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

Agronomy - Bachelor of Science in Agriculture (http://catalogs.nmsu.edu/nmsu/agricultural-consumer-environmental-sciences/plant-environmental-sciences/agronomy-bachelor-science-agriculture)

Horticulture - Bachelor of Science in Agriculture (http://catalogs.nmsu.edu/nmsu/agricultural-consumer-environmental-sciences/plant-environmental-sciences/horticulture-bachelor-science-agriculture)

Soil Science - Bachelor of Science in Agriculture (http://catalogs.nmsu.edu/nmsu/agricultural-consumer-environmental-sciences/plant-environmental-sciences/soil-science-bachelor-science-agriculture)

Turfgrass Science and Management - Bachelor of Science in Agriculture (http://catalogs.nmsu.edu/nmsu/agricultural-consumer-environmental-sciences/plant-environmental-sciences/turfgrass-science-management-bachelor-science-agriculture)

Environmental Science - Bachelor of Science in Environmental Science (http://catalogs.nmsu.edu/nmsu/agricultural-consumer-environmental-sciences/plant-environmental-sciences/environmental-science-bachelor-science-environmental-science)

Genetics and Biotechnology - Bachelor of Science in Genetics (http://catalogs.nmsu.edu/nmsu/agricultural-consumer-environmental-sciences/plant-environmental-sciences/genetics-biotechnology-bachelor-science-genetics)

Horticulture - Master of Science (http://catalogs.nmsu.edu/nmsu/agricultural-consumer-environmental-sciences/plant-environmental-sciences/horticulture-master-science)


Minors for the Department

Agronomy - Undergraduate Minor

Horticulture - Undergraduate Minor

Soil Science - Undergraduate Minor

Turfgrass Science and Management - Undergraduate Minor

Professors

R. St. Hilaire, Department Head

Professors


Associate Professors

- Angadi, Flynn, Goss, Heerema, Marsalis, Yao

Assistant Professors

- Brungard, Burney, Ghimire, Grover, Guzman, Holguin, Lombard, Pietraiska Webb

College Professors

- Lauriault, College Associate Professor

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. Boone, Ph.D. (Louisiana State University) – aquatic ecology; P.W. Bosland, Assistant Department Head, Ph.D. (University of Wisconsin-Madison) – chile breeding and genetics; C. Brungard, Ph.D. (Utah State University) – pedology; D. 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; D. DuBois, Ph.D. (University of Nevada) – atmospheric science; M.C. Duniway, Ph.D. (New Mexico State University) – agronomy; R. Flynn, Ph.D. (Auburn University) – soil and water quality; R. Ghimire, Ph.D. (University of Wyoming, Laramie) – soil & crop management; R.M. Goss, Ph.D. (University of Nebraska, Lincoln) – turf science; K. Grover, Ph.D. (Pennsylvania State University) – agriculture; I. Guzman, Ph.D. (Utah State University) – horticulture; N. Hanan, 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) – biochemistry analysis; J. Idowu, Ph.D. (Cranfield University, United Kingdom) – agronomy and land management; 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; M.A. O’Connell, Ph.D. (Cornell University) – plant biochemistry and molecular genetics; M. O’Neill, Ph.D. (University of Arizona) – agronomy; G.A. Picchioni, Ph.D. (Texas A&M University) – plant-mineral relations; N. Pietraiska, Ph.D. (University of California, Riverside) – soil and water sciences; R. Pratt, Ph.D. (Purdue University) – plant breeding and genetics; N. Puppala, Ph.D. (New Mexico State University) – plant breeding and genetics; I.M. Ray, Ph.D. (University of Wisconsin-Madison) – alfalfa breeding and genetics; D. Rucker, Ph.D. (University of Arizona) – hydrogeophysics; C. Sengupta-Gopalan, Ph.D. (Ohio State University) – biochemical genetics; M.K. Shukla, Ph.D. (University of Agricultural Sciences, Vienna, Austria) – 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; A.L. Ulery, 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); S. Yao, Ph.D. (Cornell University) – pomology/horticulture; J. Zhang, Ph.D. (University of Arkansas, Fayetteville) – cotton breeding, genetics, and genomics

AGRO 250. 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 250.

AGRO 275. Introduction to Meteorology
4 Credits (3+3P)
Introduction to Earth’s atmosphere and the dynamic world of weather as it happens. Working with current meteorological data delivered via the Internet and coordinated with learning investigations keyed to the current weather; and via study of select archives. 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.

AGRO 303V. Genetics and Society
3 Credits
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 fingerprinting, 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
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 111G, BIOL 211G and either CHEM 111G or CHEM 115.

AGRO 311. Introduction to Weed Science
4 Credits
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 111G and BIOL 211G.

AGRO 315. Crop Physiology
3 Credits
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/HORT 100, CHEM 111G or equivalent and MATH 120 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. S/U Grading (S/U, Audit).
Prerequisite(s): Consent of instructor.

AGRO 447. Seminar
1 Credit
Organization, preparation, and presentation of current topics in agronomy, horticulture, and soil science. Same as HORT 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
Principles and practices involved with the genetic improvement of plants. Same as HORT 462.
Prerequisites: ANSC/AGRO/BIOL/HORT 305.

AGRO 471. Plant Mineral Nutrition
3 Credits
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/BIOI 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 or HORT 365.

AGRO 485. Materials from Biorenewable Resources
3 Credits
Types, sources, composition and properties of biomass. Production, processing, and applications of biomass materials with energy, water, cost, sustainability, and waste management considerations. Crosslisted with: HORT 486, E S 485, SOIL 485 and CHME 485.
Prerequisite(s): CHEM 211 or CHEM 313 or permission of instructor.

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 and SOIL 505

AGRO 506. Plant Genetics
3 Credits
Advanced treatment of the principles of classical genetics and heredity with emphasis on the nature and action of the gene including molecular analysis. CHEM 345 recommended. Same as HORT 506.
Prerequisite: AGRO 305 or consent of instructor.

AGRO 511. Introduction to Weed Science (f)
4 Credits
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 111G and BIOL 190 or BIOL 211G, or consent of instructor.
AGRO 514. Soil-Plant Relationships
3 Credits
Physical, chemical, and biological soil environment as it affects plant and crop growth. Same as HORT 514 and SOIL 514.
Prerequisites: BIOL 314, SOIL 252.

AGRO 515. Crop Physiology
3 Credits
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
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 533. Environmental Physiology of Plants
3 Credits
Integral responses of plants and crop productivity to naturally occurring and modified environmental factors such as radiation, temperatures, water vapor, carbon dioxide, and air flow. Same as BIOL/HORT 533.
Prerequisite: BIOL 314 or consent of instructor.

AGRO 590. Graduate Seminar
1 Credit
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
Current research proposal written by maters level graduate students. Consent of Instructor required. Crosslisted with: E S 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
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
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
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
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
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: E S 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/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. 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

E S 110G. Introductory Environmental Science
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.

E S 256. Environmental Engineering and Science
3 Credits
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 111G and MATH 191G.

E S 256 L. Environmental Science Laboratory
1 Credit
Laboratory experiments associated with the material presented in
E S 256. Same as C E 256L.
Corequisite: E S 256.

E S 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.

E S 301. Principles of Ecology
3 Credits
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 111G, A ST 311, and grade of C or better in
MATH 191G or Math Placement Exam score adequate to enroll in
mathematics courses beyond MATH 191G.

E S 312. Emergency Response to Hazardous Material Incidents
2 Credits
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.

E S 330. Environmental Management Seminar I
1 Credit
Restricted to: Main campus only. Crosslisted with: A EN 330, C E 330,

E S 361. Basic Toxicology
3 Credits
BIOL 110G or BIOL 190 recommended. Same as TOX 361.
Prerequisite: CHEM 110G, CHEM 112G, or CHEM 114.

E S 370. Environmental Soil Science
3 Credits
Continuation of SOIL 252 that emphasizes soil properties and processes
that directly relate to environmental pollution problems. Same as
SOIL 370.
Prerequisite: SOIL 252.

E S 391. Internship
3 Credits
Professional work experience under the joint supervision of the employer
and a faculty member. A written report is required. Maximum of 3 credits

E S 422. Environmental Chemistry
3 Credits
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 112G and either CHEM 211 or CHEM 313.

E S 423. Environmental Toxicology
3 Credits
Toxicological tests required by the EPA to determine human and
environmental safety of pesticides and industrial pollutants; discussion
of environmental fate of major pesticide classes and industrial pollutants.
Crosslisted with: TOX 423
Prerequisite(s): TOX 361 or TOX 461.

E S 430. Environmental Management Seminar II
1 Credit
Survey of practical and new developments in environmental management
field, hazardous and radioactive, waste management, and related health
issues, provided through a series of guest lectures and reports of ongoing
research. Restricted to: Main campus only. Crosslisted with: C E 430, CH
E 430, E E 430, E T 430, I E 430 and WERC 430

E S 434. Aquatic Contaminants and Toxicology
4 Credits
Basic principles and methodologies of aquatic toxicity testing. Routes of
exposure and modes of action. Environmental legislation and ecological
risk assessment. Crosslisted with: WLSC 434
Prerequisite(s): Senior standing or consent of instructor.

E S 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
forward to a degree. May be repeated up to 6 credits. Consent of Instructor
required. Restricted to: E S majors.
E S 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.

E S 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.
Prerequisite(s): Junior or Senior.

E S 459. Aquatic Ecology
4 Credits
Ecological functions of plant and animal communities in aquatic ecosystems with emphasis on chemical and physical properties, productivity, species interactions, population dynamics, and concepts for diagnosing problems and restoring aquatic ecosystems. Crosslisted with: WLSC 459
Prerequisite(s): (E S, WLSC or BIOL 301), CHEM 112G, (MATH 142G or MATH 191G).

E S 460. Introduction to Air Pollution
3 Credits
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 215G, CHEM 112G, MATH 191G.

E S 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.
Prerequisite(s): E S 256.

E S 470. Environmental Impacts of Land Use and Contaminant Remediation
3 Credits
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. Crosslisted with: WSAM 470.
Prerequisite(s): E S 256, E S 462, E S 370.

E S 485. Materials from Biorenewable Resources
3 Credits
Types, sources, composition and properties of biomass. Production, processing, and applications of biomass materials with energy, water, cost, sustainability, and waste management considerations. Crosslisted with: AGRO 485, HORT 486, SOIL 485 and CHME 485.
Prerequisite(s): CHEM 211 or CHEM 313 or permission of instructor.

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

E S 599. Master’s Thesis
1-15 Credits

E S 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. Crosslisted with: WSAM 605.

E S 696. Doctors Proposal
1 Credit
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.

E S 700. Doctoral Dissertation
1-15 Credits

Genetics
GENE 110. Experimental Systems in Genetics
1 Credit
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 303V. Genetics and Society
3 Credits
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: AGRO 303V.

GENE 305. Principles of Genetics
3 Credits
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 111G, BIOL 211G and either CHEM 111G or CHEM 115.

GENE 305 L. Genetic Techniques
1 Credit
Experimental procedures used in genetic research including: sexual transmission genetics, eukaryotic DNA isolation, DNA marker development and genotyping, polymerase chain reaction, and cytogenetics. Pre/
Corequisite(s): GENE 315, or AGRO/ANSC/BIOL/HORT 305.
GENE 315. Molecular Genetics
3 Credits
Covers fundamental principles of DNA structure and replication, transcription, translation, gene regulation, recombinant DNA technology, and a survey of genomics and bioinformatics.
Prerequisite(s)/Corequisite(s): Prerequisite(s): CHEM 112 and BIOL 211. Recommend CHEM 313.

GENE 320. Hereditary and Population Genetics
3 Credits
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 111G & BIOL 211G.

GENE 440. Genetics Seminar
1 Credit
Organization, preparation, and presentation of genetic studies in model microorganisms, 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
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
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
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

HORT 100G. 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 100G.

HORT 110. Athletic Field and Golf Course Management
1 Credit
Survey of proper management of athletic fields, golf courses and other turfgrass stands. Career opportunities in athletic field and golf course management will be discussed. Course includes field trips to local and regional sports turf facilities.

HORT 200. 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 205. Introduction to Horticulture
3 Credits
Principles and practices of horticulture. Basic chemical, physical, and biological principles that govern plant growth in different environments. Economics of plant science as related to the field of horticulture. Online course entirely. Intended for non-majors.

HORT 210. Ornamental Plants I
4 Credits (3+2P)
Covers identification, botanical characteristics, culture, and landscape uses of woody plants. Emphasis on deciduous trees, native shrubs, and evergreens.

HORT 211. Ornamental Plants II
4 Credits (3+2P)
Identification, botanical characteristics, culture, and landscape uses of woody plants. Emphasis on flowering trees, cacti, and members of the pea and rose families.

HORT 240. 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 241. Floriculture Field Practicum
1 Credit
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 240 or consent of instructor.

HORT 250. 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 250.
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
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
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 111G, BIOL 211G and either CHEM 111G or CHEM 115.

HORT 307. Landscape Design
3 Credits (1+4P)
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 210 or HORT 211 or concurrent enrollment or consent of instructor.

HORT 310. Medicinal Herbs
3 Credits
Introduction to ethnobotany, including plant cultivation, extraction methods, and analysis of active chemistries.

HORT 315. Crop Physiology
3 Credits
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/HORT 100, CHEM 111G or equivalent and MATH 120 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. Prerequisite(s): HORT 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
Review of current literature. Same as AGRO 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
Principles and practices involved with the genetic improvement of plants. Same as AGRO 462.
Prerequisites: ANSC/AGRO/BIOL/HORT 305.

HORT 465. Landscape Construction and Maintenance
4 Credits (3+2P)
Application of landscape design and construction principles to build and maintain residential, small commercial and selected public managed landscapes.

HORT 471. Plant Mineral Nutrition
3 Credits
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 479. Advanced Turfgrass Science
3 Credits
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 or HORT 365, or consent of instructor.

HORT 486. Materials from Biorenewable Resources
3 Credits
Types, sources, composition and properties of biomass. Production, processing, and applications of biomass materials with energy, water, cost, sustainability, and waste management considerations. Crosslisted with: AGRO 485, SOIL 485, E S 485 and CHME 485. Prerequisite(s): CHEM 211 or CHEM 313 or permission of instructor.
HORT 488. Greenhouse Management
4 Credits (3+3P)
Principles and practices involved in greenhouse structures and construction, site considerations, covering materials, heating and cooling systems, greenhouse crop production techniques, and case studies.
Prerequisite: 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 and SOIL 505

HORT 506. Plant Genetics
3 Credits
Advanced treatment of the principles of classical genetics and heredity with emphasis on the nature and action of the gene including molecular analysis. CHEM 345 recommended. Same as AGRO 506 and MOLB 506.
Prerequisite: AGRO 305 or consent of instructor.

HORT 514. Soil-Plant Relationships
3 Credits
Physical, chemical, and biological soil environment as it affects plant and crop growth. Same as AGRO/SOIL 514.
Prerequisites: BIOL 314, SOIL 252.

HORT 515. Crop Physiology
3 Credits
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 516. Molecular Analysis of Complex Traits
3 Credits
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 AGRO 516.
Prerequisite: AGRO 305 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 533. Environmental Physiology of Plants
3 Credits
Integral responses of plants and crop productivity to naturally occurring and modified environmental factors such as radiation, temperatures, water vapor, carbon dioxide, and air flow. Same as AGRO/BIOL 533.
Prerequisite: BIOL 314 or consent of instructor.

HORT 590. Graduate Seminar
1 Credit
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. Maters Proposal
1 Credit
Current research proposal written by maters level graduate students. Consent of Instructor required. Crosslisted with: AGRO 596, E S 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/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. 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
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
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 670. Biometrical Genetics and Plant Breeding
3 Credits
A statistical approach to gene action and population parameters as applied to plant improvement. Same as AGRO 670.
Prerequisite: AGRO 462 or consent of instructor.

HORT 685. Plant Genetic Engineering
3 Credits
Analysis of plant genome structure and potential applications of emerging molecular techniques to the genetic improvement of plants. Same as AGRO/BIOL 685.
Prerequisites: HORT/AGRO 585 and AGRO/HORT 506 or CHEM 545, or consent of instructor.

HORT 696. Doctors Proposal
1 Credit
Current research proposal written by PhD level graduate students. Consent of Instructor required. Crosslisted with: AGRO 696, E S 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/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. Crosslisted with: AGRO 697 and SOIL 697

Soil

SOIL 200. 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 252. Soils
3 Credits
Origin, classification, morphology, and physical, chemical, and biological properties of soils.
Prerequisite: CHEM 111G and CHEM 112G.

SOIL 252 L. Soils Laboratory
1 Credit
Morphological, chemical, physical and biological properties of soil in the laboratory and field.
Corequisite: SOIL 252.

SOIL 257. Introduction to Weather Science
4 Credits (3+3P)
Introduction to Earth's atmosphere and the dynamic world of weather as it happens. Working with current meteorological data delivered via the Internet and coordinated with learning investigations keyed to the current weather; and via study of select archives. Consent of instructor required. Crosslisted with: GEOG 257 and AGRO 257

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
Management, conservation, and fertility of soils; physical conditions affecting growth, nutrition, and plant production.
Prerequisite: SOIL 252.
Corequisite: SOIL 312L.

SOIL 312 L. Soil Management and Fertility Lab
1 Credit
Hands-on experience. Includes field trips, videos, calculations, visiting lecturers and other lab activities as possible.
Prerequisite: SOIL 252.
Corequisite: SOIL 312.

SOIL 350. Soils and Land Use
3 Credits (2+2P)
Relationship of soils to the limitations and potentials of land use. Emphasis on soil interpretations and soils as a resource in urban, rural, and recreational development. Same as PLAN 350.

SOIL 357. Climatology
3 Credits
Elements and controls of climate. Energy and hydrologic cycles, general circulation, climate classification, distribution of climate types, microscale effects, applications. Same as AGRO/GEOG 357.
Prerequisites: MATH 120.

SOIL 370. Environmental Soil Science
3 Credits
Continuation of SOIL 252 that emphasizes soil properties and processes that directly relate to environmental pollution problems. Same as E S 370.
Prerequisite: SOIL 252.

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. S/U Grading (S/U, Audit).

SOIL 424. Soil Chemistry
3 Credits
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 252L or CHEM 111G and 112G.

SOIL 447. Seminar
1 Credit
Organization, preparation, and presentation of current topics in agronomy, horticulture, and soil science. Same as AGRO/HORT 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. May be repeated up to 9 credits. Consent of Instructor required.

SOIL 456. Irrigation and Drainage  
3 Credits  
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. Same as GEOG 472.  
Prerequisite: SOIL 252.

SOIL 476. Soil Microbiology  
3 Credits  
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 252 and BIOL 311 recommended. Same as BIOL 476.

SOIL 476 L. Soil Microbiology Laboratory  
1 Credit  
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  
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  
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: SOIL 252.

SOIL 479. Environmental Soil Chemistry  
3 Credits  
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 252L or CHEM 111G and 112G.

SOIL 485. Materials from Biorenewable Resources  
3 Credits  
Types, sources, composition and properties of biomass. Production, processing, and applications of biomass materials with energy, water, cost, sustainability, and waste management considerations. Crosslisted with: AGRO 485, HORT 486, E S 485 and CHME 485.  
Prerequisite(s): CHEM 211 or CHEM 313 or permission of instructor.

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: AGRO 505 and HORT 505.

SOIL 514. Soil-Plant Relationships  
3 Credits  
Physical, chemical, and biological soil environment as it affects plant and crop growth. Same as AGRO/HORT 514.  
Prerequisites: BIOL 314, SOIL 252.

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  
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  
Current research proposal written by masters level graduate students. Consent of Instructor required. Crosslisted with: AGRO 596, E S 596, GENE 596 and HORT 596. Restricted to: Masters HORT; Masters PLEN majors.  
Corequisite(s): Master level graduate students.

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/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. 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 630. Advanced Soil Classification
3 Credits
Philosophy and organization of various soil classification systems, some international in scope, with emphasis on the new USDA system and classroom and field experience in using this system.
Prerequisite: SOIL 472 or consent of instructor.

SOIL 640. Advanced Soil Microbiology
3 Credits
Advanced topics in soil microbiology and biochemistry, including carbon cycling, nitrogen cycling, humus formation and nature, and microbial-plant root interactions. Consent of instructor required.

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
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
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. Pre/Corequisite(s): Graduate student with at least two 400.

SOIL 694. Doctoral Seminar
1 Credit
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
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/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. Crosslisted with: AGRO 697 and HORT 697