PLANT AND ENVIRONMENTAL SCIENCES

Undergraduate Program Information

The undergraduate program in Plant and Environmental Science prepares you for a variety of careers in agriculture and related fields. Accordingly, a flexible curriculum has been designed that will allow specific programs to be developed in consultation with your academic advisor. Programs may also be developed if you wish to prepare for advanced studies in graduate school. In addition to the courses listed for each major, 35 credits must be taken in the College of Agricultural, Consumer and Environmental Sciences, and the university general education requirements must be met.

The minors require a minimum of 18 credits of which at least 9 hours must be at the 300 or higher level. Specific coursework requirements apply. See advisor for course requirements and scheduling.

Graduate Program Information

More than ever, we are linked in an interconnected world: both in agriculture and sustainability of environmental systems. The department has programs in

- plant sciences,
- environmental science,
- soil science,
- water management,
- natural resources management and
- turf management.

Students trained in these areas are in demand for U.S. and international positions. This demand is at all levels of training—BS, MS, and Ph.D. Therefore, the course work and original research in Plant and Environmental Sciences leading to the Master of Science and Doctor of Philosophy are designed for and have proven to be successful in preparing students for commercial companies, educational institutions, governmental agencies and private production enterprises.

The student may emphasize study in several discipline areas described in the following pages.

- The agronomy section emphasizes sustainable crop production, plant-pest/disease/weed interactions, soil-water-plant relations, crop physiology, and breeding and genetics of cotton, alfalfa, maize and peanuts.
- The genetics section places special emphasis on genetic basis of agronomic or horticultural traits, applied bioinformatics, gene regulation and genomics.
- The environmental and soil science sections emphasize environmental quality and ecosystem services, bioremediation, recycling of organic wastes and wastewater, water use efficiency, soil-plant relations, soil-geomorphology and desert ecology, and the fertility, chemistry, physics, and microbiology of soils, including forest soils.
- The horticulture section emphasizes the creative use of plants by humans, and studies on the technical advancements in the husbandry of most economic commodity groups of fruits, vegetables, or ornamentals as well as managed turf. Emphasis may be in breeding and genetics of chile or onions, plant growth and development, nutrition, dormancy and cold hardiness, plant stress (water and/or salinity) response, fruit and vegetable physiology, forestry, and turfgrass.

Most students will be expected to complete a thesis. The research detailed in a thesis should be of a scope and quality to merit publication in a refereed journal. Depending on prior training and experience, a non-thesis option is available subject to approval by a departmental committee. The non-thesis option requires completion of a research project and paper of limited scope. In both the thesis and non-thesis options, suitability of the research project and resulting thesis or paper will be judged by the student's graduate committee. A minor is recommended and may be taken in chemistry, biology, molecular biology, environmental management, applied statistics, toxicology or other areas.

Prerequisite to major graduate work is completion of a curriculum essentially equivalent to that required by the department for the BS degree at New Mexico State University.

Degrees for the Department

Bachelor Degree(s)

- Agronomy - Bachelor of Science in Agriculture
- Horticulture - Bachelor of Science in Agriculture
- Soil Science (Environment & Resource Management) - Bachelor of Science in Agriculture
- Soil Science (Soil & Water Science) - Bachelor of Science in Agriculture
- Soil Science (Soils) - Bachelor of Science in Agriculture
- Turfgrass Science and Management - Bachelor of Science in Agriculture
- Environmental Science - Bachelor of Science in Environmental Science
- Genetics and Biotechnology - Bachelor of Science in Genetics

Master Degree(s)

- Horticulture - Master of Science
- Plant and Environmental Science - Master of Science

Doctoral Degree(s)

- Plant and Environmental Science - Doctor of Philosophy
- Agronomy - Undergraduate Minor
- Environmental Science - Undergraduate Minor
- Genetics and Biotechnology - Undergraduate Minor
- Horticulture - Undergraduate Minor
- Soil Science - Undergraduate Minor
- Turfgrass Science and Management - Undergraduate Minor

Minors for the Department

- Agronomy - Undergraduate Minor
- Environmental Science - Undergraduate Minor
- Genetics and Biotechnology - Undergraduate Minor
- Horticulture - Undergraduate Minor
- Soil Science - Undergraduate Minor
- Turfgrass Science and Management - Undergraduate Minor

Regents Professor, Rolston St. Hilaire, Department Head

Professors Angadi, Cramer, Guldan, Hanan, Heerema, Leinauer, Marsalis, Piccioni, Pratt, Puppala, Ray, Shukla, Ulery, Zhang; Associate Professors Burney, Flynn, Goss, Grover, Holguin, Idowu, Lombard, Yao; Assistant
R. St. Hilaire, Department Head, Ph.D. (Iowa State University)—plant stress physiology and landscape horticulture; S. Angadi, Ph.D. (University of Manitoba, Canada)—crop physiology; D. L. Auld, Ph.D. (Montana State University)—plant genetics; W. Boeing, Ph.D. (Louisiana State University)—aquatic ecology; C. Brungard, Ph.D. (Utah State University, Logan)—pedology; O. Burney, Ph.D. (Purdue University, West Lafayette)—silviculture and forest biology; K. C. Carroll, Ph.D. (University of Arizona)—hydrology and water resources; C. S. Cramer, Ph.D. (North Carolina State University)—onion breeding and horticulture; M. Darapuneni, Ph.D. (Texas A&M, College Station)—Agronomy and semi-arid crop rotations; K. Djaman, Ph.D. (University of Nebraska-Lincoln)—soil & water resources and irrigation engineering; D. DuBois, Ph.D. (University of Nevada)—atmospheric science; B. Edwards, Ph.D. (Louisiana State University—geomorphology, Aeolian processes; R. Flynn, Ph.D. (Auburn University)—soil and water quality; R. Ghimire, Ph.D. (University of Wyoming, Laramie)—soil & crop management; R. Gioannini, M.S. (New Mexico State University)—ornamental horticulture, landscape design; R. M. Goss, Ph.D. (University of Nebraska, Lincoln)—turf science; K. Grover, Ph.D. (Pennsylvania State University)—agronomy; S. J. Guzman, Ph.D. (University of Minnesota)—sustainable agriculture; I. Guzman, Ph.D. (New Mexico State University)—horticulture; N. Hanan, Assistant Department Head, Ph.D. (Queen Mary College, UK)—dryland ecology; S. F. Hanson, Ph.D. (University of Wisconsin-Madison)—genetics and microbiology; R. J. Heerema, Ph.D. (University of California, Davis)—pecans; F. O. Holguin, Ph.D. (New Mexico State University)—biochemical analysis; J. Idowu, Ph.D. (Cranfield University, United Kingdom)—agronomy and land management; J. Jarvis, Ph.D. (Florida State University, Tallahassee)—chemical analysis, analytical instrumentation; B. Leinauer, Ph.D. (Hohenheim University, Germany)—turfgrass; K. Lombard, Ph.D. (New Mexico State University)—horticulture; M. Marsalis, Ph.D. (Texas Tech University)—forages; G. Niu, Ph.D. (Chiba University, Japan)—horticulture; G. A. Picchioni, Ph.D. (Texas A&M University)—plant-mineral relations; N. Pietrasiai, Ph.D. (University of California, Riverside)—soil and water relations; R. Pratt, Ph.D. (Purdue University)—plant breeding and genetics; N. Puppala, Ph.D. (New Mexico State University)—plant breeding and genetics; R. M. Ray, Ph.D. (University of Wisconsin-Madison)—alfalfa breeding and genetics; L. Rodriguez-Urueña, Ph.D. (New Mexico State University)—molecular genetics; D. Rucker, Ph.D. (University of Arizona)—hydrogeophysics; M. K. Shukla, Ph.D. (University of Agricultural Sciences, Vienna)—agronomy; environmental soil physics; B. Stringam, Ph.D. (Utah State University)—biological and agricultural engineering; C. Steele, Ph.D. (King’s College, University of London, United Kingdom)—range soils; M. Thompson, Ph.D. (New Mexico State University)—horticulture; A. L. Uleri, Ph.D. (University of California, Riverside)—environmental soil chemistry; S. J. Walker, Ph.D. (New Mexico State University)—horticulture; N. Webb Ph.D. (University of Queensland, Australia)—Aeolian processes, land degradation processes and rangeland management; S. Yao, Ph.D. (Cornell University)—plant biology and horticulture; J. Zhang, Ph.D. (University of Arkansas, Fayetteville)—cotton breeding, genetics, and genomics

Emeritus

P.W. Bosland, Ph.D. (University of Wisconsin, Madison)—chile breeding and genetics; J.G. Mexal, Ph.D. (Colorado State University)—plant physiology; M. O’Neill, Ph.D. (University of Arizona, Tucson)—agronomy and crop physiology

M.A. O’Connell, Ph.D. (Cornell University)—plant biochemistry and molecular genetics; C. Sengupta-Gopalan, Ph.D. (Ohio State University)—biochemical genetics

Agronomy Courses

AGRO 1110G. Introduction to Plant Science (Lecture & Lab) 4 Credits (3+2P)
This is an introductory course for understanding plant science. Basic biological, chemical, and physical principles of various plants are covered. The focus of this course is on plants/crops used in agriculture production of food and fiber as well as pasture and range plants. Plant taxonomy and soil properties will also be discussed. Same as HORT 1115G.

AGRO 2160. Plant Propagation 3 Credits (2+2P)
Practical methods of propagating horticultural plants by seed, cuttings, layering, grafting, division and tissue culture. Examination of relevant physiological processes involved with successful plant propagation techniques. Crosslisted with HORT 2160.

AGRO 2996. Special Topics 1-4 Credits (1-4)
Specific subjects and credits to be announced in the Schedule of Classes. Maximum of 4 credits per semester. No more than 9 credits toward a degree. May be repeated up to 9 credits. Consent of Instructor required.

AGRO 300. Special Topics 1-4 Credits (1-4)
Specific subjects and credits to be announced in the Schedule of Classes. Maximum of 4 credits per semester. No more than 9 credits toward a degree. May be repeated up to 9 credits. Consent of Instructor required. Restricted to Las Cruces campus only.

AGRO 303V. Genetics and Society 3 Credits (3)
Relates the science of genetics with social ramifications. Ways in which genetics and evolution interact with social, political, and economic issues. Includes genetic engineering, gene therapy, DNA finger-printing, ancient DNA, plant and animal improvement, and future prospects. Students required to formulate value judgments on contemporary biological issues that will impact society. Crosslisted with: GENE 303V.

AGRO 305. Principles of Genetics 3 Credits (3)
Covers fundamental principles of reproduction, variation, and heredity in plants and animals. Crosslisted with: ANSC 305, BIOL 305, HORT 305 and GENE 305.

Prerequisite(s): BIOL 2610G, BIOL 2110G and either CHEM 1215G or CHEM 1216.

AGRO 311. Introduction to Weed Science 4 Credits (4)
Principles of weed science with emphasis on characteristics of invasive plants, methods of integrated weed management, and current issues impacting weed management. Identification of local weeds. Same EPWS 311.

Prerequisite: junior standing or consent of instructor and CHEM 1215G and BIOL 2110G.
AGRO 315. Crop Physiology
3 Credits (3)
Whole plant physiological processes as related to growth, development, yield, quality and post harvest physiology of crop plants within the environment of the crop community. Crosslisted with: HORT 315
Prerequisite(s): EPWS/BIOL 314 or consent of instructor.

AGRO 365. Principles of Crop Production
4 Credits (3+3P)
Basic principles of crop production including environmental and physiological factors limiting production, plant nutrition and soil science, soil-water management, cropping systems and management, pest management, and economic factors influencing crop production. Crosslisted with: HORT 365
Prerequisite(s): AGRO 1110G/HORT 1115G, CHEM 1215G or equivalent and MATH 1215 or equivalent.

AGRO 377. Introduction to Turfgrass Management
4 Credits (3+3P)
Establishment and maintenance of turfgrass with emphasis on seeding methods, soil and water management, mowing, disease, insects and turfgrass varieties. Consent of instructor required. Crosslisted with: HORT 377

AGRO 391. Internship
1-6 Credits
Professional work experience under the joint supervision of the employer and a faculty member. A written report is required. No more than 6 credits toward a degree. Consent of instructor required. Graded: S/U Grading (S/ U, Audit).
Prerequisite(s): Consent of instructor.

AGRO 447. Seminar
1 Credit (1)
Organization, preparation, and presentation of current topics in agronomy, environmental sciences, horticulture, and soil science. Crosslisted with: HORT 447, ENVIS 447 and SOIL 447.

AGRO 449. Special Problems
1-3 Credits (1-3)
Research problem, experience training, or other special study approved by a faculty adviser. Maximum of 3 credits per semester and a grand total of 6 credits. May be repeated up to 6 credits. Consent of Instructor required.

AGRO 450. Special Topics
1-4 Credits (1-4)
Specific subjects to be announced in the Schedule of Classes. Maximum of 4 credits per semester and a total of 9 credits toward a degree. May be repeated up to 9 credits. Consent of Instructor required.

AGRO 462. Plant Breeding
3 Credits (3)
Principles and practices involved with the genetic improvement of plants. May be repeated up to 3 credits.
Prerequisite(s): ANSC/AGRO/BIOL/HORT/GENE 305 or GENE 315 and GENE 320.

AGRO 471. Plant Mineral Nutrition
3 Credits (3)
Basic and applied aspects of plant requirements for soil-derived minerals and the processes whereby minerals are acquired, absorbed, translocated, and utilized throughout the plant. Same as HORT 471 and EPWS 471.
Prerequisite: EPWS/BIOL 314, or concurrent enrollment, or consent of instructor.

AGRO 483. Sustainable Production of Agronomic Crops
4 Credits (3+2P)
Characteristics and objectives of sustainable agricultural systems with application to the production, utilization, and improvement of cereal grain, fiber, forage and oilseed crops.
Corequisite(s): AGRO 365/ HORT 365.

AGRO 492. Diagnosing Plant Disorders
3 Credits (2+3P)
Systematic diagnosis of the physiological, pathological, and entomological causes of plant disorders. Same as EPWS 492 and HORT 492.
Prerequisites: EPWS 303 and EPWS 310.

AGRO 500. Special Topics
1-4 Credits
Specific subjects and credits to be announced in the Schedule of Classes. Maximum of 4 credits per semester. No more than 9 credits toward a degree.

AGRO 505. Research Orientation
4 Credits (3+2P)
Training in writing research proposals, presentation of research results, and interpretation of research results. Crosslisted with: HORT 505, SOIL 505 and ENVIS 505.

AGRO 506. Plant Genetics
3 Credits (3)
Advanced treatment of the principles of classical genetics and heredity with emphasis on the nature and action of the gene including molecular analysis. May be repeated up to 3 credits. Crosslisted with: HORT 506. BCHE 341 recommended.
Prerequisite(s): AGRO 305/GENE 305/HORT 305/BIOL 305/ANSC 305 or consent of instructor.

AGRO 511. Introduction to Weed Science (f)
4 Credits (4)
Covers the principles of weed science with emphasis on characteristics of invasive plants, methods of integrated weed management, and current issues impacting weed management. Includes identification of local weeds. Research paper required for graduate credit. Same as EPWS 511.
Prerequisites: CHEM 1215G or BIOL 2110G, or consent of instructor.

AGRO 515. Crop Physiology
3 Credits (3)
Whole plant physiological processes as related to growth, development, yield, quality and post harvest physiology of crop plants within the environment of the crop community. Crosslisted with: HORT 515
Prerequisite(s): EPWS/BIOL 314 or consent of instructor.

AGRO 516. Molecular Analysis of Complex Traits
3 Credits (3)
Provide a comprehensive overview of molecular genetic analysis of complex phenotypes, including case histories/experiments in plants, animals and humans. Emphasize technological developments in DNA marker technologies and their application to molecular quantitative genetics. Explore the efficient application of these technologies in the future to complex genetic systems, breeding, and other areas of life sciences. Same as HORT 516.
Prerequisite: AGRO 305 or consent of instructor.
AGRO 525. Scientific Writing- How to be a Productive and Effective Writer
1-3 Credits (1-3)
Students will learn to improve their writing skills so that their manuscript preparation process is more efficient and productive. Students will also gain experience in peer-review. Crosslisted with: HORT 525, EPWS 525, SOIL 525, AGRO 625, HORT 625 and SOIL 625.

AGRO 590. Graduate Seminar
1 Credit (1)
Current research discussions presented by masters level graduate students. Not more than one credit toward the degree. Same as HORT/ SOIL 590. Crosslisted with: HORT 590 and SOIL 590.

AGRO 595. Internship
1-6 Credits
Supervised professional on-the-job learning experience. Limited to Master of Agriculture candidates. Not more than 6 credits toward the degree.

AGRO 596. Masters Proposal
1 Credit (1)
Current research proposal written by maters level graduate students. Consent of Instructor required. Crosslisted with: ENVS 596, GENE 596, HORT 596 and SOIL 596. Restricted to: Masters HORT; Masters PLEN majors.
Prerequisite(s): Master level graduate students.

AGRO 597. University Teaching Experience
1-3 Credits (1-3)
Certain graduate students will be permitted to teach up to one-third of one AGRO/HORT/SOIL/ES course. The student will prepare and deliver lectures and will prepare, administer, and grade at least one examination. The professor in charge of the course will attend and evaluate the student's lectures. Consent of instructor required. Restricted to: Main campus only. Restricted to Agronomy and Horticulture Graduate Students. Crosslisted with: HORT 597 and SOIL 597

AGRO 598. Special Research Programs
1-6 Credits
Individual investigations, either analytical or experimental. Maximum of 6 credits per semester. No more than 9 credits towards degree. Same as SOIL 598.

AGRO 599. Master's Thesis
15 Credits
Thesis.

AGRO 600. Doctoral Research
1-15 Credits
Research.

AGRO 609. Breeding for Plant Disease Resistance
3 Credits (3)
A practically-oriented course of lectures and discussion on concepts and principles of breeding for disease and pest resistance. Labs familiarize students with preparation, quantification, and application of inoculum to hosts. Same as HORT 609.

AGRO 610. Advanced Crop Breeding
4 Credits (3+3P)
Applications of breeding principles to crop improvement. Emphasis on breeding methodologies using modern techniques, including biotechnology. Same as HORT 610.
Prerequisite: AGRO 462 or consent of instructor.

AGRO 620. Instrumentation in Agronomy
3 Credits (3)
Use of instruments used in research in all areas of agronomy including gas chromatography, high performance liquid chromatography, neutron soil moisture probe, and other instruments. Same as HORT/SOIL 620.

AGRO 625. Scientific Writing- How to be a Productive and Effective Writer
1-3 Credits (1-3)
Students will learn to improve their writing skills so that their manuscript preparation process is more efficient and productive. Students will also gain experience in peer-review. Students in the 600-level course will be required to perform additional research than those students in the 500-level cross-listing Crosslisted with: AGRO 525, HORT 525, EPWS 525 and SOIL 525.

AGRO 670. Biometrical Genetics and Plant Breeding
3 Credits (3)
A statistical approach to gene action and population parameters as applied to plant improvement. Same as HORT 670.
Prerequisite: AGRO 462 or consent of instructor.

AGRO 694. Doctoral Seminar
1 Credit (1)
Current research discussions presented by doctoral level graduate students. Not more than 2 credits toward the degree. Same as SOIL 694.
Prerequisite: doctoral level graduate students.

AGRO 696. Doctoral Proposal
1 Credit (1)
Current research proposal written by doctoral level graduate students. Not more than 1 credits toward the degree. May be repeated up to 1 credits. Crosslisted with: ENVS 696, AGRO 696, HORT 696 and SOIL 696.
Prerequisite(s): Doctoral level graduate students.

AGRO 697. University Teaching Experience
1-3 Credits (1-3)
Certain graduate students will be permitted to teach up to one-third of one AGRO/HORT/SOIL/ENVS course. The student will prepare and deliver lectures and will prepare, administer, and grade at least one examination. The professor in charge of the course will attend and evaluate the student's lectures. Consent of instructor required. Crosslisted with: HORT 697 and SOIL 697

AGRO 698. Topics in Agronomy
1-6 Credits
Topics of current interest, designated by title and credit. Maximum of 6 credits per semester. No more than 9 credits toward a degree.

AGRO 700. Doctoral Dissertation
15 Credits
Dissertation.

Environmental Science Courses

ENVS 1110G. Environmental Science I
4 Credits (3+2P)
Introduction to environmental science as related to the protection, remediation, and sustainability of land, air, water, and food resources. Emphasis on the use of the scientific method and critical thinking skills in understanding environmental issues.
ENVS 2111. Environmental Engineering and Science
3 Credits (3)
Principles in environmental engineering and science: physical chemical systems and biological processes as applied to pollution control. Restricted to: Main campus, Alamogordo campus, Grants campus, Carlsbad campus. Crosslisted with: C E 256. Prerequisite(s): CHEM 1215G and MATH 1511G or higher

ENVS 2111L. Environmental Science Laboratory
1 Credit (1)
Laboratory experiments associated with the material presented in ENVS 2111. Same as C E 256 L. Corequisite(s): ENVS 2111.

ENVS 300. Special Topics
1-4 Credits
Special subjects and credits to be announced in the Schedule of Classes. Consent of instructor required. Maximum of 4 credits per semester. Restricted to majors.

ENVS 301. Principles of Ecology
3 Credits (3)
A survey of ecology including general theory, the adaptations of organisms, population dynamics, species interactions, and the structure and function of natural communities and ecosystems. Crosslisted with: BIOL 301. Prerequisite(s): BIOL 2610G, A ST 311, and grade of C or better in MATH 1511G or Math Placement Exam score adequate to enroll in mathematics courses beyond MATH 1511G.

ENVS 312. Emergency Response to Hazardous Material Incidents
2 Credits (2)
EPA approved Environmental Response Training Program Course 165.15. In compliance with OSHA 29 CFR 1910.120. Normally taken during last year of study. Same as E T 312 and WERC 312. Prerequisite: consent of instructor.

ENVS 361. Basic Toxicology
3 Credits (3)
Same as TOX 361. Prerequisite: CHEM 1120G or CHEM 1225G and BIOL 1190G.

ENVS 370. Environmental Soil Science
3 Credits (3)
Continuation of SOIL 2110 that emphasizes soil properties and processes that directly relate to environmental pollution problems. Same as SOIL 370. Prerequisite: SOIL 2110.

ENVS 391. Internship
3 Credits (3)
Professional work experience under the joint supervision of the employer and a faculty member. A written report is required. Maximum of 3 credits toward a degree. Consent of instructor required. Graded: S/U Grading (S/U, Audit).

ENVS 422. Environmental Chemistry
3 Credits (3)
Chemistry of organic and metal ion pollutants in the environment and principles important to their remediation including bioremediation. Restricted to: Main campus only. Crosslisted with: CHEM 422. Prerequisite(s): CHEM 1225G and either CHEM 2115 or CHEM 313.

ENVS 447. Seminar
1 Credit (1)
Organization, preparation, and presentation of current topics in agronomy, environmental sciences, horticulture, and soil science. Crosslisted with: AGRO 447, HORT 447 and SOIL 447.

ENVS 449. Special Problems
1-3 Credits
Research problem, experience training, or other special study approved by a faculty adviser. Maximum of 3 credits per semester and 6 credits toward a degree. May be repeated up to 6 credits. Consent of Instructor required. Restricted to: E S majors.

ENVS 451. Special Topics
1-4 Credits (1-4)
Specific subjects and credits to be announced in the Schedule of Classes. Maximum of 4 credits per semester and a total of 9 credits toward a degree. May be repeated up to 9 credits. Consent of Instructor required.

ENVS 452. Geohydrology
4 Credits (3+2P)
Origin, occurrence, and movement of fluids in porous media and assessment of aquifer characteristics. Development and conservation of ground water resources, design of well fields. Crosslisted with: C E 452 and GEOL 452.

ENVS 457. Water Measurement
3 Credits (3)
The fundamentals of measuring water will be covered. Participants will learn about measurement techniques that are used to estimate evapotranspiration as well as commonly used water measurement structures to estimate water use. The benefits and problems that are associated with using each measurement will be discussed. Students will also learn about the principles of how to use water measurement as a management tool. Prerequisite(s): MATH 1215 or higher, or consent of Instructor.

ENVS 460. Introduction to Air Pollution
3 Credits (3)
An introduction to the physics and chemistry of tropospheric air pollution including sources of air pollution, local and long-range transport, instrumentation, regulatory requirements, control technology. Prerequisite(s): PHYS 1310G, CHEM 1225G, MATH 1511G.

ENVS 462. Sampling and Analysis of Environmental Contaminants
3 Credits (1+6P)
Theory, application, methodology, and instrumentation used in the sampling and analysis of environmental contaminants. Same as ENVE 462. Prerequisites: ENVS 2111.
**ENVS 470. Environmental Impacts of Land Use and Contaminant Remediation**  
*3 Credits (3)*  
The course will cover the integrated assessment of soil erosion, contaminant transport in soil and water, and contaminant remediation from site scale to watershed scales. Understanding of the controlling factors for each type land use impact will be gained through the use of risk assessment, case studies, and computer modeling. Case studies will illustrate the processes under various environmental applications. This course will also cover the application of solute transport principles and methods for the remediation of contaminated soil and groundwater. It will also discuss the contaminated site characterization, monitoring, and remediation design. Discussions of innovative methodologies will be supported with case studies. May be repeated up to 3 credits. Crosslisted with: WSAM 470.  
**Prerequisite(s):** ENVS 2111, ENVS 370, ENVS 452, ENVS 462.

**ENVS 471. Water Quality and Geochemistry**  
*3 Credits (3)*  
We will cover the connection of water chemistry with water quality and apply geochemical modeling to practical problems. Discussions of assessment methodologies will be supported with case studies. The focus of this course is on team-based project learning. Computer software and models (mainly PHREEQC from USGS) will be used to learn analysis techniques.  
**Prerequisite(s):** ENVS 370 or ENVS 452 or consent of instructor.

**ENVS 505. Research Orientation**  
*4 Credits (4)*  
Training in writing research proposals, presentation of research results, and interpretation of research results. Crosslisted with: AGRO 505, HORT 505 and SOIL 505.

**ENVS 557. Water Measurement**  
*3 Credits (3)*  
The fundamentals of measuring water will be covered. Participants will learn about measurement techniques that are used to estimate evapotranspiration as well as commonly used water measurement structures to estimate water use. The benefits and problems that are associated with using each measurement will be discussed. Students will also learn about the principles of how to use water measurement as a management tool.

**ENVS 596. Masters Proposal**  
*1 Credit (1)*  
Current research proposal written by masters level graduate students. Consent of Instructor required. Crosslisted with: AGRO 596, HORT 596 and SOIL 596. Restricted to: Masters PLEN majors.  
**Prerequisite(s):** Master level graduate students.

**ENVS 599. Master’s Thesis**  
*1-15 Credits*  

**ENVS 605. Arid Land Water Resources**  
*3 Credits (2+2P)*  
The course will cover various issues of relevance to water resources and water supply management within the Southwest US and other semiarid and arid regions. Discussions may include development and sustainability, climate change and drought, socioeconomic and cultural, and transboundary issues. Students will develop literature reviews, draft proposals, and conduct presentations. May be repeated up to 3 credits. Crosslisted with: WSAM 605.

**ENVS 696. Doctors Proposal**  
*1 Credit (1)*  
Current research proposal written by PhD level graduate students. Consent of Instructor required. Crosslisted with: AGRO 696, HORT 696 and SOIL 696. Restricted to: Doctors PLEN majors.  
**Prerequisite(s):** PhD level graduate students.

**ENVS 700. Doctoral Dissertation**  
*1-15 Credits*  

**Genetics Courses**

**GENE 1110. Experimental Systems in Genetics**  
*1 Credit (1)*  
Survey of molecular, biochemical, organismal, and computer science based approaches to investigate how genes determine important traits. Historical development and topics of current interest will be discussed.

**GENE 305. Principles of Genetics**  
*3 Credits (3)*  
Covers fundamental principles of reproduction, variation, and heredity in plants and animals. Crosslisted with: AGRO 305, ANSC 305, BIOL 305 and HORT 305  
**Prerequisite(s):** BIOL 2610G, BIOL 2110G and either CHEM 1215G or CHEM 1216.

**GENE 305 L. Genetic Techniques**  
*1 Credit (3P)*  
Experimental procedures used in genetic research including: sexual transmission genetics, eukaryotic DNA isolation, DNA marker development and genotyping, polymerase chain reaction, and cytogenetics.  
**Prerequisite(s)/Corequisite(s):** GENE 315, or AGRO/ANSC/BIOL/HORT 305.

**GENE 315. Molecular Genetics**  
*3 Credits (3)*  
Covers fundamental principles of DNA structure and replication, transcription, translation, gene regulation, recombinant DNA technology, and a survey of genomics and bioinformatics. Recommend CHEM 313.  
**Prerequisite(s):** CHEM 1225G and BIOL 2110G.

**GENE 320. Hereditary and Population Genetics**  
*3 Credits (3)*  
Covers fundamental principles of reproduction, variation, and heredity in plants and animals including: Mendelian inheritance, mitosis, meiosis, genetic linkage, random mating, genetic drift, natural selection, inbreeding, migration, mutation, interrelationships between individuals, populations and communities and the environment.  
**Prerequisite(s):** CHEM 1215G & BIOL 2110G.

**GENE 391. Genetics Internship**  
*1-6 Credits (1-6)*  
Professional work experience in genetics under the joint supervision of an employer and a faculty member. Documentation of proposed internship activities must be submitted prior to the start of the internship. A written report is required after the internship is completed. No more than 6 credits toward a degree. May be repeated up to 6 credits. Graded: S/U, Audit.
GENE 440. Genetics Seminar
1 Credit (1)
Organization, preparation, and presentation of genetic studies in model microorganism, plant, or animal systems that have been used to solve problems in molecular, cellular, and developmental biology. Consent of instructor required.
Prerequisite(s): Seniors only; GENE 315 & GENE 320.

GENE 449. Special Problems
1-3 Credits (1-3)
Research problem, experience training, or other special study approved by a faculty adviser. Maximum of 3 credits per semester and a grand total of 3 credits toward a degree. Consent of instructor required.

GENE 450. Special Topics
1-3 Credits (1-3)
Specific subjects to be announced in the schedule of classes. Maximum of 3 credits per semester and a total of 3 credits toward a degree. Consent of instructor required.

GENE 452. Applied Bioinformatics
3 Credits (3)
Survey and application of publicly available bioinformatic tools that treat genomic DNA, cDNA, and protein sequences, RNA abundance, as well as tools that allow inference based on phylogenetic relationships.
Prerequisites: AGRO/ANSC/BIOL/HORT 305 or GENE 315 and GENE 320, and BCHE 341, or BCHE 395.

GENE 486. Genes and Genomes
3 Credits (3)
Extensive coverage of nuclear and organelle genome structure in plants and animals, genome restructuring including duplication, aneuploidy, chromosome translocations and inversions, comparative genomics, and molecular systematics.
Prerequisites: AGRO/ANSC/BIOL/HORT 305 or GENE 315, and GENE 320.

GENE 488. Gene Regulation
3 Credits (3)
Extensive coverage of signal transduction processes and approaches used to monitor large scale changes in gene regulation and protein synthesis that occur during development and in response to environmental changes.
Prerequisites: AGRO/ANSC/BIOL/HORT 305 or GENE 315.

Horticulture Courses

HORT 1115G. Introductory Plant Science
4 Credits (3+2P)
Introduction to the physical, biological, and chemical principles underlying plant growth and development in managed ecosystems. In the laboratory portion of the class, students perform experiments demonstrating the principles covered in lecture. The course uses economic plants and agriculturally relevant ecosystems to demonstrate basic principles. Appropriate for nonscience majors. Same as AGRO 1110G.

HORT 2110. Ornamental Plants I
4 Credits (2+3P)
Covers identification, botanical characteristics, culture, and landscape uses of woody plants. Emphasis on deciduous trees, native shrubs, and evergreens.

HORT 2120. Ornamental Plants II
4 Credits (2+3P)
Identification, botanical characteristics, culture, and landscape uses of woody plants. Emphasis on flowering trees, cacti, and members of the pea and rose families.

HORT 2130. Floral Quality Evaluation and Design
2 Credits (1+2P)
Critical hands-on evaluation of the quality of cut and potted floral and tropical foliage crops, their specific merits and faults, and fundamentals of floral design.

HORT 2160. Plant Propagation
3 Credits (2+2P)
Practical methods of propagating horticultural plants by seed, cuttings, layering, grafting, division and tissue culture. Examination of relevant physiological processes involved with successful plant propagation techniques. Same as AGRO 2160.

HORT 2990. Floriculture Field Practicum
1 Credit (1)
Participation as team member in the National Intercollegiate Floral Quality Evaluation and Design Competition. Intensive week-long travel for competition, networking with industry, academia, and floriculture tours. May be repeated for a maximum of 3 credits.
Prerequisite(s): HORT 2130 or consent of instructor.

HORT 2996. Special Topics
1-4 Credits
Specific subjects and credits as announced. Maximum of 4 credits per semester and a grand total of 9 credits. May be repeated up to 9 credits. Consent of Instructor required.

HORT 300. Special Topics
1-4 Credits
Specific subjects as announced in the Schedule of Classes. Maximum of 4 credits per semester and a grand total of 9 credits. May be repeated up to 9 credits. Consent of Instructor required. Restricted to Las Cruces campus only.

HORT 302V. Forestry and Society
3 Credits (3)
Global study of the development and use of forest resources for production of wood, fuel, fiber, and food products. Climatic, edaphic, cultural, and economic influences on forests of the world evaluated. Same as RGSC 302V.

HORT 305. Principles of Genetics
3 Credits (3)
Covers fundamental principles of reproduction, variation, and heredity in plants and animals. Crosslisted with: AGRO 305, ANSC 305, BIOL 305 and GENE 305.
Prerequisite(s): BIOL 2610G, BIOL 2110G and either CHEM 1215G or CHEM 1216.

HORT 307. Landscape Design
3 Credits (2+3P)
Design elements, the design process, and contemporary planting design used in the design of residential and small commercial landscapes. Basic drafting, drawing, and landscape plan presentation techniques. Prerequisites : HORT 2110 or HORT 2120 or concurrent enrollment or consent of instructor.

HORT 310. Medicinal Herbs
3 Credits (3)
Introduction to ethnobotany, including plant cultivation, extraction methods, and analysis of active chemistries.
HORT 315. Crop Physiology 
3 Credits (3) 
Whole plant physiological processes as related to growth, development, yield, quality and post harvest physiology of crop plants within the environment of the crop community. Crosslisted with: AGRO 315 
Prerequisite(s): EPWS/BIOL 314 or consent of instructor.

HORT 365. Principles of Crop Production 
4 Credits (3+3P) 
Basic principles of crop production including environmental and physiological factors limiting production, plant nutrition and soil science, soil-water management, cropping systems and management, pest management, and economic factors influencing crop production. Crosslisted with: AGRO 365 
Prerequisite(s): AGRO 1110G/HORT 1115G, CHEM 1215G or equivalent and MATH 1215 or equivalent.

HORT 377. Introduction to Turfgrass Management 
4 Credits (3+3P) 
Establishment and maintenance of turfgrass with emphasis on seeding methods, soil and water management, mowing, disease insects and turfgrass varieties. Crosslisted with: AGRO 377

HORT 378. Turfgrass Science 
4 Credits (3+3P) 
Introduction to the scientific fundamentals for turfgrass management cultural practices, pest management, rootzone construction and ecology. Crosslisted with: AGRO 377 or consent of instructor.

HORT 391. Internship 
1-6 Credits 
Professional work experience under the joint supervision of the employer and a faculty member. A written report is required. No more than 6 credits toward a degree. Consent of instructor required. Graded: S/U. Crosslisted with: AGRO 391 and SOIL 391

HORT 447. Seminar 
1 Credit (1) 
Organization, preparation, and presentation of current topics in agronomy, environmental sciences, horticulture, and soil science. Crosslisted with: AGRO 447, ENVS 447 and SOIL 447.

HORT 449. Special Problems 
1-3 Credits 
Research problem, experience training, or other special study approved by a faculty adviser. Maximum of 3 credits per semester and a grand total of 6 credits. May be repeated up to 6 credits. Consent of Instructor required.

HORT 450. Special Topics 
1-4 Credits 
Specific subjects as announced in the Schedule of Classes. Maximum of 4 credits per semester and a grand total of 9 credits. May be repeated up to 9 credits. Consent of Instructor required.

HORT 462. Plant Breeding 
3 Credits (3) 
Principles and practices involved with the genetic improvement of plants. May be repeated up to 3 credits. 
Prerequisite(s): ANSC/AGRO/BIOL/HORT/GENE 305 or GENE 315 and GENE 320.

HORT 465. Landscape Construction and Maintenance 
4 Credits (2+3P) 
Application of landscape design and construction principles to build and maintain residential and small commercial landscapes. 
Prerequisite(s)/Corequisite(s): HORT 307 or consent of instructor.

HORT 471. Plant Mineral Nutrition 
3 Credits (3) 
Basic and applied aspects of plant requirements for soil-derived minerals and the processes whereby minerals are acquired, absorbed, translocated, and utilized throughout the plant. Same as AGRO/EPWS 471. 
Prerequisite: EPWS/BIOL 314, or concurrent enrollment, or consent of instructor.

HORT 477. Advanced Turfgrass Science 
3 Credits (3) 
Extensive reviews of turfgrass sciences including ecology, physiology, entomology, pathology, weed science, and soil science. 
Prerequisite: HORT 378 or consent of instructor.

HORT 485. Vegetable Crop Management 
4 Credits (3+2P) 
Physiological, environmental and cultural aspects of vegetable crop production. Corequisite(s): AGRO 365/HORT 365

HORT 488. Greenhouse Management 
4 Credits (3+3P) 
Principles and practices involved in greenhouse structures and construction, site considerations, heating and cooling systems, greenhouse crop production techniques, sustainability practices. May be repeated up to 4 credits. 
Prerequisite(s): HORT/AGRO 365 or consent of instructor.

HORT 492. Diagnosing Plant Disorders 
3 Credits (2+3P) 
Systematic diagnosis of the physiological, pathological, and entomological causes of plant disorders. Same as EPWS 492 and AGRO 492. 
Prerequisites: EPWS 303 and EPWS 310.

HORT 500. Special Topics 
1-4 Credits 
Specific subjects and credits to be announced in the Schedule of Classes. Maximum of 4 credits per semester. No more than 9 credits toward a degree.

HORT 505. Research Orientation 
4 Credits (3+2P) 
Training in writing research proposals, presentation of research results, and interpretation of research results. Crosslisted with: AGRO 505, SOIL 505 and ENVS 505.

HORT 505. Plant Genetics 
3 Credits (3) 
Advanced treatment of the principles of classical genetics and heredity with emphasis on the nature and action of the gene including molecular analysis. May be repeated up to 3 credits. Crosslisted with: AGRO 506. BCHE 341 recommended. 
Prerequisite(s): AGRO 305/GENE 305/HORT 305/BIOL 305/ANSC 305 or consent of instructor.

HORT 515. Crop Physiology 
3 Credits (3) 
Whole plant physiological processes as related to growth, development, yield, quality and post harvest physiology of crop plants within the environment of the crop community. Crosslisted with: AGRO 515 
Prerequisite(s): EPWS/BIOL 314 or consent of instructor.
HORT 525. Scientific Writing: How to be a Productive and Effective Writer 1-3 Credits (1-3)
Students will learn to improve their writing skills so that their manuscript preparation process is more efficient and productive. Students will also gain experience in peer-review Crosslisted with: AGRO 525, AGRO 625, EPWS 525, SOIL 625 and SOIL 525.

HORT 590. Graduate Seminar 1 Credit (1)
Current research discussions presented by masters level graduate students. Not more than one credit toward the degree. Same as AGRO/SOIL 590. Crosslisted with: AGRO 590 and SOIL 590.

HORT 595. Internship 1-6 Credits
Supervised professional on-the-job learning experience. Limited to Master of Horticulture or Plant & Environmental Science candidates. Not more than 6 credits toward the degree.

HORT 596. Masters Proposal 1 Credit (1)
Current research proposal written by maters level graduate students. Consent of Instructor required. Crosslisted with: AGRO 596, ENV 596, GENE 596 and SOIL 596. Restricted to: Masters HORT, Masters PLEN majors.
Prerequisite(s): Master level graduate students.

HORT 597. University Teaching Experience 1-3 Credits (1-3)
Certain graduate students will be permitted to teach up to one-third of one AGRO/HORT/SOIL/ENV course. The student will prepare and deliver lectures and will prepare, administer, and grade at least one examination. The professor in charge of the course will attend and evaluate the student's lectures. Consent of instructor required. Crosslisted with: AGRO 597 and SOIL 597

HORT 598. Special Research Programs 1-6 Credits
Individual investigations, either analytical or experimental. Maximum of 6 credits per semester. No more than 9 credits toward a degree.
Prerequisite: consent of instructor.

HORT 599. Master's Thesis 15 Credits
Thesis.

HORT 609. Breeding for Plant Disease Resistance 3 Credits (3)
A practically-oriented course of lectures and discussion on concepts and principles of breeding for disease and pest resistance. Labs familiarize students with preparation, quantification, and application of inoculum to hosts. Same as AGRO 609.

HORT 610. Advanced Crop Breeding 4 Credits (3+3P)
Applications of breeding principles to crop improvement. Emphasis on breeding methodologies using modern techniques, including biotechnology. Same as AGRO 610.
Prerequisite: AGRO 462 or consent of instructor.

HORT 620. Instrumentation in Agronomy 3 Credits (3)
Use of instruments used in research in all areas of agronomy including gas chromatography; high performance liquid chromatography, neutron soil moisture probe, and other instruments. Same as AGRO/SOIL 620.

HORT 625. Scientific Writing: How to be a Productive and Effective Writer 1-3 Credits (1-3)
Students will learn to improve their writing skills so that their manuscript preparation process is more efficient and productive. Students will also gain experience in peer-review. Students in the 625 course will be required to perform additional research than those students in the 525 cross-listing Crosslisted with: AGRO 525, EPWS 525, HORT 525 and SOIL 525.

HORT 696. Doctors Proposal 1 Credit (1)
Current research proposal written by PhD level graduate students. Consent of Instructor required. Crosslisted with: AGRO 696, ENV 696 and SOIL 696. Restricted to: Doctors PLEN majors.
Prerequisite(s): PhD level graduate students.

HORT 697. University Teaching Experience 1-3 Credits (1-3)
Certain graduate students will be permitted to teach up to one-third of one AGRO/HORT/SOIL/ENV course. The student will prepare and deliver lectures and will prepare, administer, and grade at least one examination. The professor in charge of the course will attend and evaluate the student's lectures. Consent of instructor required. Crosslisted with: AGRO 697 and SOIL 697

Soil Courses

SOIL 2110. Introduction to Soil Science 3 Credits (3)
An overview of fundamental concepts in soil science and soils as a natural resource. Students will be introduced to the physical, chemical, and biological properties as it relates to soil management in environmental science, conservation, and agronomy. Prerequisite: (CHEM 1120G or MATH 1215 or higher) or CHEM 1215G

SOIL 2110L. Introduction to Soil Science Laboratory 1 Credit (1)
Morphological, chemical, physical and biological properties of soil in the laboratory and field.
Corequisite(s): SOIL 2110.

SOIL 2996. Special Topics 1-4 Credits
Specific subjects and credits to be announced in the Schedule of Classes. Maximum of 4 credits per semester. No more than 9 credits toward a degree. May be repeated up to 9 credits. Consent of Instructor required.

SOIL 300. Special Topics 1-4 Credits
Specific subjects and credits announced in the Schedule of Classes. Maximum of 4 credits per semester. No more than 9 credits toward a degree. May be repeated up to 9 credits. Consent of Instructor required. Restricted to Las Cruces campus only.

SOIL 312. Soil Management and Fertility 3 Credits (3)
Management, conservation, and fertility of soils; physical conditions affecting growth, nutrition, and plant production.
Prerequisite(s): SOIL 2110.
Corequisite(s): SOIL 312L.

SOIL 312 L. Soil Management and Fertility Lab 1 Credit (1)
Hands-on experience. Includes field trips, videos, calculations, visiting lecturers and other lab activities as possible.
Prerequisite(s): SOIL 2110.
Corequisite(s): SOIL 312.
SOIL 370. Environmental Soil Science
3 Credits (3)
Continuation of SOIL 2110 that emphasizes soil properties and processes that directly relate to environmental pollution problems. Same as ENVS 370.
Prerequisite: SOIL 2110.

SOIL 391. Internship
1-6 Credits (1-6)
Professional work experience under the joint supervision of the employer and a faculty member. A written report is required. No more than 6 credits toward a degree. Consent of Instructor required. Graded: S/U Grading (S/ U, Audit).

SOIL 424. Soil Chemistry
3 Credits (3)
Basic elements of soil chemistry including clay mineralogy, cation and anion exchange and the chemistry of problem (acid, saline and flooded) soils. Credit not given for both SOIL 424 and SOIL 479.
Prerequisite(s): SOIL 2110L or CHEM 1215G and CHEM 1225G.

SOIL 447. Seminar
1 Credit (1)
Organization, preparation, and presentation of current topics in agronomy, environmental sciences, horticulture, and soil science. Crosslisted with: AGRO 447, HORT 447 and ENVS 447.

SOIL 449. Special Problems
1-3 Credits
Research problem, experience training, or other special study approved by a faculty adviser. Maximum of 3 credits per semester and a grand total of 6 credits. May be repeated up to 6 credits. Consent of Instructor required.

SOIL 450. Special Topics
1-4 Credits
Specific subjects to be announced in the Schedule of Classes. Maximum of 4 credits per semester and a total of 9 credits towards a degree. Maximum of 4 credits per semester and a total of 9 credits towards a degree. May be repeated up to 9 credits. Consent of Instructor required.

SOIL 456. Irrigation and Drainage
3 Credits (3)
Principles and practices required for irrigation to exist as a permanent economy. Equipment and methods for measurement and control of water.

SOIL 472. Soil Morphology and Classification
4 Credits (2+2P)
Terminology used to describe soils. Soil classification systems of the world with emphasis on systems used in the United States. Theory of classification and taxonomy as applied to soils. May be repeated up to 4 credits. Crosslisted with: GEOG 472.
Prerequisite(s): SOIL 2110.

SOIL 476. Soil Microbiology
3 Credits (3)
Nature and physiology of soil microorganisms, how they affect plant growth and recycle nutrients. Land farming, bioremediation and other environmental problems as influenced by soil microorganisms. SOIL 2110 and BIOL 311 recommended. Same as BIOL 476.

SOIL 476 L. Soil Microbiology Laboratory
1 Credit (3P)
Enumeration of soil microorganisms, their activities, and transformations they mediate. Same as BIOL 476L.
Prerequisites: SOIL 476 or concurrent enrollment.

SOIL 477. Environmental Soil Physics
3 Credits (3)
A description of the physical characteristics of porous media including soil. Examination of processes describing the transport of water, chemicals, heat and gases through porous media with application to environmental quality, waste management, and crop production.

SOIL 477 L. Environmental Soil Physics Laboratory
1 Credit (1)
Concurrent enrollment with SOIL 477 recommended. Hands on experience with techniques for characterizing soil physical properties such as particle size distribution, bulk density, water retention, hydraulic conductivity and solute transport. Demonstrations of field and laboratory techniques for measuring moisture content, soil water potential, gas/air flow and thermal conductivity.
Prerequisite(s): SOIL 2110.

SOIL 479. Environmental Soil Chemistry
3 Credits (3)
Basic elements of soil chemistry including discussion of clay mineralogy, cation and anion exchange and the chemistry of problem (acid, saline and flooded) soils. Credit not given for both SOIL 424 and SOIL 479.
Prerequisite(s): SOIL 2110L or CHEM 1215G and CHEM 1225G.

SOIL 500. Special Topics
1-4 Credits
Specific subjects and credits to be announced in the Schedule of Classes. Maximum of 4 credits per semester. No more than 9 credits toward a degree.

SOIL 505. Research Orientation
4 Credits (3+2P)
Training in writing research proposals, presentation of research results, and interpretation of research results. Crosslisted with: HORT 505, AGRO 505 and ENVS 505.

SOIL 525. Scientific Writing- How to be a Productive and Effective Writer
1-3 Credits (1-3)
Students will learn to improve their writing skills so that their manuscript preparation process is more efficient and productive. Students will also gain experience in peer-review Crosslisted with: AGRO 525, AGRO 625, HORT 525, HORT 625, SOIL 625 and EPWS 525.

SOIL 590. Graduate Seminar
1 Credit (1)
Current research discussions presented by master level graduate students. Not more than one credit toward the degree. Same as AGRO/ HORT 590. Crosslisted with: AGRO 590 and HORT 590.

SOIL 596. Masters Proposal
1 Credit (1)
Current research proposal written by masters level graduate students. Consent of Instructor required. Crosslisted with: AGRO 596, ENVS 596, GENE 596 and HORT 596. Students must be a Master level graduate student to enroll in this course. Restricted to: Masters HORT; Masters PLEN majors.

SOIL 597. University Teaching Experience
1-3 Credits (1-3)
Certain graduate students will be permitted to teach up to one-third of one AGRO/HORT/SOIL/ENVS course. The student will prepare and deliver lectures and will prepare, administer, and grade at least one examination. The professor in charge of the course will attend and evaluate the student’s lectures. Consent of instructor required. Crosslisted with: AGRO 597 and HORT 597.
SOIL 598. Special Research Programs
1-6 Credits
Individual investigations, either analytical or experimental. Maximum of 6 credits per semester. No more than 9 credits toward a degree.

SOIL 600. Doctoral Research
1-15 Credits
Research.

SOIL 625. Scientific Writing - How to be a Productive and Effective Writer
1-3 Credits (1-3)
Students will learn to improve their writing skills so that their manuscript preparation process is more efficient and productive. Students will also gain experience in peer-review. Students in the 625 course will be required to perform additional research than those students in the 525 cross-listing. Crosslisted with: AGRO 525, HORT 525 and EPWS 525.

SOIL 650. Advanced Topics
1-3 Credits
Colloquium on contemporary topics associated with agriculture, environmental science and engineering. Multidisciplinary topics will be chosen to encourage participation of students from diverse disciplines. May be repeated for a maximum of 9 credits.
Prerequisite: consent of instructor.

SOIL 652. Advanced Soil Physics
3 Credits (3)
Advanced treatment of soil physics, modeling, includes working on an existing/new research project, modeling existing or new data, step by step guide on the use of some 1-D and 2-D models. Specific areas of specialization will be field scale variability of soil properties, water flow, solute transport, and plant water relations.
Prerequisite(s): SOIL 477 and computer literacy, or consent of instructor.

SOIL 655. Moisture Heat Contaminant Transport Modeling
3 Credits (3)
Provides clear coverage of the basic principles of heat, moisture and contaminant transport through porous media, and a step-by-step guidance and hands on application on the use of some spreadsheet based and physically based one and two-dimensional transport models. A similar course does not exist in the college for students that can encourage them to pursue modeling as a means of solving vadose zone and groundwater contamination and remediation problems. Consent of instructor required.

SOIL 694. Doctoral Seminar
1 Credit (1)
Current research discussions presented by doctoral level graduate students. Not more than 2 credits toward the degree. Same as AGRO 694.
Prerequisite: doctoral level graduate students.

SOIL 696. Doctoral Proposal
1 Credit (1)
Current research proposal written by doctoral level graduate students. Not more than 1 credit toward the degree. Same as AGRO 696.
Prerequisite: doctoral level graduate students.

SOIL 697. University Teaching Experience
1-3 Credits (1-3)
Certain graduate students will be permitted to teach up to one-third of one AGRO/HORT/SOIL/ENVS course. The student will prepare and deliver lectures and will prepare, administer, and grade at least one examination. The professor in charge of the course will attend and evaluate the student's lectures. Consent of instructor required. Crosslisted with: AGRO 697 and HORT 697.