural Education. 3 seminars. Prerequisite: Graduate standing or consent of instructor.

ANT–ANTHROPOLOGY

ANT 201 Cultural Anthropology (4) GE D3
Contemporary human cultures throughout the world. General patterns sought within the diversity of individual cultures. Includes such topics as: family organization; 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. 4 lectures.

ANT 202 World Prehistory (4)
Development of the diverse human cultures of both the Old and New Worlds from the earliest times until the dawn of history; cultural growth. 4 lectures. Prerequisite: ANT 201.

ANT 250 Biological Anthropology (4) GE B2
Biological aspects of human unity and diversity. Primate and human evolution, including anatomical, physiological and behavioral adaptations. Origin and diversity of modern races. 4 lectures.

ANT 309 Elements of Archaeology (4)
Archaeological method and theory covering the history and development of archaeological thought, approaches to data recovery, dating and analysis of artifacts and ecofacts, the construction of models of prehistoric human behavior through application of archaeological and anthropological theories. 4 lectures. Prerequisite: ANT 201 or ANT 202, or consent of instructor.
ANT 310 Archaeological Field Methods (4)
Hands-on introduction to the methods and techniques of archaeology with an emphasis on reconnaissance and survey. Training in artifact and ecofact identification with a focus on lithic technology. Practical experience in orienteering, map-reading, and simple cartography. Methodological approaches to both academic research questions and compliance with environmental planning mandates. 3 lectures, 1 laboratory. Prerequisite: ANT 202 or ANT 309, or consent of instructor.

ANT 311 Archaeological Laboratory Methods (4)
Hands-on introduction to the methods employed in post-field processing, classification, analysis, and preservation of archaeological materials. Compilation of quantitative and qualitative information in data base format to assist in the classification and interpretation of faunal remains and artifacts. 3 lectures, 1 laboratory. Prerequisite: ANT 309 or ANT 310.

ANT 312 Introduction to Cultural Resource Management (4)
Contemporary issues in the preservation of archaeological, historic, and ethnographic resources within the framework of legally mandated environmental planning. Introduction to federal, state, and local legislation pertinent to the identification, evaluation, and treatment of cultural resources. A history of preservation legislation, culminating with detailed discussion of Section 106 of the National Historic Preservation Act and the California Environmental Quality Act. 4 lectures. Prerequisite: ANT 201, ANT 202 or ANT 309, or consent of instructor.

ANT 325 Precolumbian Mesoamerica (4) GE D5
Cultures of Mesoamerica (Mexico and Central America) from earliest times to the Spanish Conquest. Olmec, Teotihuacano, Zapotec, Maya and Aztec civilizations. Major topics include religion, politics, warfare, art, writing, calendrics, ecology and trade. 4 lectures. Prerequisite: Completion of GE Area A, one course in D2 and one course in D3. Social Sciences majors will not receive GE Area D5 credit.

ANT 344 Sex, Death, and Human Nature (4) GE D5
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. 4 lectures. Prerequisite: Completion of GE Area A, one course in D3 and one course in D4. Social Sciences majors will not receive GE Area D5 credit.

ANT 360 Human Cultural Adaptations (4) GE D5
Social and cultural evolution from Paleolithic times to the present. Interactions of demographic, economic and ecological factors are emphasized. Main topics include human nature/culture, sex and gender, cooperation and conflict, the "agricultural revolution", state formation, social inequality and globalization. 4 lectures. Prerequisite: Completion of GE Area A, one course in D2 and one course in D3. Social Sciences majors will not receive GE Area D5 credit.

ANT 401 Culture and Health (4)

ANT 415 Native American Cultures (4) USCP
Survey of Native American cultures from earliest times to present, emphasizing regional diversity in traditional lifeways. Origins of New World peoples, domestication, war, social organization, trade and gender roles. 4 lectures. Prerequisite: One upper division ANT course or consent of instructor.

ANT 470 Selected Advanced Topics (1–4)
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 8 units. 1 to 4 lectures. Prerequisite: Consent of instructor.

ARCE–ARCHITECTURAL ENGINEERING

Note: All ARCE majors must obtain a grade of C- or better in ARCE courses that are prerequisites for other ARCE courses.

ARCE 211 Structures I (3)
Introduction to the role of structures in the making of buildings. Introduction to statics and creation of simple three-dimensional structures. Development of skills to analyze structures composed of axial force (truss) members. 2 lectures, 1 activity. Prerequisite: For ARCE majors: PHYS 131, MATH 142; for ARCH and CM majors: PHYS 121 or PHYS 131, MATH 142 or MATH 182.

ARCE 212 Structures II (3)
Introduction to the role of structures in the making of buildings. Introduction to shear and moment diagrams using the principles of statics and the application of the diagrams to simple three-dimensional structures. Development of skills, particularly free body diagrams, to analyze structures composed of bending (beams) members. 2 lectures, 1 activity. Prerequisite: ARCE 211.

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 Introduction to Mechanics of Structural Members (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 (4)
Advanced topics of stresses in beams: plastic and unsymmetrical bending, combined stresses, stress transformation, buckling, and beam deflections. Material testing laboratory. 3 lectures, 1 laboratory. Prerequisite: ARCE 212 or ARCE 222. Concurrent: ARCE 351.

ARCE 225 Dynamics (3)
Dynamics of particles and rigid bodies. 3 lectures. Prerequisite: ARCE 212 or ARCE 221 and MATH 241.

ARCE 226 Structural Systems for Architects (3)
Description, behavior and comparison of structural building systems. Concepts of structural stability, load flow, framing schemes and building configuration related to vertical and lateral loads. For architecture and construction management students. 3 lectures. Prerequisite: ARCE 212 or ARCE 222.

ARCE 227 Structural Analysis I (2)
Continuation of selected concepts covered in ARCE 211 and ARCE 212. Advanced topics in two-dimensional and three-dimensional equilibrium of structural building systems. 2 lectures. Prerequisite: ARCE 222 or ARCE 212.

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 257 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. 1 lecture, 1 laboratory. Prerequisite: ARCH 123, CM 211.

ARCE 302 Structural Analysis II (4)
Analysis of statically indeterminate structures using virtual work, slope deflection, and the force method. Analysis of structural systems using approximate methods and influence lines. 4 lectures. Prerequisite: ARCE 223 and ARCE 227. Concurrent: ARCE 352.
ARCE 303  Steel Design I (3)
Analysis and design of steel structural members subjected to bending, shear and axial forces. 3 lectures. Prerequisite: ARCE 227. Concurrent: ARCE 302 and ARCE 371.

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, ARCE 227, and ARCE 371.

ARCE 305  Masonry Design (2)
Design of load-bearing walls, shear walls, columns and beams in masonry. 2 lectures. Prerequisite: ARCE 223, ARCE 227 and ARCE 371.

ARCE 306  Matrix Analysis of Structures (3)
Analysis of statically indeterminate structures by direct stiffness method including continuous beams, plane trusses, and frames. Introduction to finite-element methods. 3 lectures. Prerequisite: ARCE 302. Concurrent: ARCE 353.

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 315  Small Scale Structures (4)
Introduction to structures that use timber and steel as the primary construction material. Introduction to gravity load carrying systems and lateral load resisting systems using steel and timber elements. Development of skills to analyze structures using free body diagrams and the concept of load flow. 4 lectures. Prerequisite: ARCE 226.

ARCE 316  Large Scale Structures (4)
Introduction to structures that use steel and concrete as the primary construction material. Introduction to gravity load carrying systems and lateral load resisting systems using steel and concrete elements. Development of skills to analyze structures using free body diagrams and the concept of load flow. 4 lectures. Prerequisite: ARCE 315.

ARCE 321  Timber Structural Systems (3)
Concepts related to system behavior; selection; design and construction specific to timber structures. Preliminary member design and detailing. Load flow implications related to building configurations; including vertical and lateral load resisting elements. For architecture and construction management students. 3 lectures. Prerequisite: ARCE 226. May not be taken concurrently with ARCE 322 or ARCE 323.

ARCE 322  Steel Structural Systems (3)
Concepts related to system behavior; selection; design and construction specific to steel structures. Preliminary member design and detailing. Load flow implications related to building configurations; including vertical and lateral force resisting elements. For architecture and construction management students. 3 lectures. Prerequisite: ARCE 226. May not be taken concurrently with ARCE 321 or ARCE 323.

ARCE 323  Concrete Structural Systems (3)
Concepts related to system behavior; selection; design and construction specific to concrete structures. Preliminary member design and detailing. Load flow implications related to building configurations; including vertical and lateral force resisting elements. Introduction to issues related to foundation design. For architecture and construction management students. 3 lectures. Prerequisite: ARCE 226. May not be taken concurrently with ARCE 321 or ARCE 323.

ARCE 351  Structural Computing Analysis I (1)
Computer calculations, programming basics and technical reporting. Emphasis on use of spreadsheets as a tool to analyze building elements. 1 laboratory. Prerequisite: ARCE 212 or ARCE 222, CSC 231 or CSC 234 or approved equivalent. Concurrent: ARCE 223.

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. 1 laboratory. Prerequisite: ARCE 222, ARCE 351. Concurrent: ARCE 302.

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. 1 laboratory. Prerequisite: ARCE 302, ARCE 352. Concurrent: ARCE 306.

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 and load flow. 3 laboratories. Prerequisite: ARCE 223, ARCE 227, and third year standing in Architectural Engineering. Co-requisite: ARCE 302.

ARCE 372  Steel Structures Design Laboratory (3)
Steel framed project incorporating structural system configuration and selection, structural analysis for gravity and lateral loads, and construction drawings and specifications. Integration of building services and architectural design, constructability issues, and relationships between construction methods and cost. 3 laboratories. Prerequisite: ARCE 257, 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 372.

ARCE 412  Dynamics of Framed Structures (3)
Analysis of structures subjected to dynamic loads with single- and multidegrees of freedom. Development of techniques for analysis of structures in response to seismic, wind, and moving loads: Solution of problems by digital computer. 3 lectures. Prerequisite: ARCE 225 or ME 212, MATH 244, CSC 341 and ARCE 306.

ARCE 414  Precast Concrete (3)
Precast and prestressed concrete principles, materials and techniques of construction. Design of basic precast elements and connections and prestressed concrete fundamentals as applied to precast concrete. Design potentials, aesthetics, cost and construction time as related to buildings and other structures. 3 laboratories. Prerequisite: ARCE 444.

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 212 or ARCE 222, GEOL 201.

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, mat foundations, and combined footings. Pile foundations and sheet pile retaining structures. Deep foundation systems; piles and drilled piers. 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 302.

ARCE 445  Prestressed Concrete Design Laboratory (3)
Design and analysis of prestressed concrete structures. 3 laboratories. Prerequisite: ARCE 444.
Directed group study of selected topics for advanced students. Open to ARCE 470 Selected Advanced Topics (1–4) ARCE 372 or ARCE 451 or ARCE 452. Total credit limited to 2 units. 1 laboratory. Prerequisite: ARCE 371 and create a successful design team through the development of specific projects. Topics covered in the ARCE curriculum. Projects may include analysis, experimental testing, research, or construction. Interdisciplinary projects encouraged. 3 laboratories. Prerequisite: ARCE 257, ARCE 304, ARCE 305, and ARCE 371.

ARCE 452 Concrete Structures Design Laboratory (3)
Cast in place concrete framed project incorporating structural system configuration and selection, structural analysis for gravity and lateral loads, and construction drawings and specifications. Integration of building services and architectural design, constructability issues, and relationships between construction methods and cost. 3 laboratories. Prerequisite: ARCE 257, ARCE 304, ARCE 305, and ARCE 371.

ARCE 453 Senior Project Laboratory (3)
Projects by individuals or teams under faculty supervision that go beyond topics covered in the ARCE curriculum. Projects may include analysis, design, experimental testing, research, or construction. Interdisciplinary projects encouraged. 3 laboratories. Prerequisite: ARCE 371, ARCE 451 or ARCE 452, ARCE 483.

ARCE 460 Collaborative Design Laboratory (1)
Investigation of the collaborative nature of the design process as it relates to the structural engineer and architect. Development of skills necessary to create a successful design team through the development of specific projects. Total credit limited to 2 units. 1 laboratory. Prerequisite: ARCE 371 and ARCE 372 or ARCE 451 or ARCE 452.

ARCE 470 Selected Advanced Topics (1–4)
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 8 units. 1–4 lectures. Prerequisite: Consent of instructor.

ARCE 471 Selected Advanced Laboratory (1–4)
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 8 units. 1–4 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) (Reinstated)
Application of techniques of physical modeling to obtain solutions to structural design problems. 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 372, ARCE 412, CSC 342.

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. Credits to not count toward graduation in the ARCE Degree Program. Prerequisite: Sophomore standing and consent of department head.

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. Credits to not count toward graduation in the ARCE Degree Program. Prerequisite: Sophomore standing and consent of instructor.

ARCE 504 Finite Element Method for Building Structures (3)

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.

ARCE 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.

ARCE 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. Credit/No Credit grading only. 2 lectures.

ARCH 105 Architectural Practice 1 (1)
Shop safety, machine and tool operation and small-scale design and construction. 1 laboratory. Corequisite: ARCH 121 or ARCH 131.

ARCH 106 Materials of Construction (2)
Use and application of construction processes and materials. 2 lectures.
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 121 Design and Drawing 1.1 (3)
An introduction to the issues, concepts, processes and skills pertaining to
two- and three-dimensional design and the freehand and constructed
representation and visual communication of ideas, objects and environ-

ARCH 122 Design and Drawing 1.2 (3)
Continuation of ARCH 121 plus the issues, concepts, processes and skills
pertaining to color theory and the design and visual communication of
architectural space. 3 laboratories. Prerequisite: ARCH 121 or ARCH 131.

ARCH 123 Design and Drawing 1.3 (3)
Continuation of ARCH 121 and ARCH 122 plus the issues, concepts,
processes and skills pertaining to the analysis and design of architectural
form, space and organizations. 3 laboratories. Prerequisite: ARCH 122 or
ARCH 132.

ARCH 131 Design and Visual Communication 1.1 (4)
An introduction to the issues, concepts, processes and skills pertaining to
two- and three-dimensional design and the freehand, constructed and digital
representation and visual communication of ideas, objects and
environments. Purchase of a laptop computer, software and peripherals
is highly recommended to participate in this course. 4 laboratories.
Corequisite: ARCH 105; concurrent: EDES 101.

ARCH 132 Design and Visual Communication 1.2 (4)
Continuation of ARCH 131 plus the issues, concepts, processes and skills
pertaining to color theory and the design and visual communication of
architectural space. Purchase of a laptop computer, software and peripherals
is highly recommended to participate in this course. 4 laboratories.
Prerequisite: ARCH 131.

ARCH 133 Design and Visual Communication 1.3 (4)
Continuation of ARCH 131 and ARCH 132 plus the issues, concepts,
processes and skills pertaining to the analysis and design of architectural
form, space and organizations. Purchase of a laptop computer, software and
peripherals is highly recommended to participate in this course. 4
laboratories. Prerequisite: ARCH 132.

ARCH 160 Digital Tools for Architecture (4)
Substantive introduction to the use of digital tools in architectural design
and visual communication in the areas of 3-D modeling, 2-D drawing,
image editing and page layout. 4 seminars.

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 in small-scale buildings. Emphasis on architectural
methods of ventilating, cooling, heating, and lighting for envelope-load
dominated buildings. 2 lectures, 2 activities. Prerequisite: PHYS 132 or

ARCH 217 History of World Architecture:
Prehistory – Middle Ages (4)  GE C3
Architecture and urbanism in the ancient world, from prehistory to the
Middle Ages. Social, cultural and physical conditions that influenced the
built environment to the Mediterranean basis, plus Europe, Asia, Africa and
Pre-Columbian America. 4 lectures.

ARCH 218 History of World Architecture:
Middle Ages – 18th Century (4)  GE C3
World architecture and urbanism from the Middle Ages until the end of the
18th century Baroque. Social, cultural and physical conditions which
influenced the built environment of Europe, Asia, and the Pre-Columbian and
Colonial Americas. 4 lectures.

ARCH 219 History of World Architecture:
18th Century – Present (4)  GE C3
Architecture and urbanism of the modern world, from the 18th century to
the present. Social, cultural and physical conditions influencing the built
environment of Europe, Asia, Africa and the Americas. 4 lectures.

ARCH 221 Architectural Design Fundamentals 2.1 (3)
Continuation of ARCH 123 or ARCH 133 in terms of materiality, structure
and function and the theories, concepts, processes and skills pertaining to
the design of architectural form, space and organizations. 3 laboratories.
Prerequisite: ARCH 123 or ARCH 133.

ARCH 222 Architectural Design Fundamentals 2.2 (3)
Continuation of ARCH 221 plus the theories, concepts, processes and skills
pertaining to site, context and climate as determinants that shape the built
environment. 3 laboratories. Prerequisite: ARCH 221.

ARCH 231 Architectural Practice (3)
Wood construction methods and processes. Construction documents used as
communication medium for such methods and processes. 1 lecture, 2
activities. Prerequisite: ARCH 106 plus ARCH 122 or ARCH 132 or
ARCH 111. Corequisite: ARCH 252.

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 241 Architectural Practice 2.1 (4)
The history, concepts and methods associated with the use and application
of construction systems, processes and materials. 2 lectures, 2 activities.
Prerequisite: ARCH 123 or ARCH 133. Corequisite: ARCH 251.

ARCH 242 Architectural Practice 2.2 (4)
A continuation of ARCH 241 with an emphasis on the concepts, methods,
processes, detailing and documentation of wood construction. 2 lectures, 2
activities. Prerequisite: ARCH 241. Corequisite: ARCH 252.

ARCH 250 Computer Applications (3)
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. 2 lectures,
1 laboratory.

ARCH 251 Architectural Design 2.1 (5)
Continuation of ARCH 123 or ARCH 133 in terms of materiality and the
theories, concepts, processes and skills pertaining to the analysis and design
of architectural form, space and organizations to communicate intended
concepts and meanings. 5 laboratories. Prerequisite: ARCH 123 or ARCH
133; corequisite: ARCH 241.

ARCH 252 Architectural Design 2.2 (5)
Continuation of ARCH 251 plus the theories, concepts, processes and skills
pertaining to light, construction and function as determinants that shape the
built environment and support the communication of intended concepts and
meanings. 5 laboratories. Prerequisite: ARCH 251; corequisite: ARCH 242.

ARCH 253 Architectural Design 2.3 (5)
Continuation of ARCH 251 and ARCH 252 plus the theories, concepts,
processes and skills pertaining to context, structure and climate as
determinants that shape the built environment and support the
communication of intended concepts and meanings. 5 laboratories.
Prerequisite: ARCH 252 and ARCH 160; corequisite: ARCH 207.
ARCH 270 Selected Topics (1–4)
Directed group study of selected topics. Class Schedule will list topic selected. Open to first-, second-, third-year students. Total credit limited to 8 units. 1 to 4 lectures.

ARCH 302 Theories of Architectural Design (3)
Theories of architecture and their application in architectural design. 3 lectures. Prerequisite: ARCH 253.

ARCH 307 Environmental Control Systems 2 (4)
Theory and application of climate, energy use and comfort as determinants of architectural form in large-scale buildings. Emphasis on architectural and mechanical methods of ventilating, cooling, heating, lighting, acoustics, and water and waste systems for internal-load dominated buildings. 2 lectures, 2 activities. Prerequisite: ARCH 207. Concurrent: 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 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)
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 134.

ARCH 320 History of Asian Architecture and the Built Environment (4)
Architecture and the built environment of Asia from prehistory to the present. Major monuments, urbanism, and common building. Some important historical, geographic, religious and cultural factors that affected the shaping of the built environment. 4 lectures. Prerequisite: GE Area A1 and one of the following Area C3 courses: ARCH 217, 218, 219, or ART 112. Architecture majors will not receive GE C4 credit.

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 123 or ARCH 133.

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 123 or ARCH 133.

ARCH 340 Architectural Photography (4)
Photography specifically related to architecture and design. Advancement of students' technical skills in communicating design through the medium of photography. 2 lectures, 2 laboratories. Prerequisite: ARCH 337.

ARCH 341 Architectural Practice 3.1 (4)
Concepts, methods and processes pertaining to the detailing and construction of masonry, steel, concrete and combination structures. 2 lectures, 2 activities. Prerequisite: ARCH 242 and ARCH 253. Corequisite: ARCH 351.

ARCH 342 Architectural Practice 3.2 (4)
Continuation of ARCH 341 content plus the concepts, methods and processes pertaining to the preparation of outline specifications, production of design development drawings, life safety, systems integration and cost estimating. 2 lectures, 2 activities. Prerequisite: ARCH 341. Corequisite: ARCH 353.

ARCH 351 Architectural Design 3.1 (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. 5 laboratories. Prerequisite: ARCH 212, ARCH 242, ARCH 253 or consent of department head. Corequisite: ARCH 341.

ARCH 352 Architectural Design 3.2 (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. 5 laboratories. Prerequisite: ARCH 351. Corequisite: ARCH 307.

ARCH 353 Architectural Design 3.3 (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. 5 laboratories. Prerequisite: ARCH 352. Corequisite: ARCH 342.

ARCH 363 Off-Campus Orientation Seminar (2) (CR/NC)
Preparation for off-campus architectural study programs includes cultural orientation, an introduction to basic language skills, travel and housing protocols as well as academic and financial advising. Credit/No Credit grading only. Total credit limited to 4 units, with a maximum of 2 units per quarter. 2 seminars. Prerequisite: Consent of instructor.

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 3 (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. 4 lectures. Prerequisite: 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, Theory and Criticism (4)
Special topics based on the exploration of specific approaches, periods of time, and cultural or geographic areas. Class Schedule will list topic selected. Total credit limited to 12 units; repeatable in same term. 4 seminars. Prerequisite: 4th year standing and ARCH 217, ARCH 218, and ARCH 219, or consent of instructor.

ARCH 441 Professional Practice (3)
A critical analysis of the roles and responsibilities of the architect in providing comprehensive services to the client from project acquisition and inception to project delivery and closeout. 3 lectures. Prerequisite: ARCH 342 and ARCH 353.

ARCH 442 Professional Practice (3)
Case study of an architectural project that addresses selected professional practice issues presented in ARCH 441. 3 lectures. Prerequisite: ARCH 342 and ARCH 353.

ARCH 443 Professional Practice (4)
A critical analysis of the roles and responsibilities of the architect in providing comprehensive services to the client from project acquisition
and inception to project delivery and closeout and the process and requirements for internship development and attaining registration. 2 lectures, 2 activities. Prerequisite: ARCH 342, ARCH 353.

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 134.

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 (4) (Also listed as CRP 447)
Practical application of fundamental zoning, subdivision, design/development standards, and building codes in the design review process, either in the form of a proposed development project or preparation of ordinances, codes, standards, and/or guidelines to apply to a project. 3 lectures, 1 activity. Prerequisite: Fourth year standing, or consent of instructor.

ARCH 450 Digital Design and Visualization (5)
Theory, principles and techniques of computer aided architectural or product design, visualization, and digital animation. Utilization of desk-top computers and 2-D and 3-D software as integrated tools for development of a comprehensive computer enhanced design process. 5 laboratories. Prerequisite: For architecture majors, all prerequisites required by the year and course level for which the student is seeking credit; for non-architecture majors, junior standing or permission of instructor; for local professionals not seeking academic credit, permission of instructor.

ARCH 451 Architectural Design 4.1 (5)
Problems of increasing architectural complexity involving the comprehensive integration of architectural theory, design processes, and building systems with emphasis placed on multifunction singular buildings. 5 laboratories. Prerequisite: ARCE 316, ARCH 353, or consent of department head.

ARCH 452 Architectural Design 4.2 (5)
Problems of increasing architectural complexity involving the comprehensive integration of architectural theory, design processes, and building systems with emphasis placed on multibuilding, multifunctional projects. 5 laboratories. Prerequisite: ARCE 316, ARCH 353, or consent of department head.

ARCH 453 Architectural Design 4.3 (5)
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. 5 laboratories. Prerequisite: ARCE 316, ARCH 353, or consent of department head.

ARCH 457 Computer Graphics in Architecture (4)
Two-dimensional drawing systems in architectural practice with particular emphasis on office productivity in the production side of the design process; includes drawing database administration, local area networks, management and cost issues. 2 lectures, 2 laboratories. Prerequisite: Fourth year standing.

ARCH 460 Advanced Computer Graphics in Architecture (3)
Advanced methods in the application of computer graphics and multi-media techniques in architectural design. 2 lectures, 1 activity. Prerequisite: ARCH 133 or ARCH 160 or 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. 2 lectures, 1 activity. Prerequisite: ARCH 457 or equivalent and consent of instructor.

ARCH 462 Topics in Architectural Practice (3)
Selected topics addressing various aspects of Architectural Practice for advanced students in CAED. Topics may include strategic planning, managing quality, ethics, and legal considerations. Open to undergraduate and graduate students. Class Schedule will list topic selected. Total credit limited to 6 units; repeatable in same term. 3 lectures. Prerequisite: ARCH 342 or 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. Total credit limited to 6 units. 2 seminars. Prerequisite: Fourth-year standing in architecture. Credit/No Credit grading only.

ARCH 464 Computer Applications in Design (3)
Exposure to all aspects of two-dimensional computer-aided design. Introduction to three-dimensional CAD through the use of AUTOCAD 12 software. Class Schedule will list topic selected. Total credit limited to 12 units. 3 lectures. Prerequisite: Junior standing and current participation in Washington Alexandria Architectural Consortium off-campus program.

ARCH 465 Design Related Media (3)
The role of various media of visual communication as tools of documentation, analysis and creation in the design visual environment. Skills in graphics, photography, product design, film, video techniques, and printmaking graphics will be developed in specific relation to environmental design study and presentation. Class Schedule will list topic selected. Total credit limited to 12 units. 3 lectures. Prerequisite: Junior standing and current participation in Washington Alexandria Architectural Consortium off-campus program.

ARCH 466 Topics in Architectural History and Theory (3)
Design from its beginning with the crafts design period to its expression of industrial design in its present form. Various stages in the evolution of design explored through analyzing the influence and contributions of leading artists. Class Schedule will list topic selected. Total credit limited to 12 units. 3 lectures. Prerequisite: Junior standing and current participation in Washington Alexandria Architectural Consortium Off-campus program.

ARCH 467 Undergraduate Research (3)
Architecture and urban theoretical intentions and results in the context of the Capitol of the United States – Washington, DC. This theoretical and historical study will not occur within the confines of the classroom, but directly within the “laboratory” of the city. Class Schedule will list topic selected. Total credit limited to 12 units. 3 lectures. Prerequisite: Junior standing and current participation in Washington Alexandria Architectural Consortium Off-campus program.

ARCH 468 Advanced Environmental Building Systems (3)
Technologies which provide a “well building” environment by engaging in: weather protection; thermal/moisture control; natural and artificial lighting; and electrical and other “energy source” utility service. 3 lectures. Prerequisite: Junior standing and current participation in Washington Alexandria Consortium Off-campus program.

ARCH 469 Topics in Design Methods (3)
Relationship of art and architecture addressed to encourage critical debate. Historically, the “art” and the “architecture” were not as polarized as today. Both historical perspective and practical issues concerning collaboration. Class Schedule will list topic selected. Total credit limited to 12 units. 3 lectures. Prerequisite: Junior standing and current participation in the Washington Alexandria Architectural Consortium Off-campus program.

ARCH 470 Selected Advanced Topics (1–4)
Directed group study of selected topics for advanced students. Class Schedule will list topic selected. Total credit limited to 8 units. 1 to 4 lectures. Prerequisite: Consent of instructor.
ARCH 471 Selected Advanced Laboratory (1–4)
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 8 units. 1 to 4 laboratories. Prerequisite: Consent of instructor.

ARCH 472 Housing Design Concepts (3)
For students preparing for further study or practice relating to housing, urban design and new communities. This course will address design objectives, concepts, and current theories and forms in housing and mixed-use projects. 3 activities. Prerequisite: Third-year standing or consent of instructor.

ARCH 477 Advanced Topics in Environmental Architecture (4)
Theory and application of methods used to address energy and ecological issues of integrated building and site design. Class Schedule will list topic selected. Total credit limited to 12 units, repeatable in same term. 4 seminars. Prerequisite: ARCH 307.

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 College of Liberal Arts. Total credit limited to 36 units. Prerequisite: Junior standing.

ARCH 481 Senior Architectural Design 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, 5 laboratories. Prerequisite: 5th-year standing or consent of department head.

ARCH 485 Cooperative Education Experience (4), (4 or 8) (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. Change effective Fall 2005.

ARCH 492 Senior Design Thesis (3)
Development of the framework and format of a thesis project proposal related to the specific design option. Work to include: research topic, intent, scope, methodology, assumptions, outline of work program and documentation. To be taken concurrently with first quarter of ARCH 481. 3 seminars. Prerequisite: 5th year standing or consent of instructor.

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 1, 2 (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 521 Graduate Architectural Design 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. 5 laboratories. Prerequisite: ARCH 407, ARCH 441, ARCH 442, ARCH 451, ARCH 452, ARCH 453 and 5th-year 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 592 Graduate Design Thesis (3)
Development of the framework and format of a thesis project proposal related to the specific design option. Work to include: research topic, intent, scope, methodology, assumptions, outline of work program and documentation. To be taken concurrently with first quarter of ARCH 521. 3 seminars. Prerequisite: 5th year standing or consent of instructor.

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 advisor.

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 advisor.

ART

ART 101 The Fundamentals of Drawing (4) GE C3
Introduction to the artistic practice and cultural value of drawing from the Renaissance to the 21st Century. Emphasis and expansion of the practical skills of observation, rendering, and understanding the signs of meaning produced in visual art. Development of formal techniques, media experimentation, and content creation through personal expression. Exercises to encourage growth in technical skill, conceptual innovation, critical thinking, and visual communication. 1 lecture, 3 activities.

ART 111 Introduction to Art (4) GE C3
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 (4) GE C3
History of major art movements in western civilization from ancient art to the twentieth century. Representative periods of western culture, such as the ancient world, the Middle Ages, the Renaissance, and the modern world. 4 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)
Core course in research and application of principles, elements and criticism of three-dimensional design concepts. 1 lecture, 2 laboratories.

ART 148 Sculpture (4) GE C3
Exploration of three dimensional form through problems in modeling, casting, carving, and techniques of assembly. Historical and contemporary concepts as applied to the discipline of sculptural styles. 1 lecture, 3 activities.

ART 181 Computer Imaging and Design (3)
Introduction to the Macintosh system to acquaint students with operating procedures. Students will learn Adobe InDesign, Adobe Illustrator, and Adobe Photoshop for use in their own creative design or photography. 2 lectures, 1 laboratory. Prerequisite: ART 132 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 or concurrent: ART 134, or consent of instructor. Change effective Winter 2007.

ART 203 Art Theory and Practice (3)
Contemporary issues in art and design, linking “ideas” in art theory to problem-solving. Emphasis on creative expression through knowledge of contemporary thinking, aesthetics, techniques, and vocabulary. 1 lecture, 2 activities. Prerequisite: ART 101 and ART 148.

ART 209 Beginning Painting (3)
Introduction to technical and formal problems in painting. Physical characteristics of paint, various tools and substrates. Projects emphasize creative understanding of pictorial space, color and concept. 3 activities. Prerequisite: ART 101 and ART 132 or consent of instructor.

ART 211 Art History–Ancient to Renaissance (4)
Development of art from antiquity to the early stages of the Renaissance in Europe. Particular emphasis on European art with appropriate references to sources from antiquity which have been particularly influential on European painting and sculpture. Comparison of relevant parallel examples of the art of non-European cultures. 4 lectures.

ART 212 Art History–Renaissance through Baroque Eras (4)
The significant visual expressions of Northern and Southern European art of the Renaissance and Baroque period. Relevant parallel examples of the art of non-European cultures. 4 lectures.

ART 221 Basic B/W Photography (3)
Fundamental techniques in black and white photography. Mechanics of film/digital cameras and equipment, optics, composition, filters, subject content, developing, printing, and mounting. Understanding of 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. Assignments encourage development of composition and visual communication skills. Emphasis on “photographic seeing” and professional quality enlargements. 2 lectures, 1 laboratory. Prerequisite: ART 221 or equivalent.

ART 224 Introduction to Artificial Lighting for Photography (3)
Studio lighting is used to introduce the student to contemporary professional studio photography. Quality developing and printing skills are required. Introduction to current examples of professional studio lighting. 2 lectures, 1 laboratory. Prerequisite: ART 222.

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 181.

ART 241 Introduction to 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. Total credit limited to 6 units. 1 lecture, 2 laboratories. Prerequisite: ART 101 and ART 134 or ART 148 or consent of instructor.

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. 1 lecture, 2 laboratories. Prerequisite: ART 134 or consent of instructor.
ART 255 Jewelry Design (3)
Studio course in nonferrous metal techniques including cutting, forming, soldering, and forging with emphasis on creative design solutions. 3 activities. Prerequisite: ART 134 or consent of instructor.

ART 301 Advanced Drawing (3)
Development of advanced methods and techniques in the study of form, content, and structure. Emphasis on problem-solving. Total credit limited to 9 units. 3 activities. Prerequisite: ART 131, ART 134 and ART 201, or consent of instructor. Change effective Winter 2007.

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 309 Intermediate Painting (3)
Continuation of study of technical and formal problems in painting. Expanded study of physical characteristics of paint, tools, and substrates. Emphasis on the creative process from concept to finished art. Contemporary issues in painting introduced. Class Schedule will list topic selected. Total credit limited to 9 units. 3 activities. Prerequisite: ART 209, 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 that have shaped images in American art. 4 lectures. Prerequisite: One lower division art history course or consent of instructor.

ART 311 Art History–Nineteenth Century Art (4)
History of painting and sculpture from the French Revolution to the beginning of the 20th century. Significant movements such as Neo-Classicism, Romanticism, Realism, Impressionism and Post-Impressionism. 4 lectures. Prerequisite: One lower division art history course or consent of instructor.

ART 312 Art History–Twentieth Century Art (4)
History of major art movements from the beginning of the twentieth century to the present. Major emphasis will be placed on Fauvism, Cubism, Expressionism, Dada, Surrealism, and the period of Post-World War II art to that of contemporary twenty-first century art. 4 lectures. Prerequisite: ART 211 or ART 212 or consent of instructor.

ART 313 Design History (4)
Survey of design from the Victorian era to the present, including major philosophies and movements, political, social, cultural, and technological trends that influenced designers in the 20th century. 4 lectures. Prerequisite: Any lower division art history course.

ART 314 History of Photography (4)  GE C4
In-depth survey of the artistic and cultural achievements in photography from its invention to the present day. Significant photographers, the evolution of aesthetic criteria in the context of other visual arts as well as social/cultural impact. 4 lectures. Prerequisite: Completion of GE Areas A and C3. Art and Design majors will not receive GE C4 credit.

ART 316 Women as Subject and Object in Art History (4)  (Also listed as WS 316)
Exploration of the role of women in the visual arts. Women as artists, women as portrayed in art, and feminist theory as it applies to the study of the visual arts and art history. 4 lectures. Prerequisite: ART 111, ART 112 or consent of instructor.

ART 317 Asian Art Survey (4)
Survey of the traditional arts of Asia – primarily India, China and Japan. Emphasis on the connections between the visual arts in Asia and the philosophical, social and cultural environments in which they arose. 4 lectures. Prerequisite: ART 111 or ART 112, or ART 211, or consent of instructor.

ART 318 Asian Art Topics: National, Religious, and Intellectual Movements (4)  GE C4
In-depth examination of significant art movements in Asia. Each topic will focus on the development of art in Asia within the context of a specific geographical or theoretical framework. Details will vary depending on topic. Class Schedule will list topic selected. Total credit limited to 12 units. 4 lectures. Prerequisite: Completion of GE Areas A and C3. Art and Design majors will not receive GE C4 credit.

ART 322 Color Photography (3)
Fundamental techniques in color photography. Theory of color, visual concepts, exposing color transparencies and negatives, printing from color negatives, finishing and presentation. Studio electronic flash and available light. 2 lectures, 1 laboratory. Prerequisite: ART 222.

ART 323 Introduction to Digital Image Making (3)
Creation and modification of color images using transparency materials and digital files. Digital photographic vocabulary as well as theory of color in expression and communication. Survey of contemporary color photography and digital image making. 2 lectures, 1 laboratory. Prerequisite: ART 181, ART 222 or consent of instructor.

ART 324 Photographic Expression (4)
Emphasis on personal expression and developing style, introduction to symbolism, visual source development and the work of contemporary creative photographers. 2 lectures, 2 laboratories. Prerequisite: ART 224.

ART 325 4x5 Camera Techniques (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, color transparencies, and high-resolution digital imaging. 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 329 Editorial and Corporate Photography (3)
Creating, lighting and executing editorial assignments. 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 required for appropriate problems. 3 activities. Prerequisite: Junior standing. ART 133, ART 134, ART 181, ART 232, or consent of instructor.

ART 332 Symbology (3)
Use of symbolism and metaphor in graphic design. Communication of complex or abstract concepts with connotative/denotative imagery. Development of ideas from research, reference materials, and the imagination. Computer applications are required for appropriate problems. 3 activities. Prerequisite: ART 133, ART 331, junior standing.

ART 333 Corporate Identity (3)
Design and implementation of corporate logos. Development of a graphic standards manual for use of identity in diverse applications. For Art and Design majors only. Computer applications are required for appropriate
Development of skills and techniques in the use of three-dimensional digital technology. Capabilities of current software in the design and modeling of three-dimensional form. 2 lectures, 2 activities. Prerequisite: ART 134 and ART 181, or consent of instructor.

**ART 335 Digital 3D Modeling and Design (4)**

Survey of history of glass and introduction to contemporary glass art, presented through visual examples in slide/lecture format. Development of tools and forming processes introduced while student develops three-dimensional projects. 3 lectures, 1 activity. Prerequisite: ART 101, ART 148 and ART 241; or consent of instructor.

**ART 341 Glassblowing (4)**

Studio course emphasizing individual and collaborative creative exploration of project content derived from student's experience. Focus on using traditional as well as new genres of artistic expression such as site specific installations, video art, book works, and performance art. Class Schedule will list topic selected. Total credit limited to 8 units. 1 lecture, 3 activities. Prerequisite: ART 101, ART 131, and ART 148, or consent of instructor. Change effective Winter 2007.

**ART 355 Metalsmithing (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. Total credit limited to 9 units. 3 activities. Prerequisite: ART 255, or consent of instructor.

**ART 356 Jewelry Casting (3)**

Intermediate sculpture course in expressive use of form with modeling, casting, carving, and/or assembly. 1 lecture, 2 laboratories. Prerequisite: ART 134 and ART 148, or consent of instructor.

**ART 384 Intermediate Sculpture (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. Total credit limited to 9 units. 2 lectures, 1 laboratory. Prerequisite: ART 148, ART 134, 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 402 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. Total credit limited to 6 units. 3 activities. Prerequisite: ART 302.

**ART 406 Advanced Selected Topics in 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. Class Schedule will list topic selected. Total credit limited to 9 units. 3 activities. Prerequisite: ART 302, ART 304.

**ART 409 Advanced Painting (3)**

Advanced problems in painting. Emphasis on the creative process from concept to finished art. Investigation of traditional, non-traditional and explorative work, to encourage development of personal approach. Total credit limited to 9 units. 3 activities. Prerequisite: ART 309, or consent of instructor.

**ART 427 Illustration Photography (3)**

Advanced principles of design and color to produce a photograph that sells an idea, product, or service. Both traditional and digital applications used. Joint projects with ART 432, Advertising Design. Emphasis on thinking, planning, interpreting, and presenting an idea graphically. 2 lectures, 1 laboratory. Prerequisite: ART 326 and senior standing.

**ART 428 Portfolio Production Photography (1)**

Advanced principles of letterform design and modification related to the communication of ideas. Emphasis on computer application to the typographic design processes. 3 activities. Prerequisite: ART 333 and senior standing.

**ART 430 Advanced Typographic Design (3)**

Studio course in hand, wheel, mold, extruder, jigger, and press forming skills. Design of single and multiple forms and kiln firing procedures. Total credit limited to 9 units. 3 activities. Prerequisite: ART 101, ART 148 and ART 241; or consent of instructor.

**ART 431 Package Design (3)**

Study of package and graphic design for projects. Projects address research, analysis, designer development and implementation. For Art and Design majors only. Computer applications are required for appropriate problems. 3 activities. Prerequisite: ART 232, ART 333 and senior standing.

**ART 432 Advertising Design (3)**

Studio course emphasizing individual and collaborative creative exploration of project content derived from student's experience. Focus on using traditional as well as new genres of artistic expression such as site specific installations, video art, book works, and performance art. Class Schedule will list topic selected. Total credit limited to 8 units. 1 lecture, 3 activities. Prerequisite: ART 101, ART 131, and ART 148, or consent of instructor.

**ART 433 Editorial Design (3)**

Development of print advertising from concept to final presentation. Emphasis on art direction, photo direction and copywriting. For Art and Design majors only. Computer applications are required for appropriate problems. 3 activities. Prerequisite: ART 431 and senior standing.

**ART 435 Metalsmithing (3)**

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 440 Advanced Selected Topics in Glass (4)**

Continued exploration into the expressive use of glass as a creative medium. Topics may include glass casting, glass blowing, cane work, mold making, and kiln work. Total credit limited to 12 units. 2 lectures, 2 activities. Prerequisite: ART 241 or ART 341, or consent of instructor.

**ART 448 Advanced Topics in Sculpture (3)**

Studio course emphasizing individual and collaborative creative exploration of project content derived from student's experience. Focus on using traditional as well as new genres of artistic expression such as site specific installations, video art, book works, and performance art. Class Schedule will list topic selected. Total credit limited to 9 units; may be in same term. 3 activities. Prerequisite: ART 309, or consent of instructor.

**ART 470 Advanced Typographic Design (3)**

Studio course in hand, wheel, mold, extruder, jigger, and press forming skills. Design of single and multiple forms and kiln firing procedures. Total credit limited to 9 units. 3 activities. Prerequisite: ART 101, ART 148 and ART 241; or consent of instructor.

**ART 472 Illustration Photography (3)**

Advanced principles of design and color to produce a photograph that sells an idea, product, or service. Both traditional and digital applications used. Joint projects with ART 432, Advertising Design. Emphasis on thinking, planning, interpreting, and presenting an idea graphically. 2 lectures, 1 laboratory. Prerequisite: ART 326 and senior standing.

**ART 480 Professional Practices (2)**

Professional practices in the art, photography, and design fields, including legal and ethical issues, taxes, contracts, fees and copyrights. Current job opportunities are researched and a business plan is prepared. Course lectures augmented by visiting professionals. For Art and Design majors only. 2 lectures. Prerequisite: Senior standing.

**ART 481 Senior Project (2)**

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.

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ART 462 Senior Portfolio Project (2)
Preparation of portfolio system for entrance into the professional job market or graduate school. 2 activities. 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 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 (1–4)
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 4 units. 1 to 4 lectures. Prerequisite: Consent of instructor.

ART 471 Selected Advanced Laboratory (1–4)
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 8 units. 1 to 4 laboratories. Prerequisite: Consent of instructor.

ART 474 Collaborative Studio: Rendering, Animation and Modeling (4)
A collaborative visualization and design studio focusing on rendering, animation and modeling. Modeling and animation software for design conceptualization and expression. Collaboration in teams. Total credit limited to 8 units. 2 lectures, 2 activities. Prerequisite: ART 335 or consent of instructor.

ART 483 Video and Multimedia Production (4)
Video and computer generated multimedia presentation scripting, editing, storyboarding and sound cutting. Emphasis on effective communication using presentation techniques and application software to create high impact applications. 2 lectures, 2 laboratories. Prerequisite: ART 181.

ART 484 Animation and Interactive Design (3)
Creation of in-depth animations and interactive presentations. Advanced scripting, storyboarding and interactive communication techniques. 2 lectures, 1 laboratory. Prerequisite: ART 181.

ART 486 Advanced Digital Image Making (3)
Expressive possibilities of latest image manipulation software. Advanced capabilities of this software explored with focus on development of conceptual and expressive abilities in the digital medium. Art and Design majors only. 2 lectures, 1 laboratory. Prerequisite: ART 181.

ART 487 Web Design (3)
Planning and implementation of web sites. Focus on site structure, navigation, HTML, animation, and design considerations. Art and Design majors only. Total credit limited to 6 units. 2 lectures, 1 laboratory. Prerequisite: ART 181 or ART 323 and senior standing.

ART 488 Advanced Web Design (3)
Conceptual and technical objectives: the development of the theoretical skills necessary to design a successful web user interface, information architecture and visual identity for digital projects, and the development of technical skills necessary to design advanced interactivity with Macromedia Flash and JavaScript. 2 lectures, 1 laboratory. Prerequisite: Art and Design majors only, ART 484, ART 487 and senior standing.

ART 494 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 112 Principles of Animal Science (4) GE B2
Economic and environmental roles of animal production and companionship to society. Introductory nutrition, genetics, reproduction, behavior, growth and development, animal products, biosecurity, and food processing and safety of animals. 4 lectures.

ASCI 200 Special Problems for Undergraduates (2–3) (CR/NC)
Individual investigation, research, studies, or surveys of selected problems. Total credit limited to 4 units, with a maximum of 3 units per quarter. Credit/No Credit grading only. Prerequisite: Consent of instructor.

ASCI 209 Animal Food Products (3)
Composition of muscle-based foods in relation to cost, yield, quality, meal preparation and nutritional value. Buying, storing, handling and preservation. Uniform retail and food service identity standards for fresh cuts. Classification and methods of making processed meat products. Credit not allowed for students having completed ASCI 211. 2 lectures, 1 laboratory.

ASCI 211 Meat Science (4)
Muscle food processing methods and operations. Conversion of muscle to meat. Meat inspection, grading, curing, preservation, food safety and related topics. Carcass beef, pork, and lamb processed into consumer ready products. Credit not allowed for students having completed ASCI 209. 3 lectures, 1 laboratory.

ASCI 212 Livestock Show Management (3)
Application of the management and operations of Cal Poly’s Western Bonanza Livestock Show. Principles and procedures in planning, organizing, financing, promoting and managing a major livestock show and the fair industry. Total credit limited to 6 units. 1 lecture, 2 activities.

ASCI 214 Equine Management (2)
Application of safety, risk reduction, horsemanship skills. Develop a working equine/human relationship. Selection and application of nutrition, equipment, preventive health and farrier program, and equitation skills. 2 laboratories. Prerequisite: Consent of instructor.

ASCI 216 Meat Grading and Evaluation (2)
Factors related to carcass quality and yield. USDA meat grading principles and practices. Judging of carcass and wholesale cuts. Field trip to meat packing plants required. 1 lecture, 1 laboratory. Prerequisite: ASCI 211.

ASCI 220 Introductory Animal Nutrition and Feeding (4)
Nutrient digestion and absorption; basic functions of major nutrient classes; NRC feed classification and feedstuff characteristics; Van Soest system of fiber analysis and practical applications; feed processing: effects on feeds and nutrient availability; nutrient requirements of animals; diet formulation techniques. 3 lectures, 1 laboratory. Prerequisite: ASCI 112.

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ASCI 221  Introduction to Beef Production (4)
Survey of industry characteristics, breeds, market classes, production systems, and current issues facing the beef industry. 3 lectures, 1 laboratory. Prerequisite: ASCI 112 or ASCI 231.

ASCI 222  Systems of Swine Production (4)
Structure of the pork industry in the U.S.; production standards and new technologies; breed systems. Market classification, product quality and quality assurance. Swine behavior and husbandry systems; biosecurity, health and feeding systems and management. 3 lectures, 1 laboratory. Prerequisite: ASCI 112 or ASCI 231.

ASCI 223  Systems of Sheep Management (4)
Sheep industry overview, populations, trends, cultural implications, breed identification, nutritional, reproductive, health, and marketing management of sheep. 3 lectures, 1 laboratory. Prerequisite: ASCI 112 or ASCI 231.

ASCI 224  Equine Science (4)
History, status of the horse industry, breeds. Application of management skills, safety, conformation evaluation, hoof and leg conformation and care. Understanding equine behavior. Insurance and tax ramifications. Pedigree analysis. Alternate therapies. 3 lectures, 1 laboratory. Prerequisite: ASCI 112 or ASCI 231.

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 232  General Animal Science Laboratory (1)
Basic handling skills of livestock; introductory selection of livestock; basic feedstuff identification and processing; and health care practices. 1 laboratory.

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 265  Equine Behavior and Training (3)
Training of weanling and yearling horses at halter. Selection of proper attire for the handler and equipment for the horse. Application of safe, behavioral training techniques enabling the horse to accept handling, farrier and health care. 3 activities.

ASCI 290  Livestock Management Enterprise (2–4) (CR/NC)
Changes effective Spring 2007. See Updates.
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 302 or BIO 303.

ASCI 311  Advanced Beef Cattle System Management (4)
Management principles for the sustainability of commercial beef cattle operations. Systems approach for goal setting, financial analysis, range management, breeding systems, nutrition, health programs, marketing, and production practices to enhance profitability of commercial cow-calf operations. 3 lectures, 1 laboratory. Prerequisite: ASCI 221 or consent of instructor.

ASCI 315  Equine Biomechanics (4)
Anatomy and physiology of the equine hoof and limb. An understanding of the art and science of the farrier's work. Evaluation of proper hoof care, trimming, and shoeing. Foot and leg conformation as it relates to sound locomotion. 3 lectures, 1 activity. Prerequisite: ASCI 224 or equivalent. Recommended: VS 223.

ASCI 320  Physiological Chemistry of Animals (4)
Interactions between the biological and chemical reactions in livestock. Physiology explained at the organ, tissue and cellular level as it relates to the whole animal system. 4 lectures. Prerequisite: BIO 111 or BIO 161, CHEM 312 or CHEM 316, VS 223.

ASCI 324  Advanced Equine Evaluation (2)
Appraising the relative merit of individual horses in halter and performance through the application, development and refinement of deductive and inductive logical processes. Oral and written expression of the selection rationale. 2 laboratories. Prerequisites: ASCI 226 and/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 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. 4 lectures, 1 laboratory. Prerequisite: ASCI 224 and VS 223.

ASCI 339  Internship in Animal Science (1–12) (CR/NC)
Selected Animal Science 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. Degree credit limited to 6 units. Credit/No Credit grading only. Prerequisite: Consent of internship instructor.

ASCI 340  Computer Applications in Ration Formulation (2)
Development of nutritionally balanced rations for livestock. Balancing of rations using Pearson Square, algebraic methods, linear programming methods, and commercial software. 2 activities. Prerequisites: ASCI 220 or DSCI 101, CSC 110 or consent of instructor.

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 activities. Prerequisites: ASCI 214, or consent of instructor.

ASCI 345  Equine Behavior Modification (5)
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 different stimuli, management of young equine athlete. 5 activities. Prerequisite: ASCI 344 or consent of instructor.

ASCI 346  Equine Nutrition (3)
Equine digestion, diet development considerations and evaluations, nutritional management, and the relationship of respective topics to recommended feeding practices, research data, and nutritional portfolios. Information is based on recent advances in horse nutrition and the

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National Research Council's Nutrient Requirements for Horses. A distance learning course. 3 lectures. Prerequisite: ASCI 224 and ASCI 220.

ASCI 347 Equine Exercise Physiology (3)
Applied physiology of the exercising horse. Examine different physiological systems: muscular, cardiovascular, respiratory, and nutritional. Gait analysis, lameness, and treatment. The athletic horse: sports medicine, conditioning, drugs, and necropsy evaluation. A distance learning course. 3 lectures. Prerequisite: ASCI 224 and any human/animal physiology class.

ASCI 350 Applied Nonruminant Nutrition (4)
Comparison of nonruminant and ruminant digestive systems, nutrient requirements, risk management for ingredients, formulation and nutritional management. Influence of growth and production curves, consumption patterns, and feeding management in commercial poultry and swine industries. Feed manufacturing and governmental regulations. 3 lectures, 1 laboratory. Prerequisite: ASCI 220 or DSCI 101.

ASCI 351 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 223.

ASCI 355 Ruminant Nutrition (4)

ASCI 384 Processed Meat Products (4)
Physical, chemical and functional characteristics of meat food raw materials. Science and technology of value-added processing including curing, sausage manufacture, low moisture products, and restructuring. Quality assurance and related current industry topics. 3 lectures, 1 laboratory. Prerequisite: ASCI 209 or ASCI 211, junior standing.

ASCI 400 Special Problems for Advanced Undergraduates (2–4) (CR/NC)
Individual investigation, research, studies, or surveys of selected problems. Total credit limited to 4 units, with a maximum of 4 units per quarter. Credit/No Credit grading only. Prerequisite: consent of instructor.

ASCI 403 Applied Biotechnology in Animal Science (5)
Coverage of current resources, techniques and methodologies used in animal research and biotechnology as well as experimental design, model assessment, and data interpretation with application to an experimental setting in the laboratory. 3 lectures, 2 laboratories. Prerequisite: BIO 161, BIO 162, upper division genetics course or consent of instructor.

ASCI 405 Domestic Livestock Endocrinology (4)
Endocrine system and its role in the homeostasis of the animal. Use of hormones in increasing productivity of domestic animals. Endocrinology of reproduction, growth, metabolism and immunology. Discussions of cost-benefit relationships in the use of hormones. 4 lectures. Prerequisite: VS 223, ASCI 220.

ASCI 406 Applied Animal Embryology (5)
Technology of promoting oocyte development, fertilization, culturing, cryopreservation and micromanipulation of embryos. Mouse, cattle and horse embryos used for learning the techniques involved in embryology. 3 lectures, 2 laboratories. Prerequisite: VS 223, ASCI 351 recommended.

ASCI 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, ASCI 351, VS 223 and senior standing.

ASCI 415 HACCP for Meat and Poultry Operations (3)
Using Hazard Analysis and Critical Control Point (HACCP) principles to develop regulatory inspection plans for meat and poultry operations; development and use of prerequisite programs; microbiological and process overviews. 3 lectures. Prerequisite: ASCI 209 or ASCI 211; ASCI 384 or PM 325, or consent of instructor.

ASCI 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: ASCI 220 and CHEM 212/312 (or CHEM 216/316 and CHEM 217/317).

ASCI 425 Meat Industry Study Tour (2)
Study tour of commercial meat businesses. Livestock harvest and carcass fabrication, further meat processing, retail and food service operations. Personnel, processing procedures, regulatory standards, industry specifications and current issues. Travel for 4 days. 2 activities. Prerequisite: ASCI 384 or consent of instructor.

ASCI 450 Computer Applications in Animal Science: Spreadsheet Analysis (4)
Development of spreadsheets relating to livestock production. Integration of database and analytical techniques. Cost-benefit analyses of livestock production systems. 2 lectures, 2 activities. Prerequisite: AG 250, CSC 110, or consent of instructor.

ASCI 461 Senior Project Planning (1)
Evaluation of project options and expectations. Selection of a project and an appropriate advisor. Projects selected in the student's expected field of employment. Outline and literature review will be presented as part of the ASCI 462 final report. 1 seminar. Prerequisite: Junior standing.

ASCI 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.

ASCI 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. Prerequisite: Senior standing and ASCI 462.

ASCI 470 Selected Advanced Topics (1–4)
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 8 units. 1 to 4 lectures. Prerequisite: Consent of instructor.

ASCI 471 Selected Advanced Laboratory (1–4)
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 8 units. 1 to 4 laboratories. Prerequisite: Consent of instructor.

ASCI 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.

ASCI 485 Cooperative Education Experience in Animal Science (6) (CR/NC)
Part-time work experience with an approved Animal Science firm engaged in production or related business, industry or governmental agency. 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. Degree credit limited
to 6 units. Credit/No Credit grading only. Prerequisite: Sophomore standing and consent of instructor.

ASTR 112 Introduction to the Stars and Galaxies (4) GE B3 & B4
Descriptive astronomical properties of the Sun, stars, galaxies and interstellar material. Exploration of cosmological models of an expanding universe. Laboratory activities include real and virtual astronomical viewing and experiments. Not open to students who have completed or are taking ASTR 102, ASTR 301, ASTR 302, or PHYS 132. ASTR 101 is not a prerequisite. 3 lectures, 1 activity.

ASTR 301 The Solar System (3)
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)
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 326 Relativity and Cosmology (3)
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.

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 111 General Biology (4) GE B2 & B4
Principles of cellular biology, heredity, ecology, biological diversity, and evolution, with emphasis on their relationships to human affairs. A Saturday field trip may be required. Not open to students who have completed BIO 115 or BIO 161. 3 lectures, 1 laboratory.

BIO 112 Environmental Biology and Conservation (4) GE B5
A biologically centered exploration of our planet focusing on natural resource conservation and contemporary environmental issues. Interactions between components of the biosphere and impacts of human society on interrelationships within ecosystems. Trends in natural resource conservation and biodiversity preservation. 4 lectures.

BIO 113 Animal Diversity and Ecology (4) GE B2 & B4
Animal diversity and ecology in aquatic and terrestrial communities including structural and functional adaptations of animals to their environment. Identification of common invertebrate and vertebrate animals. Field experience in local ecosystems. Saturday field trips. 2 lectures, 2 laboratories.

BIO 114 Plant Diversity and Ecology (4) GE B2 & B4
Plant diversity and ecology in aquatic and terrestrial plant communities including adaptations of plants to their environment. Identification of common, local native plants and plant communities, uses of native plants by Native Americans, and human impacts on native plant communities. Saturday field trips. 2 lectures, 2 laboratories.

BIO 115 Animal/Human Structure and Function (4) GE B2 & B4
Survey of the structure and function of animal cells, tissues, organs, and organ systems, with examples drawn from vertebrates and invertebrates; emphasis will be on vertebrates, especially the human. Not open to students who have completed BIO 153 or BIO 162. 3 lectures, 1 laboratory. Recommended prerequisite: a course in chemistry.

BIO 151 Introduction to Biology (5) GE B2 & B4
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. Final term: Summer 2005.

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. Final term: Summer 2005.
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. Final term: Summer 2005.

BIO 160  Diversity and the History of Life (4)
Overview of the history, diversity and genetic relatedness of life on Earth; broad-scale evolutionary framework of the organization and expansion of life on Earth. 2 lectures, 2 laboratories.

BIO 161  Introduction to Cell and Molecular Biology (4) GE B2 & B4
Fundamentals of cellular biology with an emphasis on the molecular perspective of life: metabolism, photosynthesis, cell structure and reproduction, meiosis, immunology, classical and molecular genetics, gene regulation. 3 lectures, 1 laboratory. Recommended prerequisite: BIO 160 and one college-level introductory chemistry course.

BIO 162  Introduction to Organismal Form and Function (5)
Fundamentals of the structure and physiology of cells, tissues, and organs of higher plants and animals: energy acquisition and food distribution, gas exchange and fluid transport, and sensing and responding to the environment. 3 lectures, 2 laboratories. Prerequisite: BIO 161 or consent of instructor. Recommended: One college-level introductory chemistry course.

BIO 200  Special Problems for Undergraduates (1-2)
Individual investigation, research, studies or surveys of selected problems. Intended for lower division students in the Biological Sciences Department. Total credit limited to 4 units, with a maximum of 2 units per quarter. Credit does not apply to any concentration in the Biological Sciences Department. 1-2 laboratories. Prerequisite: Consent of department chair.

BIO 213  Life Science for Engineers (2) GE B2
Fundamentals of life sciences: energetics, cell biology, molecular and classical genetics, microbiology, organisal biology, and ecology. For engineering students only. 2 lectures. Prerequisite: MATH 142 and CHEM 124. Co-requisite: ENGR/BRAE 213.

BIO 227  Wildlife Conservation Biology (4) GE B2

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 course in college biology.

BIO 263  Introductory Ecology and Evolution (4)
Basic concepts in ecology and evolution. Relationships among organisms in populations, communities and ecosystems, structures and dynamics of populations, communities and ecosystems, ecosystem inputs and energy flows, nutrient cycling, biogeography, population genetics, evolution, patterns of biodiversity and issues in conservation biology. 3 lectures, 1 laboratory. Prerequisite: BIO 161 or consent of instructor. Recommended: BIO 160 and BIO 162.

BIO 301  Environmental Science and Human Ecology (4)
Introduction to natural processes regulating renewable and non-renewable physical, chemical, and biological resources. Human population ecology and the influence and interactions of human populations on/with physical, chemical, and non-human biological resources. Principles of management, environmental science, and conservation biology that lead to equilibrium or self-sustaining conditions. 4 lectures. Prerequisite: BIO 160, 162.

BIO 302  Human Genetics (4) GE B5
Basic principles of human inheritance, including the transmission of genetic traits, chromosomal abnormalities and their effects, gene structure and function, mutations and mutagenic agents, cancer genetics, population genetics, and principles of genetic counseling. 4 lectures. Prerequisite: one course from GE Area B1 (Recommended: STAT 217 or STAT 218), and one course from GE Area B2.

BIO 303  Survey of Genetics (4)
Principles of heredity and variation, including transmission, population and quantitative genetics; introduction to molecular mechanisms of inheritance. 4 lectures. Prerequisite: One quarter of college biology. Recommended: STAT 218 or equivalent.

BIO 305  Biology of Cancer (4) GE B5
Introduction to the causes, characteristics and treatment of human cancer. Topics include effects of carcinogens and radiation; the genetics of cancer; molecular, cellular and physiological changes in common cancers; conventional chemotherapy and new treatments. Not open for major credit in Biological Sciences, Microbiology or Biochemistry. 4 lectures. Prerequisite: A college-level course in biology and junior standing.

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: Two of the following: BIO 113, BIO 114, BIO 115.

BIO 307  World Aquaculture: Applications, Methodologies and Trends (4) GE Area F
Life histories and habitats of important species of fishes, invertebrates. Methodologies for the commercial propagation of specific forms. Global and regional coverage, including socioeconomic trends, controversies and applications in developed and less developed regions of the world. 3 lectures, 1 activity. Prerequisite: One course in biology (BIO, ZOO, BOT or MCRO prefix), completion of GE Area B, and junior standing. Not open for major credit in Biological Sciences (or Ecology and Systematic Biology majors on prior catalogs).

BIO 317  The World of Spatial Data and Geographic Information Technology (4) GE Area F
Basic foundation for understanding the world through geographic information and the tools available to utilize spatial data. Application of Geographic Information Systems (GIS) and related technologies, including their scientific basis of operation. 3 lectures, 1 activity. Prerequisite: Any CSC course, completion of GE Area B, and junior standing.

BIO 325  General Ecology (4)
Relationships between organisms and their physical, chemical, and biological environment in terrestrial and aquatic habitats. Laboratory emphasis on field studies. Occasional field experiences may require participation during non-scheduled times. 3 lectures, 1 laboratory. Prerequisite: BIO 160, BIO 162, and BIO 263, or consent of instructor.

BIO 327  Wildlife Biology Methods (5)
Methods for gathering information for management of wildlife. Use of the literature, inventory of plants and animal populations, use of maps, sexing and aging, trapping, handling, and marking techniques, physiological indices, and radio telemetry. 3 lectures, 2 laboratories. Prerequisite: BIO 325 or equivalent.

BIO 328  Marine Biology (5)
Introduction to the functional biology of marine plants and animals and the processes that underlie their distribution and abundance in open oceans, coastal regions, estuaries, and wetlands. 3 lectures, 2 laboratories. Several field trips. Prerequisite: BIO 160, BIO 162, BIO 263.

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 343 Principles of Systematic Biology (4)
Introduction to the concepts, methods, and data used to define and recognize the units of biological diversity, including a survey of various types of molecular and morphological data and computer programs used in their analysis. 3 lectures, 1 laboratory. Prerequisite: BIO 160, BIO 162, BIO 263, BIO 351 and STAT 218 or equivalent.

BIO 351 Principles of Genetics (5)
Principles of genetics and genetic analysis, including underlying molecular mechanisms. Subjects include gene structure and function, inheritance patterns, regulation of gene expression, mutation, recombination, recombinant DNA technology, and an introduction to population genetics. 5 lectures. Prerequisite: BIO 161 and CHEM 312 or CHEM 316. Recommended: BIO 263 and STAT 218.

BIO 361 Principles of Physiology (4)
Fundamental principles of general and organs systems physiology, including composition and concentration of cellular and other body fluids, categories of movement (e.g., diffusion, membrane transporters), energy (thermodynamics, metabolic), enzymes, and membrane potentials with application to whole organisms. Introduction to physiological measurement techniques. 2 lectures, 2 laboratories. Prerequisite: BIO 162, and CHEM 312 or CHEM 316.

BIO 375 Molecular Biology Laboratory (2)
(Also listed as CHEM 375)
Techniques used in molecular biology and biotechnology, plasmid DNA extraction, agarose gel electrophoresis, restriction endonuclease mapping, transduction, transformation, and gene cloning. 2 laboratories. Prerequisite: BIO 161, and BIO 351 or CHEM 373.

BIO 391 Field Quarter I – Field Ecology (4)
Field studies of terrestrial and aquatic ecosystems of California. Investigation of habitat diversity, environmental factors, composition and functional biology, and seasonal progression of animal and plant communities. Several extended field trips. 2 lectures, 2 laboratories. Prerequisite: BIO 160, BIO 162, BIO 263 and BIO 325; corequisite: BIO 392, BIO 393, BIO 400 (2 units).

BIO 392 Field Quarter II – Field Botany (4)
Terrestrial and aquatic plant communities of California. Field identification of native and introduced plants in nature. Factors affecting plant distribution and relationships. Several extended field trips. 2 lectures, 2 laboratories. Prerequisite: BIO 160, BIO 162, BIO 263 and BIO 325; corequisite: BIO 391, BIO 393, BIO 400 (2 units); recommended: BOT 313. Students completing BIO 392 will not be able to receive degree credit for BOT 433 as well.

BIO 393 Field Quarter III – Field Zoology (4)
Terrestrial and aquatic animal communities of California. Natural history, population and community ecology, and identification of vertebrates and invertebrates. Determinants of animal distribution. Major mechanisms determining diversity. Several extended field trips. 2 lectures, 2 laboratories. Prerequisite: BIO 160, BIO 162, BIO 263 and BIO 325; corequisite: BIO 391, BIO 392, BIO 400 (2 units).

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. 1-2 laboratories. Prerequisite: Consent of department chair.

BIO 405 Developmental Biology (5)
Events and mechanisms of embryonic development, including fertilization, morphogenesis, cell differentiation, and organogenesis, with emphasis on differential gene expression in model organisms. 3 lectures, 2 laboratories. Prerequisite: BIO 162, and BIO 303 or BIO 351.

BIO 414 Evolution (4)
Scientific evaluation of the theories, mechanisms, and patterns of biological evolution. 4 lectures. Prerequisite: BIO 263 or equivalent, and BIO 303 or BIO 351. Recommended: BIO 325 or equivalent.

BIO 415 Biogeography (4)
Plant and animal distribution patterns in relation to past and present physical and biotic factors; survey of major biomes with major emphasis on North and South America. 4 lectures. Prerequisite: BIO 263.

BIO 418 Limnology (4)
Biological, physical, and chemical dynamics of aquatic systems surrounded by land including lakes, streams, and estuaries. 3 lectures, 1 laboratory. Prerequisite: BIO 325. Recommended: One college level course in chemistry.

BIO 419 Ecological Methodology (4)
Introduction to quantitative methods used in ecology with an emphasis on the design and analysis of field studies. Population estimates, sampling design and analysis, and the determination of community structure. 4 lectures, 3 seminars, 1 activity. Prerequisite: STAT 218 or equivalent. Recommended: BIO 263, BIO 325 or BOT 326, or consent of instructor. Change effective Fall 2006.

BIO 421 Wetlands (4)
(Also listed as FNR/SS 421)
The formation, characteristics, and functions of wetlands. Genesis of hydric soils. Plant adaptations to saturated soils. Wetlands as wildlife habitat. Policies and social issues associated with wetlands. The procedures of wetland delineations. 3 lectures, 1 laboratory. Prerequisite: CHEM 128, BOT 313, SS 321.

BIO 424 Organizing and Teaching Life Sciences (4)
Objectives, content, techniques, material, and recent trends of successful instruction in secondary school biology, including strategies for English language learners (ELL) and special needs students. 4 lectures. Prerequisite: Consent of instructor.

BIO 427 Wildlife Management (4)
Important habitats, such as riparian, wetlands, and habitat features important to wildlife, such as vegetation types and snags. Basic concepts of wildlife management. Emphasis on planning and designing habitats to meet the needs of wildlife. 3 lectures, 1 laboratory. Prerequisite: BIO 325 or equivalent.

BIO 432 Vertebrate/Human Anatomy and Physiology I (5)
Anatomy and physiology of the skeletal, muscular, nervous (central and peripheral) systems, and sense organs of vertebrates, with an emphasis on human systems. Not open to students with credit in ZOO 331. 3 lectures, 2 laboratories. Prerequisite: BIO 361 or consent of instructor.

BIO 433 Vertebrate/Human Anatomy and Physiology II (5)
Anatomy and physiology of the digestive, circulatory, urinary, endocrine, and reproductive systems, with an emphasis on human systems. Not open to students with credit in ZOO 332. 3 lectures, 2 laboratories. Prerequisite: BIO 361 or consent of instructor.

BIO 434 Environmental Physiology (4)
Comparative physiological mechanisms involved in the regulation of oxygen uptake, water and ion balance, and temperature regulation in animals. Emphasis is placed on physiological adaptations which maintain or restore homeostasis in animals which are subjected to environmental changes. 3 lectures, 1 laboratory. Prerequisite: BIO 162, CHEM 312 or CHEM 316. Recommended: BIO 325 and BIO 361.

BIO 435 Plant Physiology (4)
Consideration of the principal physiological and biochemical processes of plants with emphasis on water relations, mineral nutrition, photosynthesis, and the physiology of plant development. 3 lectures, 1 laboratory. Prerequisite: BOT 121 or BIO 162; recommended: CHEM 312 or CHEM 316.

BIO 437 Marine Resources (4)
Biology of historical, current, and potential marine resources including both technical means used to harvest and biological factors important in achieving a sustainable yield. Identification, life histories, ecology, culture, and economics of pertinent organisms. 3 lectures, 1 laboratory. Prerequisite: BIO 160, BIO 162, and BIO 263 or consent of instructor.
BIO 438 Aquaculture (4)
Propagation and rearing of fishes, invertebrates and algae from marine, freshwater, and estuarine habitats. Current methodologies and general life histories. Global perspective including aquacultural development in developed and developing countries. 3 lectures, 1 laboratory. Prerequisite: BIO 160, BIO 162, and BIO 263 or consent of instructor.

BIO 444 Population Ecology (3)
Growth, fluctuations, balance, and natural mechanisms controlling terrestrial wildlife populations. 3 lectures. Prerequisite: BIO 325 or equivalent.

BIO 447 Bioinformatics Applications (4)
Introduction to new problems in molecular biology and current computer applications for genetic database analyses. Use of software for: nucleic acid, genome and protein sequence analysis; genetic databases, database tools; industrial applications in bioinformatics; ethical and societal concerns. 3 lectures, 1 laboratory. Prerequisite: One course in college biology (BIO 111 or BIO 161 recommended). Recommended: BIO 303, BIO 351 or CHEM 373.

BIO 450 Undergraduate Laboratory Assistantship (1–4) (CR/NC)
Assisting the instructor in teaching and supervising undergraduate laboratories in the Biological Sciences Department. Total credit limited to 8 units, with a maximum of 4 units per quarter. Credit/No Credit grading only. Prerequisite: Consent of instructor and department chair.

BIO 452 Cell Biology (4)
Introduction to cell structure and function, energy conversions, protein sorting, signaling, cytoskeleton, cell adhesion, and the cell cycle. 3 lectures, 1 laboratory. Prerequisite: BIO 351 or CHEM 373 and CHEM 312 or CHEM 317. Recommended: Course in biochemistry.

BIO 461, 462 Senior Project I, II (3) (2)
Projects are selected from typical problems which graduates may meet in areas of their future employment. Results are presented in written reports. BIO 461: 3 laboratories. BIO 462: 2 laboratories.

BIO 470 Selected Advanced Topics (1–4)
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 8 units. 1 to 4 lectures. Prerequisite: Consent of instructor.

BIO 471 Selected Advanced Laboratory (1–4)
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 8 units. 1 to 4 laboratories. Prerequisite: Consent of instructor.

BIO 476 Gene Expression Laboratory (2) (Also listed as CHEM 476)
Heterologous gene expression of a recombinant protein in a microbial system: gene cloning, construction of expression plasmid, DNA sequence analysis, transformation of microbial host, selection and analysis of transformed host cells, expression and purification of recombinant protein. 2 laboratories. Prerequisite: BIO/CHEM 375, CHEM 313 or CHEM 371; MCRO 433.

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 3 units. 1-3 laboratories. Prerequisite: Graduate standing in Biological Sciences and consent of instructor.

BIO 501 Molecular and Cellular Biology (4)
Principles of molecular and cellular biology including gene function and regulation, energetics, protein trafficking, cytoskeleton, signaling, adhesion, and the cell cycle. 3 lectures, 1 laboratory. Prerequisite: Graduate standing in Biological Sciences or consent of instructor.

BIO 502 Biology of Organisms (4)
Principles of and current topics in organismal biology, with an emphasis on physiology (including organ systems), behavior, and responses to the environment. 3 lectures, 1 laboratory. Prerequisite: BIO 501 and graduate standing in Biological Sciences, or consent of instructor.

BIO 503 Population Biology (4)
Considerations of theory and practice in population ecology, evolutionary biology, and bioinformatics. 3 lectures, 1 laboratory. Prerequisite: Graduate standing in Biological Sciences or consent of instructor.

BIO 511 Trends in Biology (1) (CR/NC)
Recent trends in the field of biology for graduate students new to the Biological Sciences master's degree program. Overview of current faculty research to help students choose a thesis project and mentor. Credit/No Credit grading only. 1 activity. Prerequisite: Graduate standing in Biological Sciences or consent of instructor.

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

BIO 524 Developmental Biology (4)
Consideration of developmental phenomena and principles with an emphasis on the underlying cellular and molecular mechanisms. Focus on animals, both vertebrate and invertebrate. Topics include fertilization, gastrulation, axis determination, cell differentiation, and organ formation. 3 seminars, 1 activity. Prerequisite: Graduate standing in Biological Sciences or consent of instructor. Recommended: BIO 501 and BIO 502.

BIO 531 Theory and Prediction in Ecology (3)
Considerations of theory and practice in population ecology, evolutionary biology, and bioinformatics. 3 lectures, 1 laboratory. Prerequisite: Graduate standing in Biological Sciences or consent of instructor.

BIO 542 Multivariate Biometry (4)
Studies in continuous multivariate statistics, including the multivariate linear model, principal components and factor analysis, discriminant analysis, clustering, and canonical correlation. Use of MINITAB and SAS throughout. 4 lectures. Prerequisite: Two courses in statistics or consent of instructor.

BIO 570 Selected Topics in Biology (1–4)
Directed group study of selected topics for graduate students. Class Schedule will list topics for selection. Total credit limited to 12 units. 1 to 4 seminars. Prerequisite: Graduate standing in Biological Sciences or consent of instructor.

BIO 575 College Teaching Practicum (4) (CR/NC)
Part-time teaching assignment in an undergraduate college classroom. Includes teaching and related activities under the supervision of a professor in Biological Science. Total credit limited to 8 units. Credit/No Credit grading only. 4 activities. Prerequisite: Graduate standing and
evidence of satisfactory preparation in biology. Department chair and graduate coordinator's approval required.

**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 in Biological Sciences 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 activity. Prerequisite: Graduate standing in Biological Sciences 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 in Biological Sciences 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. 3 laboratories. Prerequisite: Graduate standing in Biological Sciences; consent of instructor, and consent of thesis committee.

**BMED–BIOMEDICAL ENGINEERING**

**see new courses**

**BOT–BOTANY**

**BOT 121  General Botany (4)**
GE B2 & B4
The anatomy, physiology, reproduction, and importance of seed plants. 2 lectures, 2 laboratories.

**BOT 221  California Plants and Plant Communities (4)
(Also listed as LA 221)**
Introduction to the horticultural characteristics and landscape design potential of California native plants, California plant communities, and associated vernacular plants. Includes experiences in field identification, basic planting design, installation techniques, and maintenance requirements. Required field trips. 2 lectures, 2 laboratories. Prerequisite: BIO 114 or BOT 121 or consent of instructor.

**BOT 238  Native Plant Materials (3)**
Classification, identification, and associations of native plants. Factors that affect plant growth in natural environments. 2 lectures, 1 laboratory. Prerequisite: BOT 121.

**BOT 313  Taxonomy of Vascular Plants (4)**
Introduction to classification and identification of vascular plants, emphasizing major plant families; field and herbarium techniques. 2 lectures, 2 laboratories. Prerequisite: BIO 162 or BOT 121.

**BOT 323  Plant Pathology (4)**
Comprehensive study of the causes and effects of disease in plants. Designed to lead to an understanding of the science and modern control methods. 2 lectures, 2 laboratories. Prerequisite: BIO 162 or BOT 121.

**BOT 324  Ornamental and Forest Pathology (4)**
Causes and effects of diseases of important ornamental and forest plants, disease agents (life cycle, host range, environmental relationships), and modern approach to control. 2 lectures, 2 laboratories. Prerequisite: BIO 162 or BOT 121.

**BOT 326  Plant Ecology (4)**
Plant communities, population dynamics, and effects of the following environmental factors on plant growth and development: soil, water, temperature, light, atmosphere, topography, organisms, and fire. 3 lectures, 1 laboratory. Prerequisite: BIO 114, BIO 162, or BOT 121.

**BOT 334  Morphology of Vascular Plants (4)**
Phylogenetic relationships of the plant kingdom as illustrated by comparative morphology of the vascular plants including living and fossil forms. 2 lectures, 2 laboratories. Prerequisite: BIO 160, BOT 162 and BOT 313.

**BOT 335  Plant Anatomy (4)**
Microscopic study of vascular plants dealing with the origin, development and structure of cells, tissues and organs. 2 lectures, 2 laboratories. Prerequisite: BIO 162 or BOT 121.

**BOT 431  Advanced Plant Pathology (4)**
Methods, instruments, and materials used in diagnosis of plant diseases and in plant disease research. 2 lectures, 2 laboratories. Prerequisite: BOT 323 or BOT 324.

**BOT 433  Field Botany (4)**
Field studies of California’s diverse vegetation and flora. Factors affecting the distribution of plants and plant communities and their ecological relationships. Identification of plants and plant communities in the field. Several field trips required including two weekend trips to California’s deserts and mountains. 2 lectures, 2 laboratories. Prerequisite: BOT 313 or consent of instructor.

**BOT 437  Phycology (4)**
Comprehensive examination of the ecology, life histories, functional morphology, physiology, and taxonomy of marine and freshwater algae. Laboratories emphasize species endemic to the central coast of California. 2 lectures, 2 laboratories. Prerequisite: BIO 162.

**BOT 450  Plant Biotechnology Laboratory (2)**
Application of genetic engineering technology to plants; methods of plant tissue culture and transformation. 2 laboratories. Prerequisite: BIO 303 or BIO 351 or CHEM 373.

**BRAE–BIORESOURCE and AGRICULTURAL ENGINEERING**

**BRAE 121  Agricultural Mechanics (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. 1 lecture, 1 laboratory.

**BRAE 124  Small Engines (2)**
Operating principles of the small internal combustion engine. Maintenance and trouble-shooting applications of small power units to all types of engine applications. Repair procedures related to economic justifications. 1 lecture, 1 activity.

**BRAE 128  Careers in Bioresource and Agricultural Engineering (2)**

**BRAE 129  Laboratory Skills and Safety (1)**
Introduction to fabrication and construction materials used in the field of Agricultural Engineering. Fabrication skills in the development of wood, metal, concrete projects, and creative design. Strength tests of wood, fasteners, concrete, and student design projects. 1 laboratory. Prerequisite: BRAE and ASM majors only.
BRAE 133  Engineering Design Graphics (2)
Visual communication in engineering design and problem solving. Principles of freehand sketching, engineering graphics, and computer-aided-drafting. Perspective and orthographic sketching, orthographic drawing with instruments and computer, applied descriptive geometry. 2 laboratories.

BRAE 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.

BRAE 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: BRAE 133 or equivalent.

BRAE 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. 3 lectures, 1 laboratory. Prerequisite: BRAE 128, MATH 119 or equivalent.

BRAE 151  CAD for Agricultural Engineering (1)
Computer aided drafting on a desktop personal 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: BRAE 133 or equivalent.

BRAE 152  3-D Solids Modeling (1)
Introduction to 3-dimensional solids modeling using state-of-the-art software. Model generation and modification of associative properties, assembly modeling, extrusions and revolutions. 1 laboratory. Prerequisite: BRAE 133, BRAE 151 or equivalent courses.

BRAE 200  Special Problems for Undergraduates (1–4)
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.

BRAE 201  Enterprise Project (1–4) (CR/NC)
Introductory experience in a bioresource/agricultural engineering or agricultural systems management project. Project participation is subject to approval by the department head and the Cal Poly Foundation. Credit/No Credit grading only. Prerequisite: BRAE 129 or consent of instructor.

BRAE 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 118 or equivalent.

BRAE 213  Bioengineering Fundamentals (2) (Also listed as ENGR 213)

BRAE 216  Fundamentals of Electricity (4)
Application of electricity in BioResource and Agricultural Engineering, including basic electric circuits. Will include wiring materials, code regulations, electrical measurements, R-L-C circuit fundamentals, system planning, motors, basic electronics, and an introduction to computer usage. 3 lectures, 1 laboratory. Prerequisite: BRAE 128, BRAE 129, MATH 142, PHYS 131.

BRAE 226  Introduction to Principles of Bioresource Engineering (4)
Introduction to principles of engineering as applied to biological and agricultural systems as found in industry. Engineering properties of conventional and biological materials. Introduction to basic unit processes in industrial, agricultural, and biological systems. Special requirements of agricultural and biological processes. 3 lectures, 1 laboratory. Prerequisite: BRAE 128, BRAE 129, PHYS 131; BIO 213 and BRAE 213 or ENGR 213, or MCRO 221.

BRAE 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: BRAE 129 or consent of instructor.

BRAE 232  Agricultural Structures Planning (4)
Planning of facilities required in production systems. Materials and processes used in construction of agricultural structures. Environmental factors affecting crop storage structures and animal housing. Design of structural environments to meet the needs of commodities, animals, and plants. 3 lectures, 1 laboratory. Prerequisite: BRAE 151, PHYS 132.

BRAE 234  Introduction to Mechanical Systems in Agriculture (4)
Introduction to elements used in the mechanical transmission of power and force in agricultural systems. Power transmission using v-belts. roller chain, gear and shaft drives, hydraulic actuators. Linear and nonlinear actuation devices including linkages, cams, and hydraulic/pneumatic cylinders. 3 lectures, 1 laboratory. Prerequisite: BRAE 128, BRAE 129, PHYS 131.

BRAE 236  Principles of Irrigation (4)
Land grading design, operation, management, and evaluation of irrigation methods. 3 lectures, 1 laboratory. Prerequisite: MATH 141, BRAE 239, SS 121, a computer programming course.

BRAE 237  Engineering Surveying I (2)
Use and care of tapes, levels, theodolites and Global Positioning System (GPS) receivers. Keeping field notes, measurements by tape. Differential leveling. Turning angles and determining directions of lines. GPS measurements. Map reading. Introduction to electronic distance measurement (EDM), photogrammetry, and land modeling. 1 lecture, 1 laboratory. Prerequisite: MATH 119 or an understanding of trigonometric functions.

BRAE 238  Engineering Surveying II (2)

BRAE 239  Engineering Surveying (4)
Use and care of tapes, levels, theodolites, Global Positioning system (GPS) receivers, Electronic Distance Measurement instruments (EDM) and electronic field books. Traverses, triangulation, trilateration, earthwork and associated calculations. Topographic mapping, photogrammetry, map reading and land descriptions. 2 lectures, 2 laboratories. Prerequisite: MATH 119 or equivalent.

BRAE 240  Agricultural Engineering Laboratory (1)
Individual projects. Total credit limited to 4 units. 1 laboratory. Prerequisite: Consent of instructor.

BRAE 247  Forest Surveying (2) (Also listed as FNR 247)
Use and care of tapes, staff compass, abney levels, theodolites, and GPS receivers. Keeping field notes, measurements by tape. Closed and open traverse by compass and theodolite. Turning angles and determining directions of lines. Map reading and public land description. GPS
BRAE 301 Hydraulic and Mechanical Power Systems (4)
Selection, application and use of hydraulic components and mechanical power transmission equipment. Use of standardized circuit design procedures. 3 lectures, 1 laboratory. Prerequisite: PHYS 121.

BRAE 302 Servo Hydraulics (4)
Application of microcomputers and programmable logic controllers to hydraulic, pneumatic and mechanical systems. Theory, instrumentation and sensors used in process and control systems used in agricultural equipment. 3 lectures, 1 laboratory. Prerequisite: BRAE 216 or BRAE 324 and BRAE 234 or BRAE 301.

BRAE 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.

BRAE 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. Safety program development. 2 lectures, 1 activity. Prerequisite: Junior standing.

BRAE 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 121.

BRAE 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 121, BRAE 142.

BRAE 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: BRAE 143, ME 211, ME 302. ME 302 may be taken concurrently.

BRAE 328 Measurements and Computer Interfacing (4)
Transducers and engineering measurements in agricultural engineering. Covering transducer characteristics, signal processors and controllers, instrumentation techniques, and the use of the computer in the measurement and control of typical engineering problems. 3 lectures, 1 laboratory. Prerequisite: PHYS 206, PHYS 256, a computer programming course.

BRAE 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. 3 lectures. Prerequisite: BRAE 236, or BRAE 340.

BRAE 335 Internal Combustion Engines (4)
Principles of operation of internal combustion engines. Theory of operation and diagnosis evaluation and repair of small engines, gasoline and diesel engines and economics of operation, use and repair. Power analysis and application. 3 lectures, 1 laboratory. Prerequisite: Junior standing.

BRAE 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.

BRAE 339 Internship in BioResource and Agricultural Engineering (1–12) (CR/NC)
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. Degree credit limited to 6 units. Credit/No Credit grading only. Prerequisite: Consent of internship instructor.

BRAE 340 Irrigation Water Management (4)  GE Area F
Soil-plant-water relationships; evapotranspiration; irrigation schedules; salinity and drainage; irrigation efficiency. Water measurement; soil moisture measurement; irrigation systems and practical constraints affecting scheduling. California water supply and budget; water rights; local, state and federal water institutions; California water issues. 3 lectures, 1 laboratory. Prerequisite: Junior standing, completion of GE Area A1, A3, and Area B, including Math 118 or better.

BRAE 342 Agricultural Materials (4)
Physical properties of agricultural materials and their measurement. Strength of materials, material flow and transport, material deformation, shape and size classification, moisture relationships and biological interactions. Interactions between agricultural materials, the environment and equipment used to handle them. 3 lectures, 1 laboratory. Prerequisite: PHYS 121, CHEM 110 or CHEM 111, SS 121.

BRAE 343 Mechanical Systems Analysis (4)
Use of statics and dynamics to make original calculations, plans, sketches, graphics, drawings, schemes and layouts for the fabrication and construction of machines. 3 lectures, 1 laboratory. Prerequisite: MATH 119, BRAE 203, BRAE 301 or concurrent. Junior standing.

BRAE 344 Fabrication Systems (4)
Fabrication systems including cutting, sawing, shearing, bending, welding, grinding, cleaning, painting and proper safety procedures. Experimental projects to include team design and construction, presentation, organization, and evaluation. 2 lectures, 2 laboratories. Prerequisite: BRAE 343.

BRAE 345 Aerial Photogrammetry and Remote Sensing (3)
Object recognition, three-dimensional equipment, and interpreta-tion of aerial photographs. Print alignment, stereoscopic viewing, scales, elevation determination, and application. Orthophotos and their relationship to Geographic Information Systems (GIS). Application of aerial photos to regional studies. 2 lectures, 1 laboratory. Prerequisite: MATH 119.

BRAE 348 Energy for a Sustainable Society (4)  GE Area F
Study of how the transition can be made from fossil fuels to renewable energy sources including hydro, biomass, solar, wind, and energy conservation. Environmental, economic, and political consequences of a renewable energy-based sustainable society. 3 lectures, 1 activity. Prerequisite: Completion of GE Area B and junior standing.

BRAE 400 Special Problems for Advanced Undergraduates (1–4)
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.

BRAE 401 Enterprise Project Management (1–4) (CR/NC)
Advanced experience in a bioresource/agricultural engineering or agricultural systems management project. Project leadership and management are stressed. Project participation is subject to approval by the department head and the Cal Poly Foundation. Credit/No Credit grading only. Prerequisite: BRAE 201 or consent of instructor.

BRAE 403 Agricultural Systems Engineering (4)
Engineering and economic 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. Professional responsibilities in Agricultural Engineering including ethics, patents, copyrights, liability. 3
lectures, 1 laboratory. Prerequisite: ECON 201/211, MATH 242 or MATH 244.

**BRAE 405 Chemigation (1)**
Fertilizer and chemical injection through irrigation systems. Hardware, fertilizer compounds, and distribution uniformity. Matching chemicals and equipment to specific irrigation methods. Safety. 1 laboratory. Prerequisite: BRAE 236 or BRAE 340.

**BRAE 414 Irrigation Engineering (4)**
Design of on-farm irrigation system; micro, surface, and sprinkler irrigation systems; canals and pumps; economic and strategies of pipe design; pipeline protection. 3 lectures, 1 laboratory. Prerequisite: BRAE 331 or BRAE 340; hydraulics.

**BRAE 415 Hydrology (4)**
Collection, organization and use of precipitation and runoff data, flood frequency, stream gauging and use of hydrograph, principles of groundwater and flood routing, sizing and economics of soil and water conservation structures. 3 lectures, 1 laboratory. Prerequisite: Junior standing, MATH 141, and SS 121 or consent of instructor.

**BRAE 418, 419 Agricultural Systems Management I, II (4) (4)**
Project management of agricultural systems. Emphasis placed on a team approach to problem solution. Case studies and student projects used to explore the following topics: project leadership, project organization, communication, needs assessment, feasibility studies, cost analysis, decision making, solution implementation, and evaluation. BRAE 418: 3 lectures, 1 laboratory. BRAE 419: 2 lectures, 2 laboratories. Prerequisite: BRAE 203, AGB 301, AGB 310 and ENGL 148. For BRAE 419: BRAE 418.

**BRAE 421 Equipment Engineering (3)**
Design and construction of specialized agricultural components and equipment. 2 lectures, 1 laboratory. Prerequisite: BRAE 328, CE 205, ME 212.

**BRAE 422 Equipment Engineering (4)**
Design and construction of specialized agricultural components and equipment. 2 lectures, 2 laboratories. Prerequisite: BRAE 421.

**BRAE 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: BRAE 324, CSC 110 or CSC 119 or AG 250 or CSC 232.

**BRAE 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: BRAE 312, BRAE 430, ME 302.

**BRAE 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 or MATH 244, ME 302.

**BRAE 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 121, BRAE 342, BRAE 343.

**BRAE 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: BRAE 232, CE 205.

**BRAE 435 Drainage (4)**
Relevant principles of hydrology and porous media flow. Flow nets, wells and ground water, design of simple surface and sub-surface drains. 3 lectures, 1 laboratory. Prerequisite: Junior standing, BRAE 312, BRAE 331, or BRAE 340 or SS 432 and consent of instructor.

**BRAE 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: BRAE 312, BRAE 415, SS 121, or consent of instructor.

**BRAE 438 Drip/Micro Irrigation (4)**
Drip/micro irrigation hardware and management. Emphasizes agricultural drip/micro irrigation with some landscape application. Filtration, emitters, chemical injection, agronomic constraints, and scheduling. Field trip(s) included. 3 lectures, 1 laboratory. Prerequisite: BRAE 236 or BRAE 340.

**BRAE 439 Vineyard Water Management (4)**
Management of rain and irrigation water in vineyards. Irrigation scheduling, managing water stress, climate control with irrigation methods commonly used. Management for wine, table grapes, and raisins. 3 lectures, 1 laboratory. Prerequisite: BRAE 340 or BRAE 236.

**BRAE 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. 3 lectures, 1 laboratory. Prerequisite: BRAE 340 or consent of instructor.

**BRAE 446 CAD Software for Land Modeling (2)**
Techniques for preparing data for geographic information systems using TERRAMODEL. Digital data from surveying, orthophotography, and government data sources will be entered, displayed, edited and translated for use in other software packages. Transformation of coordinate systems. Earthwork and hydrologic examples. 1 lecture, 1 laboratory. Prerequisite: BRAE 239.

**BRAE 447 Advanced Surveying with GIS Applications (4)**
Collecting field data; processing the data; generating graphical representation of the data; design based on the data and laying out the design in the field; and available record resources for use in GIS systems and their accuracy. 2 lectures, 2 laboratories. Prerequisite: BRAE 239.

**BRAE 448 Biodeversion (4)**
Biological, thermal and physical techniques for converting biomass into useful energy forms for agriculture and industry. Laboratory exercises include experiments with anaerobic digestion of animal wastes into methane, ethanol fermentation of grains and composting of agricultural residues. Technical and economic feasibility of biofuels. 3 lectures, 1 laboratory. Prerequisite: MATH 118 (or MATH 116 and MATH 117) or equivalent, or consent of instructor.

**BRAE 452 Legal Aspects/Data Accuracy for GIS (3)**
Research of boundary descriptions, record maps, and existing survey data. Value and implications of the data. Local and state requirements and restrictions on use of data. Procedures for incorporation of data into Arc/Info. 2 lectures, 1 laboratory. Prerequisite: BRAE 237 or BRAE 239.

**BRAE 460 Senior Project Organization (1)**
Selection and organization of senior project. Involves time management, research techniques, budgeting and project presentation. 1 lecture. Prerequisite: For BRAE majors: ENGL 149; for ASM majors: ENGL 148; junior standing.

**BRAE 461, 462 Senior Project I, II (2) (2)**
Solution of an engineering or systems management problem in agriculture. May involve research methodology, problem statement, analysis, synthesis, project design, construction, and evaluation. Project requires 150 hours with a minimum of faculty supervision. Prerequisite: BRAE 460.
BRAE 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.

BRAE 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.

BRAE 470 Selected Advanced Topics (1–4)
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 8 units. 1–4 lectures. Prerequisite: Consent of instructor.

BRAE 471 Selected Advanced Laboratory (1–4)
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 8 units. 1–4 laboratories. Prerequisite: Consent of instructor.

BRAE 481 Advanced Agricultural Mechanics (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.

BRAE 485 Cooperative Education Experience in BioResource and Agricultural Engineering (6) (CR/NC)
Part-time work experience with an approved BioResource and Agricultural Engineering firm engaged in production or related business, industry or governmental agency. 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. Degree credit limited to 6 units. Credit/No Credit grading only. Prerequisite: Sophomore standing and consent of instructor.

BRAE 495 Cooperative Education Experience in BioResource and Agricultural Engineering (12) (CR/NC)
Full time work experience with an approved BioResource and Agricultural Engineering firm engaged in production or related business, industry or governmental agency. 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. Degree credit limited to 6 units. Credit/No Credit grading only. Prerequisite: Sophomore standing and consent of instructor.

BRAE 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. Total credit limited to 6 units, repeatable in same term. Prerequisite: Consent of instructor.

BRAE 521 Systems Analysis of Agricultural Systems (4)
Principles and methods of creative problem solving and systems analysis as applied to the design of agricultural systems. Problem solving using the engineering design process to analyze the need, establish boundaries, and generate creative alternative solutions. Examples worked through in feasibility analysis, transportation and network problems, linear programming, project planning, human factors and ergonomics, and system analysis with an emphasis on optimum system operation. 3 lectures, 1 laboratory. Prerequisite: Consent of instructor.

BRAE 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.

BRAE 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: BRAE 143 or equivalent, graduate standing, or consent of instructor.

BRAE 532 Water Wells and Pumps (4)
Water well drilling, design, and development. Pump characteristics and system head. Series and parallel operation. Design of pump intakes. Variable speed electric drives and engines. Pump testing. 3 lectures, 1 laboratory. Prerequisite: BRAE 340 or equivalent, or BRAE 312 or equivalent.

BRAE 533 Irrigation Project Design (4)
Engineering solutions and social aspects of improved water delivery to farms and canal automation. Flow measurement. Water user associations. Unsteady canal and pipeline controls. PID controls and modeling. Miscellaneous course fee required—see Class Schedule. 3 lectures, 1 laboratory. Prerequisite: BRAE 340, hydraulics/fluid mechanics.

BRAE 570 Selected Topics in BioResource and Agricultural Engineering (1–4)
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 12 units. 1 to 4 seminars. Prerequisite: Graduate standing or consent of instructor.

BRAE 571 Selected Advanced Laboratory in BioResource and Agricultural Engineering (1–4)
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 8 units. 1–4 laboratories. Prerequisite: Consent of instructor.

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

BRAE 599 Thesis in BioResource and Agricultural Engineering (1–9)
Systematic research of a significant problem in bioresource and agricultural engineering. 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.

BUS–BUSINESS

BUS 100 Study Skills Adjunct (2) (CR/NC)
Offered concurrently with BUS 101 to assist students in developing and improving their study skills, textbook comprehension, critical analysis, application and retention of the subject matter presented in the specific content course. Credit/No Credit grading only. 1 lecture, 1 activity.

BUS 178 Introduction to Human Relations in Business (3)
Small group dynamics, leadership, communication, motivation, and perception. The individual in the business organization. For non-Business majors. 3 lectures.

BUS 200 Special Problems for Undergraduates (1–4)
Individual investigation, research, studies, or surveys of selected problems. Total credit limited to 4 units. Prerequisite: Consent of area coordinator.