The College of Agricultural Sciences and Natural Resources began in 1869 when the university was designated as Tennessee’s Federal Land-Grant Institution. As such, the university was enabled for the first time to offer instruction in agriculture. Graduate instruction began as early as 1889. The college is not only an academic unit of the University of Tennessee, Knoxville, but is (with the Agricultural Experiment Station, the Agricultural Extension Service and the College of Veterinary Medicine) one of the four units of the University of Tennessee’s, Institute of Agriculture.

There are many shared resources and positive interactions between various units of the Institute. Most of the faculty in the College of Agricultural Sciences and Natural Resources hold joint appointments in the Agricultural Experiment Station and are actively involved in significant basic and applied research in agriculture and the associated natural resources. On campus and field research laboratories are utilized in the instructional programs of the college; Extension and research activities provide many students excellent opportunities. The Agricultural Experiment Station provides graduate research assistantships to support graduate students.

The unique association the college has with the University of Tennessee and the other units of the Institute of Agriculture makes it possible for the college to offer comprehensive, high-quality graduate programs.

The graduate student is expected to demonstrate a thorough knowledge of the subject matter in his/her specialized field of study and its relationship to the sociological, economic, and environmental impact on society. The student must demonstrate the ability to plan, conduct, analyze, and report original research. Emphasis is given to intellectual growth and the development of scholarly habits of study, reasoning and analysis so that the graduate will continue to grow and develop professionally throughout his/her career.

Master of Science Programs

Programs of graduate study leading to the Master of Science degree are offered through all departments in the College of Agricultural Sciences and Natural Resources. The graduate program may be entirely in one major subject or may include subject matter areas related to the major.

Both majors and minors are available in agricultural economics, agricultural and extension education, animal science, biosystems engineering, biosystems engineering technology, entomology and plant pathology, environmental and soil sciences, food science and technology, and plant sciences. Majors only are available in forestry and wildlife and fisheries science, and minors are available in general agriculture. The minor in general agriculture requires 12 hours of coursework. A complete listing of majors is shown on the Graduate Degrees, Majors, and Certificate Programs Chart.
**Doctoral Programs**

Graduate study leading to the Doctor of Philosophy degree with majors in animal science, biosystems engineering, food science and technology, natural resources, and plants, soils, and insects is offered in the college.

**Department of AGRICULTURAL AND EXTENSION EDUCATION**

*http://aee.tennessee.edu*

Randol G. Waters, Graduate Liaison

**Professors**

Waters, R.G. PhD ......................................................... Penn State

**Assistant Professors**

Fritz, C.A., PhD ......................................................... Iowa State

**Emeriti Faculty**

Lessly, R.R., EdD.......................................................... Oklahoma State

Todd, J.D., EdD............................................................ Illinois

**MAJOR DEGREE**

Agricultural and Extension Education ........................................ MS

The Department of Agricultural and Extension Education offers a program leading to the Master of Science degree with a major in agricultural and extension education. The program is designed primarily for teachers of Agricultural Education and staff employed by the Agricultural Extension Service. However, due to the flexibility of the program, it would be of value to any student interested in agriculture or adult and continuing education. The program may be completed under a thesis or non-thesis option with a concentration in either agricultural education or agricultural extension education. Candidates for the master’s degree must meet the general requirements of the Graduate Council and those stipulated by the department.

**MASTER OF SCIENCE**

Agricultural and Extension Education Major

**REQUIREMENTS**

**Thesis Option**

A candidate for the master’s degree who elects the thesis option must successfully complete:

- A minimum of 36 hours of graduate credit in courses approved by the student’s advisory committee. Six hours of thesis may be counted toward this requirement.
- A minimum of 20 hours of graduate credit in courses numbered at or above the 500 level.
- A minimum of 12 hours of graduate credit in courses appropriate to the area of concentration taught in the department and a minimum of 6 hours taught from outside the department.
- A minimum of 3 hours of graduate credit in coursework in either research methodology or statistics.
- A final oral examination.

**Non-Thesis Option**

A candidate for the master’s degree who elects the non-thesis option must successfully complete:

- A minimum of 36 hours of graduate credit in courses approved by the student’s advisory committee.
- A minimum of 24 hours of graduate credit in courses numbered at or above the 500 level.
- A minimum of 12 hours of graduate credit in courses appropriate to the area of concentration taught in the department and a minimum of 6 hours taught from outside the department.
- A minimum of 3 hours of graduate credit in coursework in either research methodology or statistics.
- A creative component designed by the student and approved by the student’s advisory committee for 3 hours of graduate credit.
- A written and oral comprehensive examination.

**GRADUATE COURSES**

**Agricultural and Extension Education (042)**

- **500 Thesis (1-15) P/NP only.**
  - **501 Creative Component in lieu of Thesis (3)**
    - Capstone experience completed under supervision of major professor and committee. Individual project: literature survey; development of teaching software; development of curriculum materials; development of white paper; or other suitable project. Prereq: Consent of major professor. Non-thesis majors only. Satisfactory/No Credit grading only.
  - **502 Registration for Use of Facilities (1-15)**
    - Required for the student not otherwise registered during any semester when student uses university facilities and/or faculty time before degree is completed. May not be used toward degree requirements. May be repeated. Satisfactory/No Credit grading only.
  - **511 Extension History, Philosophy and Objectives (3)**
    - Historical and philosophical foundation of adult education in American agriculture, key figures, issues, legislative movement, farmer organizations and programs. Cooperative Extension Service, origin, legislation and growth, and nature of present-day objectives and programs. Prereq: 211 or consent of instructor.
  - **521 Extension Program Planning and Evaluation (3)**
    - Theories and models of program development and evaluation and their use in extension education: planning and conducting needs assessments; planning, organizing, implementing and evaluating extension educational program content and learning activities; development and interaction of county, state and federal extension plans of work; and principles, techniques and instruments used to identify, gather and analyze information to evaluate extension programs. Prereq: 211, 511, or consent of instructor.
  - **522 Educational Technology in Agricultural and Extension Education (3)**
    - Advanced concepts and methods relevant to both formal and non-formal instructional methodologies. Processes by which professional change agents influence the introduction, adoption, and diffusion of technological change. Prereq: 435, 436, or consent of instructor.
  - **524 Research Methodology (3)**
    - Social science research methods related to research in agricultural and extension education. Issues: research design, reliability and validity in measurement, sampling procedures, logic of analysis, scaling and measurement, and selection and interpretation of appropriate inferential tests of significance. Prereq: 436, 511, or consent of instructor.
  - **525 Curriculum Development in Agricultural and Extension Education (3)**
    - Models, principles, and procedures for developing curricula in agriculture and extension education programs and scheduling learning activities used to implement these planned programs. Prereq: 435, 436, or consent of instructor.
  - **526 Agricultural Education for First-Year Teachers (2)**
    - Developing competencies needed by first-year teachers for planning, organizing and conducting program of vocational agriculture in local community. Group meetings in selected centers and visits by instructor. Prereq: 435, 436.
  - **527 Adult Education Strategies in Agricultural and Extension Education (3)**
    - Methods of developing and implementing educational programs for adults in agricultural and extension education and related contexts: different learning needs and priorities; methods and materials effective in teaching adults; developing favorable attitudes toward post-secondary education and life-long learning. Prereq: 211, 511, or 436 or consent of instructor.
Department of AGRICULTURAL ECONOMICS

Dan L. McLemore, Head
John R. Booker, Graduate Liaison

Professors
Brooker, J. R., PhD .................................................. Florida
Cross, T. L. (Assistant Dean), PhD .............................. Oregon State
Eastwood, D. B., PhD .................................................... Tufts
English, B. C., PhD .................................................... Iowa State
Garland, C. D., PhD .................................................... Tennessee
Gerloff, D. G., PhD ..................................................... Texas A&M
Hall, C. R., PhD ........................................................... Mississippi State
Jensen, K. L., PhD .................................................... Oklahoma State
Klindt, T. H. (Associate Dean), PhD ............................ Kentucky
McLemore, D. L., PhD ................................................. Clemson
Orr, R. H., PhD ........................................................ Illinois
Park, W. M., PhD ....................................................... Virginia Tech
Ray, E. D., PhD ........................................................... Virginia Tech
Riley, J. B., PhD ........................................................... Iowa State
Roberts, R. K., PhD ...................................................... Iowa State
Smith, G. F., PhD ..................................................... Tennessee

Associate Professors
De La Torre Ugarte, D.G., PhD ................................. Oklahoma State
Larson, J. A., PhD ...................................................... Oklahoma State
Yen, S. T., PhD ........................................................ Minnesota

Assistant Professors
Bazem, E. F., PhD ...................................................... Kentucky
Clark, C. D., PhD ..................................................... Vanderbilt
Tiller, K. H., PhD ........................................................ Tennessee

Emeritus Faculty
Leuthold, F. O., PhD .................................................... Wisconsin
Mundy, S. D., PhD .................................................... Tennessee

The Department of Agricultural Economics offers a program of graduate study leading to the Master of Science. The MS program may be completed under a thesis option with a concentration in agricultural economics. A non-thesis option is available with concentrations in agricultural economics or agribusiness. For specific information, contact the department head.

MASTER OF SCIENCE
Agricultural Economics Major

REQUIREMENTS
A candidate for the master’s degree must complete a minimum of 30 hours of graduate credit in courses approved by the student’s master’s committee. At least 27 hours of graduate credit must be earned in courses numbered at or above the 500 level.

Agribusiness Concentration
The agribusiness concentration is designed to prepare students to succeed in the public or private sectors of agriculture, including product manufacturing and marketing, natural resource management, farm management, and financial analysis. Fifteen hours of agricultural economics, 3 hours of economic theory, 6 hours of quantitative methods, 6 hours of business, statistics, or communications electives, and 6 hours of internship are required. Each student must pass both written and oral comprehensive examinations.

Agricultural Economics Concentration
The thesis option in agricultural economics is designed to prepare students for analytical and research careers in the public and private sectors and to prepare students interested in entering a PhD program. In the thesis option, 15 hours of agricultural economics, 6 hours of economic theory, 6 hours of quantitative methods, and 6 hours of thesis are required. Each student must pass a final oral examination.

In the non-thesis option, 24 hours in agricultural economics, 6 hours of economic theory, and 6 hours of quantitative methods are required. Each student must pass both written and oral comprehensive exams.

Agricultural Economics Minor
A minor will include 6 hours of coursework in the department, with at least 3 hours in 500-level courses. The student’s committee must include a member of the faculty from the department who will be responsible for designating courses required for the minor.

Environmental Policy Minor
The department participates in a program designed to give graduate students an opportunity to develop an interdisciplinary specialization in environmental policy. See Department of Economics for program description.

GRADUATE COURSES
Agricultural Economics (047)

412 Agricultural Finance (3) Macro-finance, financial objectives, acquisition of debt and equity funds, capital investments, capital allocation, credit analysis, borrower and lender loan application analysis, insurance strategies, computer applications, kinds and sources of agricultural credit, and financial intermediation. Prereq: 212. Economics 201.

420 International Agricultural Trade and Marketing (3) Real and monetary aspects of international trade and effect on agricultural commodity flows; partial equilibrium analysis of international trade in agricultural products; institutional aspects of international marketing of agricultural products. Prereq: 320 or consent of instructor.
430 Agricultural Policy (3) Values, goals and policy process. Economic rationale and effects of policy. Historical development and current characteristics of commodity, credit, food, and trade policy. Prereq: 320 or consent of instructor.

442 Agribusiness Management (3) Applications of advanced decision analysis concepts and tools to analyze management decision problems in farm and non-farm agribusiness settings. Case study work on strategic planning; assessing cost structure using budgeting and breakeven analysis; evaluating profitability, liquidity, and solvency using financial statements; analyzing investments using capital budgeting. Prereq: 342 or consent of instructor.

450 Agricultural Industry Analysis and Forecasting (3) Analytical tools for decision making in agricultural sector; analysis of commodity supply and demand conditions; economic modeling; market forecasting, analysis of temporal and spatial patterns. Prereq: 320, Statistics 201, or consent of instructor.

470 Natural Resource Economics (3) Nature of natural resources; economic efficiency as basis for natural resource use; externalities in natural resource use; factors influencing environmental quality; alternative public policy tools for influencing natural resource use or improving environmental quality. Prereq: Economics 201.

500 Thesis (1-15) P/NP only.

502 Registration for Use of Facilities (1-15) Required for the student not otherwise registered during any semester when student uses university facilities and/or faculty time before degree is completed. May not be used toward degree requirements. May be repeated. Satisfactory/No Credit grading only.

503 Managerial Economics for Agribusiness (3) Practical application of economic concepts to agribusiness management and marketing decisions. Topics include supply and demand analysis, demand estimation, production economics, cost analysis, pricing decisions, break-even analysis, capital budgeting, time value of money, and risk and uncertainty. Students will use Microsoft Excel to analyze managerial economic questions.

505 Microeconomic Analysis (3) Theory of utility maximization and demand, production, cost, firm behavior, and supply; price in product and factor markets; efficiency and welfare. Prereq: Calculus, Intermediate Microeconomics, or equivalent.

534 Econometric Methods in Agricultural Economics (3) Application of statistical methods to agricultural economic models; estimation of supply, demand and production functions; microeconomic forecasting models; interpretation of results. Prereq: Regression and Correlation Methods or consent of instructor.

525 Agribusiness Operations Research Methods (3) Applications of operations research methods and concepts for agribusiness. Theoretical background and applied considerations of each technique with emphasis on applications. Computer and other applications of each technique for relevant agribusiness problems. Prereq: Basic Calculus, 524.

530 Agricultural Policy Analysis (3) Evaluation of public policy as related to agricultural industry and rural areas. Prereq: 505 and Economics 513 or consent of instructor.

542 Advanced Agribusiness Production Decisions (3) Decision theory concepts and tools for analyzing agribusiness decision problems; modeling choices using decision trees and sensitivity analysis; incorporating uncertainty into decision models using probability theory and simulation; modeling preferences using utility theory and risk attitudes. Prereq 505 or equivalent.

550 Advanced Agribusiness Marketing (3) Use of economic concepts in agribusiness marketing decisions. Analysis of agricultural markets; buyer behavior in food and fiber markets; competitive environment. Profitability analysis of marketing and distribution decisions; market planning and strategy; product evaluation and new product introduction; pricing decisions. Prereq: 505 or equivalent.

570 Advanced Natural Resource Economics (3) Analysis of natural resource allocation issues; applied welfare economics, external effects and evaluation of public policy. Prereq: 470, Economics 511, or consent of instructor.

593 Special Topics in Agricultural Economics (1-3) Topics to be assigned. Prereq: Consent of instructor. May be repeated. Maximum 9 hours. Satisfactory/No Credit grading only.

594 Professional Internship (6) Supervised internship experience with appropriate agribusiness firm.

Rural Sociology (880)

580 Advanced Rural Sociology (3) Application of sociological concepts and theory to analyze changing structure and function of rural life in U.S. and developing countries. Demographic changes, rural social and community indicators, and rural development processes. Prereq: 380 or equivalent.

593 Special Topics in Rural Sociology (1-3) Current sociological issues involving application of sociological theory. Prereq: 380 or consent of instructor. May be repeated. Maximum 6 hours.

AGRICULTURE AND NATURAL RESOURCES
(Interdepartmental)

GRADUATE COURSES

Agriculture and Natural Resources (088)

491 International Experience in Agriculture and Natural Resources (1-15) Credit for formalized international experiences related to agricultural sciences and natural resources. Determination of credit based on nature of the proposed experience. Student should discuss the opportunity with their faculty advisor prior to the trip to determine if it is appropriate for credit. Credit hours will be determined by the department and college depending on the extent of activity and types of projects and/or presentations to be completed by the student upon return. Satisfactory/No Credit or letter grade.

507 Professional Development Seminar (1) Planning and executing graduate research programs; ethics and professionalism; graduate program procedures and resources. Satisfactory/No Credit grading only. (Same as Animal Science 507; Entomology and Plant Pathology 507; Food Science and Technology 507; Plant Sciences 507.)

512 Teaching Internship in Agriculture (1) Supervised experience in teaching: test preparation and evaluation of agriculture students. May be repeated. Maximum 2 hours for MS students; 4 hours for PhD students.

Department of ANIMAL SCIENCE

http://animalscience.ag.utk.edu

Alan G. Mathew, Head
K.R. Robbins, Graduate Liaison

Professors
Conatser, G.E., MS ....................................................... Kentucky
Gill, W.W., PhD ........................................................... Kentucky
Godkin, J.D., PhD ...................................................... Massachusetts
Katesh, H.G., PhD ...................................................... Virginia Tech
Kirkpatrick, F.D., PhD .................................................. Tennessee
Lane, C.D., PhD .......................................................... Tennessee
Matthew, A.G., PhD .................................................... Purdue
Meadows, D.G., PhD ..................................................... Texas A&M
Neel, J.B., PhD .......................................................... Tennessee
Oliver, S.P., PhD .......................................................... Ohio State
Robbins, K.R., PhD ...................................................... Illinois
Rogers, G.W., PhD ....................................................... North Carolina State
Saxton, A., PhD .......................................................... North Carolina State

Associate Professors
Grizzle, J.M., PhD ......................................................... Florida
Harper, F., PhD ............................................................. Rutgers
Heitmann, R.N., PhD .................................................... Maine
Schrick, F.N., PhD ...................................................... Clemson
Waller, J.C., PhD .......................................................... Nebraska

Assistant Professors
Edwards, J.L., PhD ......................................................... Florida
Pighetti, G.P., PhD ...................................................... Penn State
Richards, C.J., PhD ..................................................... Kentucky

Instructor
Fisher, A.E., MS .......................................................... Tennessee

MAJOR DEGREES

Animal Science ............................................................. MS, PhD

The Department of Animal Science offers graduate programs leading to the Master of Science and Doctor of Philosophy with a major in animal science. At the MS level, areas of concentration are animal genetics, animal health and well-being, animal management, animal nutrition, and animal physiology with orientation towards beef cattle, dairy cattle, swine, and poultry. The
PhD program offers areas of emphasis in animal genetics, animal health and well-being, animal nutrition, and animal physiology. For specific information, contact the department head.

All first- and second-year MS students are required to enroll in 596 each spring term and all first- and second-year PhD students are required to enroll in 696 each spring term.

**MASTER OF SCIENCE**

**Animal Science Major**

**ADMISSION**

For admission to the MS program, a student must have obtained a 3.0 grade point average on a 4.0 scale (or a 3.0 each term during the junior and senior years) in a completed undergraduate degree program in one of the animal sciences or in a related area. The student must submit evidence (letters of recommendation, personal interview, etc.) that indicates ability to complete requirements for the MS. Prerequisite courses may be required if the student has insufficient undergraduate background. If the student has an unsatisfactory grade point average, acceptance may be on a probationary (non-degree) basis and a minimum of 9 hours of graduate coursework must be completed the first term with a minimum grade point average of 3.0 for admission to the MS program.

**REQUIREMENTS**

The program requires the writing of a thesis based on original research; the completion of a minimum of 24 hours of graduate coursework, of which at least 14 hours must be taken in courses numbered at or above the 500 level; and 6 hours of thesis. Included in the course requirement are 1 hour of Agriculture 512 and a minimum of 3 hours in statistics. These statistics courses must be chosen from the 400, 500, or 600 level of courses approved for use in the Intercollegiate Graduate Statistical Program (ICGSP). The remainder of the coursework will be selected jointly by the student and the major professor depending on the student’s area of concentration and professional objectives.

The advisory committee will consist of the major professor, a faculty member of Animal Science, who will act as chairperson of the committee, and a minimum of two other faculty members, one of whom may be outside of the Animal Science Department. The advisory committee approves the student’s coursework and research problem and conducts the final oral examination, which consists of a comprehensive oral examination and a defense of the thesis.

**DOCTOR OF PHILOSOPHY**

**Animal Science Major**

**REQUIREMENTS**

The doctoral program requires a minimum of 48 semester hours of coursework beyond the BS and a minimum of 24 hours of doctoral research and dissertation. The 48 hours of coursework must include:

- A minimum of 16 hours in related fields outside of animal science.
- At least 24 hours credit at the 500- and 600-level, exclusive of doctoral research and dissertation, of which a minimum of 6 hours must be at the 600-level. Students in the nutrition, breeding, physiology, or anatomy concentration must complete at least 12 hours at the 500- and 600-level in the respective concentration or closely related area. Students in the management concentration must complete 12 hours at the 500- or 600-level in two non-management concentrations.
  - A minimum of 1 hour of Agriculture 512 in addition to that required at the MS level.
  - A minimum of 6 hours in 400-, 500-, or 600-level statistics courses approved for the ICGSP.

A minimum of five faculty members will constitute the student’s advisory committee, of which at least one must be outside animal science. The major professor will be the chairperson. The student and the major professor select a program of study depending on the student’s area of concentration and professional goal. The advisory committee approves the coursework and the dissertation research proposal and determines if there is to be a foreign language requirement. The advisory committee conducts the comprehensive written and oral examination and the final dissertation defense examination.

**GRADUATE COURSES**

**Animal Science (113)**

- 420 Advanced Reproduction (3) Collection, evaluation, and preservation of ova, spermatozoa and embryos; application of methods of natural breeding and techniques of artificial insemination and embryo transfer; herd sire and dam evaluation; pregnancy determination; gestation and parturition; infertility; recent advances in theriogenology. 1 hour and 2 labs. Prereq: 320 or equivalent.
- 430 Nutrient Evaluation and Ration Formulation (3) Ration nutrient analysis and formulation for beef and dairy cattle, sheep, horses, swine, poultry, laboratory, zoo, and companion animals. Mathematical and computer solutions and applications to formulating complex rations with constraints. 2 hours and 1 lab. Prereq: 330 or equivalent and introductory computer science course.
- 481 Beef Cattle Production and Management (3) Integration of principles of nutrition, breeding, physiology, and marketing into complete production and management programs. Structure of industry, enterprise establishment, systems of production, production practices, and improvement programs. Management evaluated in terms of production response and economic returns. Comparisons made to small ruminant, forage-based production systems. 2 hours and 1 lab. Prereq: Completion of Animal Science sophomore and junior core courses or consent of instructor.
- 482 Dairy Cattle Production and Management (3) Integration of principles of nutrition, breeding, physiology, and marketing into complete production and management programs. Structure of industry, enterprise establishment, systems of production, production practices, and improvement programs. Management evaluated in terms of production responses and economic returns. 2 hours and 1 lab. Prereq: Completion of 300-level core courses or equivalent or consent of instructor.
- 483 Pork Production and Management (3) Integration of principles of nutrition, breeding, physiology, and marketing into complete production and management programs. Structure of industry, enterprise establishment, systems of production, production practices, and improvement programs. Management evaluated in terms of production responses and economic returns. 2 hours and 1 lab. Prereq: Completion of 300-level core courses or equivalent or consent of instructor.
- 484 Poultry Production and Management (3) Integration of principles of nutrition, breeding, physiology, and marketing into complete production and management programs. Structure of industry, enterprise establishment, systems of production, production practices, and improvement programs. Management evaluated in terms of production responses and economic returns. 2 hours and 1 lab. Prereq: Completion of 300-level core courses or equivalent or consent of instructor.

- 500 Thesis (1-15) P/NP only.
- 502 Registration for Use of Facilities (1-15) Required for the student not otherwise registered during any semester when student uses university facilities and/or faculty time before degree is completed. May not be used toward degree requirements. May be repeated. Satisfactory/No Credit grading only.
- 507 Professional Development Seminar (1) (Same as Agriculture and Natural Resources 507; Entomology and Plant Pathology 507; Food Science and Technology 507; Plant Sciences 507.)
511 Special Problems in Animal Science (1–4) Prereq: Consent of instructor and department head. May be repeated. Maximum 9 hours.


523 Advanced Mammalian Reproduction (3) Current topics and new frontiers in reproductive biology. Prereq: 520.

530 Animal Nutrition and Metabolism (4) Comparative digestive physiology, digestion, absorption and metabolism of nutrients in ruminant and nonruminant species. Concepts and methodologies of animal growth and nutrient requirements; interrelationships, availability and deficiencies of nutrients. Prereq: Animal Nutrition, Feeds, and Ration Formulation or consent of instructor.

535 Ruminology (2) Anatomy, physiology, and microbiology of rumin ecosystem: microbial fermentation and metabolism of polysaccharides, lipids and nitrogen. Prereq: 530 or consent of instructor.

571 Design and Analysis of Biological Research (3) Experimental design and procedures; selection of experimental units; analysis and interpretation of data; statistical models and contrasts, analyses of variance: covariates, treatment arrangements, mean separation and regression. Prereq: Plant Sciences 471 or equivalent; knowledge of software package on micro- or mainframe computer. (Same as Plant Sciences 571.)

572 Least Squares Analysis (3) Least squares estimation and hypothesis testing procedures for linear models; mixed model methodology; full rank and non-full rank situations; covariance structures; estimation of variance components. 2 hours and 1 lab. Prereq: 571 or equivalent.

596 Seminar on Advanced Topics in Animal Science (1) Required of all first- and second-year MS students. May be repeated. Maximum 2 hours.

600 Doctoral Research and Dissertation (3-15) P/NP only.

621 Advanced Topics in Animal Physiology (1-4) Recent advances and concepts, research techniques, current problems. May be repeated. Maximum 6 hours.

631 Advanced Topics in Animal Nutrition (1-4) Recent advances and concepts, research techniques, current problems. May be repeated. Maximum 6 hours.

651 Advanced Topics in Animal Anatomy (1-4) Current and future research methodology, laboratory situation, recent advances in quantitative techniques for gross and microscopic anatomy. Prereq: Consent of instructor. May be repeated. Maximum 6 hours. (Same as Comparative and Experimental Medicine–Veterinary Medicine 651.)

652 Disorders of the Endocrine System (2) Pathological and physiological aspects of diseases; endocrine glands of various animal species. Prereq: 520 or consent of instructor. (Same as Comparative and Experimental Medicine–Veterinary Medicine 652.)

681 Advanced Topics in Animal Health and Well-Being (1-4) Recent advances and concepts, research techniques, and current problems associated with animal health and behavior. May be repeated. Maximum 6 hours.

696 Seminar (1) Advanced topics in animal science. Required of all first- and second-year PhD students. May be repeated. Maximum 2 hours.

Department of
BIOSYSTEMS ENGINEERING AND ENVIRONMENTAL SCIENCE
http://bioeng.cas.vt.edu

Ronald E. Yoder, Head
D. Raj Raman, Graduate Liaison

Professors
Ammons, J.T., PhD ................................................. West Virginia
Ayers, P.D., PhD, PE ............................................. North Carolina State
Buschermohle, M.J., PhD ........................................ Clemson
Essington, M.E., PhD ............................................ California (Riverside)
Freeland, R.S., PhD, PE ........................................ Tennessee
Mote, C.R. (Assistant Dean, Tennessee Agricultural Experiment Station), PhD, PE ................................ Ohio State
Tompkins, F.D. (Vice President for Research, UTK), PhD, PE ................................ Tennessee
Tyler, D.D., PhD .................................................. Kentucky
Wilhelm, L.R. (Associate Dean, College of Engineering), PhD, PE ................................................ Tennessee

Wills, J.B., MS ......................................................... Tennessee
Yoder, D.C., PhD .................................................. Purdue
Yoder, R.E., PhD, PE .............................................. Colorado State

Associate Professors
Burns, R.T., PhD, PE ............................................ Tennessee
Grandle, G.F., Ph.D .............................................. Tennessee
Hart, W.E., PhD .................................................. Purdue
Hayes, D.G., PhD ................................................ Michigan
Logan, J., PhD .................................................... Nebraska
Radoosevich, M., PhD .......................................... Ohio State
Raman, D.R., PhD, PE ........................................... Cornell
Savoy, H.J., PhD .................................................. Louisiana State
Walker, F.R., PhD ............................................... North Carolina State
Wilkerson, J.B., PhD ............................................. Purdue
Womac, A.R., PhD, PE ......................................... Tennessee

Assistant Professors
Buchanan, J.R., PhD, PE ....................................... Iowa State
Eash, N.S., PhD .................................................. Iowa State
Lee, J., PhD ....................................................... Penn State
Leib, B.G., PhD .................................................. Oklahoma State

MAJORS

WILDLANDS ENGINEERING

PhD

Wisconsin

WISCONSIN?

MAJORS

WILDLANDS ENGINEERING

PhD

Wisconsin

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MAJORS

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MAJORS

WILDLANDS ENGINEERING

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at universities. Student/faculty seminars are one of the professionally rewarding activities of the community. Accordingly, all graduate students are encouraged to participate in Biosystems Engineering 503 and other departmental seminars regardless of whether they are registered for seminar credit.

ADMISSION
A completed departmental data sheet and three completed Graduate Rating Forms are required in addition to the Application for Graduate Admission. Students must submit scores from the GRE general examination. Each applicant will be advised about any prerequisite courses before entering a program. The student’s program of study must be approved by his/her advisory committee and must comply with the requirements of the Graduate Council.

MASTER OF SCIENCE
Biosystems Engineering Major

REQUIREMENTS
Applicants accepted into the program must complete at least 30 semester hours to earn a degree. Of these 30 hours, 20 must be in courses numbered 500 or greater (6 hours of thesis plus 14 hours of other courses). Biosystems Engineering 503 Seminar (1) must be taken three times during the course of the program, the last of which must be in the student’s final semester before graduation. Other specific requirements for the 30 hours are:

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biosystems Engineering 503 (3 times 1 hour)</td>
<td>12</td>
</tr>
<tr>
<td>and other major subject coursework</td>
<td></td>
</tr>
<tr>
<td>Coursework in computational methods</td>
<td>6</td>
</tr>
<tr>
<td>Program Electives</td>
<td>6</td>
</tr>
<tr>
<td>Thesis 500</td>
<td>6</td>
</tr>
<tr>
<td>Total</td>
<td>30</td>
</tr>
</tbody>
</table>

In addition to completing the 30 semester hours, master’s students must pass a final oral examination covering the thesis, related areas, and graduate coursework.

MASTER OF SCIENCE
Biosystems Engineering Technology Major

REQUIREMENTS
Thesis Option
Applicants accepted into the program must complete at least 50 semester hours to earn a degree. Of these 50 hours, 20 must be in courses numbered 500 or greater (6 hours of thesis plus 14 hours of other courses). Biosystems Engineering Technology 503 Seminar (1) must be taken three times during the course of the program, the last of which must be in the student’s final semester before graduation. Other specific requirements for the 30 hours are:

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thesis 500</td>
<td>6</td>
</tr>
<tr>
<td>Program Electives</td>
<td>6</td>
</tr>
<tr>
<td>Coursework in computational methods</td>
<td>6</td>
</tr>
<tr>
<td>Coursework in special emphasis area</td>
<td>6</td>
</tr>
<tr>
<td>Capstone Experience (project and report, typically 508)</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>30</td>
</tr>
</tbody>
</table>

In addition to completing the 30 semester hours, non-thesis students must pass a comprehensive written final examination covering the graduate program, including the capstone experience. At the discretion of the candidate’s committee, an oral examination may also be required.

MASTER OF SCIENCE
Environmental and Soil Sciences Major
Students seeking a Master of Science degree with a major in environmental and soil sciences will generally concentrate their studies in one of the environmental and soil sciences focus areas. The focus areas include: soil and water chemistry; nutrient and elemental cycling; land management and reclamation; pedology, genesis, and classification; environmental climatology; soil biology and biochemistry; and soil physical processes. Both thesis and non-thesis options are available. Please see the environmental and soil sciences master’s concentration homepage for additional information: http://bioengr.ag.utk.edu/graduate/, or contact the environmental and soil sciences program’s graduate liaison.
ADMISSION

Applicants having bachelor’s degrees in fields that are related or unrelated to environmental and soil sciences may apply, although acceptance may be contingent upon the completion of prerequisite course work. Submit application, official transcripts, scores from the general portion of the Graduate Record Examination, and fee to the Graduate Admissions Office. In your application, indicate that you are applying to the environmental and soil sciences Master of Science program. Submit curriculum vitae, three letters of reference (or three Graduate Rating Forms), and a short statement of professional goals and reasons for applying to: ESS Master’s Program Coordinator, Biosystems Engineering and Environmental Science Department, University of Tennessee, 2506 E.J. Chapman Dr., Knoxville, Tennessee 37996-4531.

REQUIREMENTS

Thesis Option

To obtain a Master of Science degree, the student must meet the following requirements, in addition to those of the Graduate Council (as specified in the Master’s Degree section at the front of this catalog).

• Upon consultation with the department head, the student will be assigned a major professor who acts as chair of the student’s advisory committee. The student and the major professor will assemble a graduate advisory committee consisting of the major professor and a minimum of two additional faculty, each holding the rank of assistant professor or above. At least one-half of the committee members must hold teaching appointments. The advisory committee must be formalized by the end of the second semester of graduate study.

• Develop and submit an approved program of study by the end of the second semester of graduate study. A minimum of 24 hours of graduate coursework is required in the program of study, exclusive of six hours of 500 Thesis. The program of study is subject to the approval of the student’s advisory committee, and must meet the following requirements:

<table>
<thead>
<tr>
<th>Hours Credit</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>503 Seminar</td>
<td>3</td>
</tr>
<tr>
<td>Courses numbered above 503</td>
<td>12</td>
</tr>
<tr>
<td>503 and below</td>
<td>9</td>
</tr>
<tr>
<td>500 Thesis</td>
<td>6</td>
</tr>
<tr>
<td>Total</td>
<td>30</td>
</tr>
</tbody>
</table>

*Courses that are in the major include those in environmental and soil sciences. In addition, Geology 510 and Environmental Engineering 535 are in the major. The student’s committee may require additional coursework beyond the 24 hours if the student’s progress or background indicates a need or deficiency.

• Develop a research problem and presentation by means of a written proposal to the student’s committee. This must be completed during the first two semesters of graduate study and before enrollment in 500.

• Pass a final oral exam that integrates the student’s thesis and coursework, administered by the advisory committee. The student is expected to be conversant in the soil and environmental sciences, particularly in the thesis and allied areas.

• Environmental and Soil Sciences 503 Seminar (1) must be taken three times during the course of the program, the last of which must be in the student’s final semester before graduation.

A student who has started a degree program under the thesis option is not eligible to transfer to the non-thesis option after the end of the first semester of graduate study or after receiving a graduate assistantship stipend for more than one semester.

Non-Thesis Option

A student desiring the non-thesis option must declare his/her intention before the beginning of the second semester of study. The student must meet the following requirements, in addition to those of the Graduate Council (as specified in the Master’s Degrees section at the front of this catalog).

• Upon consultation with the department head, the student will be assigned a major professor who acts as chair of the student’s advisory committee. The student and the major professor will assemble a graduate advisory committee consisting of the major professor and a minimum of two additional faculty, each holding the rank of assistant professor or above. At least one-half of the committee members must hold teaching appointments. The advisory committee must be formalized by the end of the second semester of graduate study.

• Develop and submit an approved program of study by the end of the second semester of graduate study. A minimum of 33 hours of graduate coursework is required in the program of study. The program of study is subject to the approval of the student’s advisory committee, and must meet the following requirements:

<table>
<thead>
<tr>
<th>Hours Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>503 Seminar</td>
</tr>
<tr>
<td>593 Special Problems in Environmental and Soil Sciences</td>
</tr>
<tr>
<td>Courses numbered above 503 (exclusive of 593)</td>
</tr>
<tr>
<td>Courses within the major (excluding 500 and 502)</td>
</tr>
</tbody>
</table>

Courses that are in the major include those in environmental and soil sciences. In addition, Geology 510 and Environmental Engineering 535 are in the major. The student’s committee may require additional course work beyond the 33 hours if the student’s progress or background indicates a need or deficiency.

• In lieu of a thesis, students are required to complete three hours of 593 by participating in a single research program for a period of 12 weeks. The advisory committee approves the research problem. Satisfactory completion of this requirement requires a written, original research report that is acceptable to the student’s committee.

• Pass a comprehensive written examination that integrates the student’s course work and research problem. The exam is developed and administered by the advisory committee.

• Environmental and Soil Sciences 503 Seminar (1) must be taken three times during the course of the program, the last of which must be in the student’s final semester before graduation.

A student who has started a degree program under the non-thesis option may transfer to the thesis option upon approval of a potential major professor and the department head.
DOCTOR OF PHILOSOPHY
Plants, Soils, and Insects Major · Environmental and Soil Sciences Concentration

A doctorate with a major in plants, soils, and insects, with a concentration in environmental and soil sciences, is offered under a multi-departmental doctoral program. Three departments participate: Plant Sciences, Entomology and Plant Pathology, and the soils faculty in Biosystems Engineering and Environmental Sciences. Other concentrations within the PSI doctoral program include horticulture, crop sciences, weed biology, plant improvement, entomology, plant pathology, integrated pest management and plant bioactive compounds. Focus areas in the environmental and soil sciences concentration include soil and water chemistry; nutrient management; pedology, genesis and classification; environmental climatology; soil biology and biochemistry; and soil physical processes. Please see the environmental and soil sciences doctoral concentration home page for additional information, http://bioengr.ag.utk.edu/graduate/, or contact a faculty member in the area of interest.

ADMISSION

Submit application, fee, official transcripts, and scores from the general portion of the Graduate Record Examination to the Graduate Admissions Office. In your application, indicate that you are applying to the plants, soils, and insects doctoral program. Submit resume, three letters of reference (or three Graduate Rating Forms), photocopy of GRE scores and a short statement of professional goals and reasons for applying to: Environmental and Soil Sciences PhD Program Coordinator, Biosystems Engineering and Environmental Sciences Department, the University of Tennessee, Knoxville, 2506 E.J. Chapman Drive, Knoxville, Tennessee 37996-4531. In your statement letter and application, please indicate your interest in the environmental and soil sciences concentration.

REQUIREMENTS

To obtain the doctorate, the student must meet the following requirements:

- The student and the major professor will select a minimum of three additional faculty, holding the rank of assistant professor or above, to serve on the student’s doctoral committee. The major professor and two committee members must be approved to direct doctoral research by the Graduate Council, and at least half of the committee must hold teaching appointments. At least one member of the committee must be from outside the department. The doctoral committee must be formalized by the end of the second semester of graduate study. The student is expected to be conversant in the wide area of soil and environmental sciences.

- Submission of an approved program of study by the end of the second semester of graduate study. A candidate for the doctoral degree must complete a minimum of 24 hours of graduate coursework numbered 503 or higher before enrollment in 600. A candidate not having a master’s degree must complete a minimum of 48 hours of graduate coursework beyond the baccalaureate degree, 24 hours of which must be numbered 503 or higher. A minimum of 12 of the 24 hours, or 30 of the 48 hours, must be graded A-F. At least 9 hours of the student’s coursework must be from outside the PSI major, and a minimum of 6 semester hours must be taken in University of Tennessee, Knoxville, courses numbered 601 or higher. In addition, 24 hours of course 600 Doctoral Research and Dissertation are required.

- Satisfactory preparation of a written dissertation proposal and its oral defense to the student’s committee. This must be completed during the first two semesters of graduate study and before enrollment in 600.

- Passing both written and oral sections of the comprehensive examination. The candidate will be tested on his/her knowledge of the proposed dissertation and related fields. The student is expected to be conversant in the wide area of soil and environmental sciences.

- Environmental and Soil Sciences 603 Seminar (1) must be taken three times during the course of the program, the last of which must be in the student’s final semester before graduation.

- Satisfactory preparation of a written dissertation and its oral defense to the student’s doctoral committee.

Please see the Degree Program Requirements/Doctoral Degrees section at the front of this catalog for additional information.

DOCTOR OF PHILOSOPHY
Biosystems Engineering

ADMISSION

Students applying for admission into the doctoral program must submit evidence of ability to perform and report independent research to the satisfaction of the faculty of the department. An approved master’s thesis will usually be acceptable for this purpose.

REQUIREMENTS

To earn a degree, each doctoral student must complete at least 75 hours of approved graduate credit (beyond the baccalaureate degree) in biosystems engineering and supporting areas (engineering, computational methods, agricultural and biological sciences, and other related areas). Of the 75 hours, 48 must be in courses numbered greater than 500 (including 24 hours of course 600) and 6 hours of courses at the University of Tennessee, Knoxville, numbered greater than 600. Other specific requirements for the minimum 75 hours are:

<table>
<thead>
<tr>
<th>Hours</th>
<th>Credit</th>
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<tbody>
<tr>
<td>18</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>2</td>
</tr>
<tr>
<td>21</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>75</td>
</tr>
</tbody>
</table>

1Coursework in computational methods
2Biosystems Engineering 603 Seminar (1)
3Must be taken three times during the course of the program, the last of which must be in the student’s final semester before graduation.

In addition to completing the minimum 75 hours of graduate credit required for a degree, each doctoral student must also pass a comprehensive examination as required by the Graduate Council.
GRADUATE COURSES

Biosystems Engineering (196)

411 Mechanical Systems Engineering (3) Fundamentals of power delivery systems and simple mechanisms; selection and design of mechanical, hydraulic, and tractive power transmission systems. Off-road vehicles and bioprocessing systems. 2 hours and 1 lab. Prereq: Mechanical Engineering 231, 321. Coreq: 321.

416 Hydrologic and Water Quality Engineering (3) An introduction to hydrology including: hydrologic variability, precipitation, evapotranspiration, infiltration, runoff, evaporation, water quality and non-point pollution, energy dissipation, streamflow measurement, hydrographs, routing, open channel flow, and urban hydrology. Prereq: Civil Engineering 390 or Aerospace Engineering 341.

431 Bioprocessing Engineering (3) Application of basic engineering principles to processing and handling of biological materials: physical, chemical, biological properties; materials handling; material conversion operations; drying; heat processing; and bioprocessing. 2 hours and 1 lab. Coreq: 321 or equivalent.

441 Life Systems Engineering (3) Design of controlled environments to optimize conditions for organism growth and development; growth equations and population dynamics; plant growth systems; microbial growth systems; animal growth systems; biotechnological applications. 2 hours and 1 lab. Prereq: Mathematics 231; Coreq: 321.

451 Electronic Systems (4) Basic electronics with biological applications. Analog and digital electronics; sensing and controlling physical and environmental parameters; sensor selection and interfacing; signal conditioning; process control. Laboratory experiments and design projects. 3 hours and 1 lab. Prereq: Electrical Engineering 301.

500 Thesis (1-15) P/NP only.

502 Registration for Use of Facilities (1-15) Required for the student not otherwise registered during any semester when student uses university facilities and/or faculty time before degree is completed. May not be used toward degree requirements. May be repeated. Satisfactory/No Credit grading only.

503 Seminar (1) (Same as Biosystems Engineering Technology 503; Environmental and Soil Sciences 503.)

510 Similitude in Design and Research (3) Dimensional analysis; governing equations; theory of models; true, distorted, dissimilar models; prediction equations; interpretation of data; applications to machinery, soil and water structures, agricultural buildings and other agricultural engineering related problems. 2 hours and 1 lab. Prereq: Engineering Science 321, 341.

525 Soil Erosion and Sediment Yield (3) (Same as Environmental Engineering 525.)

530 Research Problems in Biosystems Engineering (1-3) Theoretical and experimental studies relating to current problems in agricultural engineering. May be repeated. 1 to 6 hours.

532 On-Site Domestic Wastewater Treatment, Disposal and Reuse (3) Design and management of on-site wastewater treatment and disposal systems, use of the soil as a medium for final treatment and for wastewater disposal, concepts of the decentralization of domestic wastewater management, and reuse of treated water for irrigation. 2 hrs and 1 lab. Prereq: Civil Engineering 395 or consent of instructor. (Same as Biosystems Engineering Technology 532.)

541 Principles of Compost Engineering (3) Comprehensive study of composting: survey of installed systems; thermodynamics of composting; biology of composting; kinetics of heat inactivation; feed conditioning; aeration; substrate characteristics; process kinetics; and odor control. Design component. Prereq: Biosystems Engineering Technology 322.

543 Instrumentation and Measurement (3) Modern instrumentation techniques. Static and dynamic response of instrumentation; signal conditioning; temperature, moisture, optical radiation, displacement, strain, pressure, velocity, acceleration, and flow transducers; digital data acquisition and control. 2 hours and 1 lab. Prereq: 451 or Electronics and Computer Circuits or equivalent. (Same as Environmental Engineering 543.)

545 Monitoring Hydrologic Phenomena (3) Application of instrumentation theory to monitoring hydrologic phenomena; strengths and weaknesses of current equipment and strategies; equipment operation and solution of environmental monitoring problems. 2 hours and 1 lab. Prereq: 543 and knowledge of basic hydrology. (Same as Environmental Engineering 545.)

550 Selected Topics (1-3) Lecture/group discussion on specialized topics. May be repeated. Maximum 6 hours.

552 Biological Treatment Theory (3) (Same as Environmental Engineering 552.)

555 GIS and GPS Applications to Biosystems (3) Theory and applications of Geographical Information Systems (GIS) and Global Positioning Systems (GPS); acquiring, managing, and analyzing spatially-varying data. Site-specific agriculture, environmental site assessment, natural resource management, and hydrology. 2 hours and 1 lab. Prereq: Graduate standing in engineering, biological or physical sciences. (Same as Biosystems Engineering Technology 555.)

575 Applied Microbiology and Biotechnology (3) (Same as Chemical Engineering 575; Environmental Engineering 575; Microbiology 575.)

600 Doctoral Research and Dissertation (3-15) P/NP only.

650 Selected Topics (1-3) Lecture, group discussion, and individual study on specialized developments. May be repeated. Maximum 6 hours.

Biosystems Engineering Technology (194)

422 Food and Process Engineering Technology (3) Application of basic engineering principles to agricultural and food processes. Fluid handling, drying, evaporation, thermal processing, heating and cooling, refrigeration systems, and materials handling. 2 hours and 1 lab. Prereq: Physics 101 or 221.

432 Agricultural Machinery and Tractors (3) Functions, selection, matching, and management of agricultural machinery systems. Tractor power ratings, engine and transmission systems, hydraulic systems, hitching, and ballasting. Field and material capacity, field efficiency, cost analysis, and machinery replacement strategies. Functional analyses of storage operations, planters and drills, no-tillage systems, hay harvest systems, forage and small grain harvesting, and cotton harvesting. Crop drying processes, off-road machinery safety considerations, and operator ergonomics. 2 hours and 1 lab. Prereq: Mathematics 123, 125 or consent of instructor.

442 Agricultural Waste Management and Pollution Control (3) Waste management fundamentals: characteristics of animal manure; techniques for collection, transportation, storing, and utilizing livestock waste. 2 hours and 1 lab. Prereq: Mathematics 123, 125 or equivalent.

452 Small Internal Combustion Engines (3) Theory, concepts, and mechanics of small internal combustion engines; theoretical cycles; selection, operation, adjustment, troubleshooting and repair of single-cylinder engines. 2 hours and 1 lab. Prereq: Mathematics 123 or 125 or equivalent or consent of instructor.

462 Agricultural Chemical Application Technology (3) Equipment for application of liquid, solid, and gaseous agricultural chemicals; system components; operational characteristics; calibration; selection and management; safety considerations; materials handling and disposal methods. 2 hours and 1 lab. Prereq: Mathematics 123, 125 or equivalent or consent of instructor.

500 Thesis (1-15) P/NP only.

502 Registration for Use of Facilities (1-15) Required for the student not otherwise registered during any semester when student uses university facilities and/or faculty time before degree is completed. May not be used toward degree requirements. May be repeated. Satisfactory/No Credit grading only.

503 Seminar (1) (Same as Biosystems Engineering Technology 503; Environmental and Soil Sciences 503.)

506 Physical Phenomena (3) Properties of materials, fundamentals of hydraulics, principles of electricity, thermal phenomena, applications in biological systems. 2 hours and 1 lab. Prereq: Consent of instructor.

508 Special Problems in Biosystems Engineering Technology (1-3) Individual studies of current problems. May be repeated. Maximum 6 hours.
Environmental and Soil Sciences (345)

434 Environmental Soil Chemistry (3) Composition and chemical properties of soils and processes that govern fate and behavior of chemicals in soil environment: clay mineralogy; soil organic matter; mineral weathering and stability; aqueous speciation; surface chemistry; ion exchange, adsorption and molecular retention; oxidation-reduction; and soil acidity, alkalinity, and salinity. Prereq: 210; Chemistry 110 or 350.

442 Soil Genesis and Classification (3) Soil genesis and formation; observing and describing morphology of agricultural and forest soils; chemical and physical properties, classification. 3 weekend field trips. 2 hours and 1 lab. Prereq: 210. 420; Physics 221 or equivalent.

444 Transport Processes in Soil (3) Basic understanding of soil physical properties and processes; influence of soil physical properties on water and chemical movement in soil; practical experience in the measurement and analysis of soil physical properties, water flow, and chemical movement in soil. Prereq: 210 and Physics 221 or equivalent.

462 Environmental Climatology (3) Study of atmosphere as environment. Physical, chemical and biological factors affecting climates of various earth environments; meteorological process affecting biosystems. Climatic change and the human impact on the atmosphere, consequences of climatic change and mitigation policies, microclimates and urban climates, atmospheric pollution, extreme events and ozone depletion. Design and operation of weather information systems; automated weather stations. Prereq: Agriculture and Natural Resources 290 or equivalent.

481 Capstone in Environmental and Soil Sciences (3) Integrative course in which students work individually and collaboratively to develop solutions for soil and water related environmental problems. Writing and oral communication emphasis course. Prereq: 434 and senior standing.

500 Thesis (1-15) P/NP only.

502 Registration for Use of Facilities (3-15) Required for the student not otherwise registered during any semester when student uses university facilities and/or faculty time before degree is completed. May not be used toward degree requirements. May be repeated. Satisfactory/No Credit grading only.

503 Seminar (1) Presentations and discussions of current scientific material. May be repeated. Maximum 3 hours. (Same as Biosystems Engineering 503; Biosystems Engineering Technology 503.)

511 Soil-Plant Relationships (3) Principles of mineral nutrition of higher plants: plant physiological characteristics that influence uptake of water and nutrients; functions of nutrient elements in plants; soil factors influencing nutrient availability to plants; important relationships at soil-plant root interface; and responses to adverse soil environmental conditions. 3 hours and 1 rec. Prereq: 434 or Integrated Plant Systems 431 or Plant Sciences 431 or General Plant Physiology.

512 Pedology (3) Physical and chemical weathering processes, factors of soil formation, soil forming processes. 2 hours and 1 lab. Prereq: 442 or consent of instructor.

513 Advanced Soil Chemistry (3) Chemical properties and processes that operate in soil environment: thermodynamics of soil solutions and surface chemistry of soils, soluble complex formation, mineral solubility, electrochemical equilibria, geochemical modeling, ion exchange equilibria, surface functionality and reactivity, adsorption phenomena, and surface complexation modeling. Prereq: 434 or consent of instructor.

514 Environmental Soil Physics (3) Principles of water, gas, heat, and solute movement in soil/water systems; application of appropriate models for the description of these processes; methods for characterizing hydraulic and chemical transport properties of soil; applications of the science of soil physics to solution of contemporary problems in water conservation, prevention of surface/ground water contamination, and management of plant water status. Prereq: 444 or equivalent.

516 Soil Biology and Biochemistry (3) Soil organisms and their activities in soils: soil ecology, biogeochemical cycling of important elements, organic matter dynamics, and applications of agricultural and environmental biology and biochemistry. 2 hours and one 3 hour lab. Prereq: 210 or consent of instructor.

593 Special Problems in Plant and Soil Science (1-3) May be repeated. Maximum 6 hours.

600 Doctoral Research and Dissertation (3-15)

601 Special Topics in Soil Science (1-3) Thermodynamics of soil solutions, clay structure and surface chemistry, soil mineralogy, plant mineral nutrition, soil microbiology, water movement and use by plants, soil structure, soil thermal properties, interaction in the soil-plant environment. May be repeated. Maximum 6 hours.

603 Seminar (1) Presentations and discussion of current scientific material. May be repeated. Maximum 3 hours. (Same as Biosystems Engineering 603.)

613 Advanced Topics in Soil Chemistry and Fertility (2) Topics of current significance; scientific literature. Prereq: 513 or equivalent.

614 Advanced Topics in Soil Biology and Biochemistry (2) Topics of current significance; scientific literature. Prereq: 516 or equivalent.

615 Advanced Topics in Soil Physics, Genesis, and Morphology (2) Topics of current significance; scientific literature.

Department of
ENTOMOLOGY AND PLANT PATHOLOGY
http://eppepservetag.ufl.edu

Carl J. Jones, Head
Reid R. Gerhardt, Graduate Liaison

Professors

Bernard, E.C., PhD ................................................................. Georgia
Bost, S.C., PhD ................................................................. North Carolina State
Burgess, E.E., PhD .............................................................. Tennessee
Gerhardt, R.R., PhD .......................................................... North Carolina State
Grant, J.F., PhD ................................................................. Clemson
Hale, F.A., PhD ................................................................. Ohio State
James, C.J., PhD ................................................................. Wyoming
Lambdin, P.L., PhD .............................................................. Virginia Tech
Newman, M.A., PhD ............................................................. Texas A&M
Patrick, C.R., PhD ............................................................... Mississippi State
Skinner, J.A., PhD ............................................................... California (Davis)
Trigiano, R.N., PhD ........................................................... North Carolina State
Windham, A.S., PhD ........................................................ North Carolina State
Windham, M.T., PhD ........................................................ North Carolina State

Associate Professors

Camaday, C.H., PhD ............................................................. Ohio State
Gwinn, K.D., PhD .............................................................. North Carolina State
Lentz, G., PhD ................................................................. Iowa State
Owney, B.H., PhD ......................................................... North Carolina State
Stewart, S.D., PhD ........................................................ Auburn
Vail, K.M., PhD ............................................................ Florida

Assistant Professors
Hajimorad, M., PhD ...................................................... Adelaide (Australia)
Lamour, K., PhD .......................................................... Michigan State
Moulton, J.K., PhD ........................................................ Arizona

MAJOR DEGREES
Entomology and Plant Pathology ........................................ MS
Plants, Soils, and Insects .................................................... PhD

The Department of Entomology and Plant Pathology offers a graduate program leading to the Master of Science with a major in entomology and plant pathology, and the Doctor of Philosophy through the interdisciplinary plants, soils and insects program. Students in the entomology concentration may specialize in crop entomology, medical and veterinary entomology, insect biology, insect pest management, or biological control. Students in the plant pathology concentration may specialize in foliar and stem fungus diseases, soilborne pathogens, disease physiology, biocontrol, plant nematology, or virology. For specific information, contact the department head.

MASTER OF SCIENCE
Entomology And Plant Pathology Major

ADMISSION

For admission to the MS program, a student must meet all requirements of the University of Tennessee, Knoxville, Graduate Council and must have completed (1) general botany or biology, 8 hours; (2) advanced biological sciences, 8 hours; (3) general inorganic chemistry, 6-8 hours; (4) organic chemistry, 3 hours. In addition, three completed rating forms and a written statement of career goals and interest in entomology or plant pathology should be submitted to the department. Submit application, fee, official transcripts, and scores from the general portion of the Graduate Record Examination to the Graduate Admissions Office.

REQUIREMENTS

The program requires a written thesis based on original research and the completion of a minimum of 24 hours of coursework for graduate credit, approved by the student’s advisory committee. Included in the course requirements are two acceptable seminar presentations for one hour each. An oral final exam must be passed to the satisfaction of the advisory committee after the thesis has been completed. A minor is not required but may be selected at the option of the student. The minor will include at least six hours and not more than 10 hours of graduate-level credit in the minor department. The student’s committee shall include a member of the faculty from the minor department to assist in designating courses required for the minor.

DOCTOR OF PHILOSOPHY
Plants, Soils, and Insects Major ∙ Entomology, Plant Pathology, Integrated Pest Management, Bioactive Natural Products Concentrations

A PhD with a major in plants, soils and insects (PSI), with concentrations in entomology, plant pathology, integrated pest management, and bioactive natural products, is offered under a multi-departmental doctoral program. Three departments participate: Plant Sciences, Entomology and Plant Pathology, and the soils faculty in Biosystems Engineering and Environmental Sciences. Other concentrations within the PSI major include horticulture, crop sciences, weed biology, plant improvement, and environmental and soil sciences. Please see the doctoral program links on the homepage of the Department of Entomology and Plant Pathology for additional information, http://eppservlet.ag.utk.edu/, or contact a faculty member in the area of interest.

ADMISSION

Submit application, fee, official transcripts, and scores from the general portion of the Graduate Record Examination to the Graduate Admissions Office. In your application, indicate that you are applying to the plants, soils and insects doctoral program. Submit resume, three letters of reference (or three Graduate Rating Forms), photocopy of GRE scores and a short statement of professional goals and reasons for applying to EPP PhD Program Coordinator, Department of Entomology and Plant Pathology, 2431 Joe Johnson Drive, 205 PSB, University of Tennessee, Knoxville, Tennessee, 37996-4560. In your statement letter and application, please indicate your concentration of interest and intended major professor.

REQUIREMENTS

To obtain the doctorate, the student must meet the following requirements:

- The student and the major professor will select a minimum of three additional faculty, holding the rank of assistant professor or above, to serve on the student’s doctoral committee. The major professor and two committee members must be approved to direct doctoral research by the Graduate Council, and at least half of the committee must hold teaching appointments. At least one member of the committee must be from outside the department. The doctoral committee must be formalized by the end of the second semester of graduate study.

- Submission of an approved program of study by the end of the second semester of graduate study. A candidate for the doctoral degree must complete a minimum of 24 hours of graduate coursework numbered 503 or higher beyond the master’s degree. Candidates not having a master’s degree must complete a minimum of 48 hours of graduate coursework beyond the baccalaureate degree, 24 hours of which must be numbered 503 or higher. A minimum of 12 of the 24 hours, or 30 of the 48 hours, must be graded A-F. At least nine hours of the student’s coursework must be from outside the PSI major, and a minimum of six semester hours must be taken in University of Tennessee courses numbered 601 or higher. In addition, 24 hours of course 600 Doctoral Research and Dissertation are required.

- Satisfactory preparation of a written dissertation proposal and its oral defense to the student’s committee. This must be completed during the first two semesters of graduate study and before enrollment in 600.

- Passing both written and oral sections of the comprehensive examination. The candidate will be tested on his/her knowledge of the proposed dissertation and related fields.
5.33 Concentrated Study in Entomology (1-3) Selected subjects in entomology for advanced students, concentrated in time and subject matter. Prereq: 321 or basic entomology course. May be repeated. Maximum 6 hours.

5.41 Seminar (1) Review of literature and current research in entomology and plant pathology. May be repeated. Maximum 2 hours. MS students only.

5.44 Protein Gel Electrophoresis (1) Practical experience with isolating native and denatured proteins from plants and fungi, determining protein concentrations, PAGE of proteins including total proteins and assays for specific enzymes (isozyme) analyses. 1 hour and 4 labs weekly for 5 weeks. Prereq: 8 hours biological/botanical sciences, 8 hours chemistry, consent of instructor. (Same as Plant Sciences 544.)

5.45 Plant Microtechnique (1) Practical light and scanning electron microscopy methods for investigating aspects of plant development, histochemistry and pathological structures in ornamental forest and crop species. 1 hour and 4 labs weekly for 5 weeks. Prereq: 8 hours biological/botanical sciences and consent of instructor. (Same as Plant Sciences 545.)

6.00 Doctoral Research and Dissertation (3-15) Doctoral Research and Dissertation. P/NP only.

6.02 Advanced Topics in Entomology (1-3) Morphology, systematics, physiology, ecology and genetics of arthropods, apiculture, medical and veterinary entomology, insect biodiversity, and insect pathology. May be repeated. Maximum 12 hours.

6.04 Advanced Topics in Plant Pathology (1-3) Biological control, disease diagnosis and management, epidemiology, fungal plant pathogens, integrated pest management, molecular plant-microbe interactions, nematology, plant pathogenesis, plant pathogenic bacteria, soil- and seed-borne pathogen, and virology. May be repeated. Maximum 12 hours.

6.06 Advanced Topics in Bioactive Natural Products (1-3) Bioactive pesticides, ethnobotany and paleoethnobotany, ethnomedicine, biocontrol of plant pathogens, bioprospecting, natural product diversity, alternative bioactive crops, organic agriculture, allelopathy in agriculture, regulatory issues in natural product development, and bioactivity-guided isolation. May be repeated. Maximum 12 hours.

6.12 Soilborne Plant Pathogens (3) Causal agents; host-parasite-soil environment interactions; epidemiology; detection and identification of soilborne plant pathogens; biological, cultural, and chemical control. MS students only. Students who have received credit for 512, may not enroll in 512. Prereq: 313 or consent of instructor.

6.14 Bacterial Plant Diseases (2) Morphology, taxonomy, ecology, physiology, and genetics of bacterial plant pathogens; infection and disease development, pathogenesis and resistance; diagnosis, detection, effect of environment, and management of bacterial plant diseases; beneficial plant-bacterial interactions. 3 hours and 1 lab for 7 weeks. Prereq: 313 or consent of instructor.

6.15 Physiology of Plant Disease (3) Biochemical and physiological events involved in host-pathogen interactions. Mechanisms of disease resistance. Prereq: Introductory plant physiology and pathology, or consent of instructor.

6.20 Plant Parasitic Nematodes (2) Morphology, physiology, taxonomy, ecology, and management of plant parasitic nematodes, host-parasite relationships. 2 hours and 2 labs weekly for 7 weeks. Prereq: 6 hrs biological science or consent of instructor.

6.21 Plant Virology (3) Symptomatology, epidemiology, and management of virus infection; structure, morphology, replication and transmission, purification, characterization, and classification of plant viruses; serology; plant pathogenic viroids, mycoplasmas and viroplasmas. 2 hours and 1 lab. Prereq: 313 or consent of instructor.

6.23 Field Crop and Vegetable Insects (2) Identification, biology and management of insects affecting commercial vegetable and home garden crops. 1 hour and 1 lab. Prereq: 321 or basic entomology course.

6.25 Medical and Veterinary Entomology (3) Morphology, taxonomy, biology and control of arthropod parasites and vectors of humans and animals. Ecology and behavior of vectors in relation to pathogen transmission and control. 2 hours and 1 lab. Prereq: 321 or 325, or consent of instructor.

6.30 Integrated Pest Management (3) Principles and application of biological, cultural, genetic, behavioral, and chemical methods of control to maintain pest populations below economic threshold levels. Prereq: 321, or consent of instructor. (Same as Plant Sciences 530.)

6.31 Special Problems in Entomology (1-3) Comprehensive individual study of current problems. May be repeated. Maximum 6 hours.

6.32 Special Problems in Plant Pathology (1-4) Comprehensive individual study of current problems. May be repeated. Maximum 6 hours.

Department of

FOOD SCIENCE AND TECHNOLOGY

http://foodscience.utk.edu

H.C. Goan, Head
David A. Golden, Graduate Liaison

Professors

Brekke, C.J., PhD .................................................. Wisconsin
Davidson, P.M., PhD .............................................. Washington State
Draughon, F.A., PhD .................................................. Georgia
Goan, H.C., PhD ...................................................... Michigan State
Morris, W.C., PhD ................................................... Iowa State
Penfield, M.P., PhD .................................................. Tennessee

Associate Professors

Golden, D.A., PhD .................................................. Georgia
Loveday, H.D., PhD .................................................. Kansas State
Mount, J.R., PhD ..................................................... Ohio State
The Department of Food Science and Technology offers the Master of Science and Doctor of Philosophy degrees with a major in food science and technology. Students in the doctoral program may choose research in the concentration areas of food processing, food chemistry, food microbiology or sensory evaluation of foods. Commodity interests (meats, dairy, fruits, vegetables, bakery products) can be emphasized in any of the areas by careful selection of courses and the research topic. Minors are available in cognate fields. For detailed information, contact the department head.

ADMISSION

Admission requirements of the Graduate Council of the University of Tennessee, Knoxville, apply. In addition, applicants must submit scores from the general section of the Graduate Record Exam (GRE), a written statement of educational and career goals, and Graduate Rating Forms or letters of recommendation from at least three people familiar with the applicant’s scholastic ability and professional potential. Admission to the program is contingent upon faculty evaluation of the applicant’s undergraduate/graduate GPA, GRE scores, rating forms, relevant work experience, and scores from the Test of English as a Foreign Language (TOEFL), if applicable.

MASTER OF SCIENCE
Food Science And Technology Major

Applicants must have a BS in food technology, food science, or a related scientific field.

REQUIREMENTS

Thesis Option

- Prior to research for the thesis, the student must develop a detailed written research plan. Registration for 6 hours of 500 Thesis is required.
- In addition to the thesis requirement, a minimum of 24 semester hours of graduate coursework is required. This work must be approved by the student’s committee and a minimum of 14 hours must be courses numbered above 500. The committee may require additional coursework if the student’s progress or background indicates such need.
- All students are required to take 2 hours of 501 Seminar in their program and are expected to attend this course and participate in discussions during their master’s program. Completion of 510 or equivalent is also required.
- An oral, final examination covering the thesis and coursework is required.

Non-Thesis Option

- In lieu of a thesis, students are required to complete a problem in cooperation with their employer (company or governmental agency) and their faculty committee. Students working on a problem must register for 6 hours of 503.
- In addition to the requirement for 6 hours of 503, a minimum of 24 semester hours of graduate coursework is required. This work must be approved by the student’s committee and a minimum of 14 hours must be courses numbered above 500. The committee may require additional coursework if the student’s progress or background indicates such need.
- All students are required to take 2 hours of 501 Seminar in their program and are expected to attend this course and participate in discussions during their master’s program. Completion of 510 or equivalent is also required.
- Students will be required to take a written comprehensive examination covering their coursework. In addition, an oral, final examination covering the problem and coursework is required. The oral examination will be held on the Knoxville campus.

DOCTOR OF PHILOSOPHY
Food Science And Technology Major

REQUIREMENTS

- Completion of a master’s degree in the field, or a closely related field, or passing a special qualifying examination is required for admission.
- A dissertation is required for the PhD degree. Each student must develop a detailed written plan for the dissertation research.
- A minimum of 72 hours beyond the bachelor’s degree, excluding credit for the master’s thesis, is required. Of this, 24 semester hours must be 600 Doctoral Research and Dissertation.
- At least 24 hours of coursework numbered above 500 are required exclusive of doctoral research and dissertation. At least 6 of the 24 hours must be courses numbered above 600.
- A minimum of 6 hours of courses for graduate credit must be taken outside the Department of Food Science and Technology.
- All candidates must complete 601 (2 hours) and are expected to attend 601 during their PhD program.
- Each candidate must pass both written and oral comprehensive examinations prior to admission to candidacy. Major professors will advise candidates on competencies expected. A final oral examination is required that includes a defense of the dissertation and subject matter that the student’s committee considers appropriate.
GRADUATE COURSES
Food Science and Technology (390)

410 Food Chemistry (4) Reactions of water, proteins, lipids, carbohydrates, minerals, enzymes, vitamins, and additives in foods. 3 hours and 1 lab. Prereq: Chemistry 110, Biochemistry and Cellular and Molecular Biology 310.

420 Food Microbiology (2) Physical, chemical and environmental factors moderating growth and survival of foodborne microorganisms; pathogenic and spoilage microorganisms affecting quality of foods and their control. Prereq: Microbiology 210. Coreq: 429.


430 Sensory Evaluation of Food (3) Principles and methods of sensory evaluation of foods. 2 hours and 1 lab. Prereq: Basic statistics.

445 Application of Food Chemistry and Processing Principles (4) Interactions and functions of dairy, egg, cereal and other plant based ingredients during the production and storage of processed foods. 3 hours lecture and 1 lab. Prerequisite: 340 and 410 or consent of instructor.

460 Meat Science (3) Carcass characteristics of meat animals, muscle structure and composition, cut identification, curing, freezing and cookery. Prereq: 140 or consent of instructor.

469 Meat Science Lab (1) Slaughter and processing methods for beef, pork, lamb and poultry. Coreq: 460.

490 Food Laws and Regulations (3) Laws and regulations designed to preserve safety, wholesomeness, and nutritional quality of United States food supply; precedent case studies and their impacts on laws and regulations. Prereq: 140: consent of instructor for non-majors.

495 Quality Assurance and Sanitation Practices (3) Design and evaluation of food processing operation to produce safe and acceptable quality food product. Prereq: 320 and 340 or consent of instructor.

500 Thesis (1-15) P/NP only.

501 Seminar (1) Individual reports and discussion on topics from current literature. May be repeated. Maximum 3 hours. Satisfactory/No Credit grading only.

502 Registration for Use of Facilities (1-15) Required for the student not otherwise registered during any semester when student uses university facilities and/or faculty time before degree is completed. May not be used toward degree requirements. May be repeated. Satisfactory/No Credit grading only.

503 Problems in Lieu of Thesis (2-3) May be repeated. Satisfactory/No Credit grading only.

507 Professional Development Seminar (1) Satisfactory/No Credit grading only. (Same as Agriculture and Natural Resources 507; Animal Science 507; Entomology and Plant Pathology 507; Plant Sciences 507.)

510 Instrumental Analysis of Food (3) Modern instrumental methods for control of food manufacturing processes. Prereq: 410. 2 hours and 1 lab.

512 Flavor of Foods (2) Chemical basis, measurements, and reactions involved in flavor changes in foods. Manufacture and application of flavorings in foods. 1 hour and 1 lab. Prereq: 410 or equivalent.

515 Food Carbohydrates, Proteins and Lipids (4) Advanced study of chemical and physical attributes of carbohydrate, protein, and lipid components of foods: effects of components on production of safe and consistent quality food products; and changes during processing and/or distribution of food products. 3 hours and 1 lab. Prereq: 410 or equivalent.

521 Advanced Food Microbiology (3) Extrtrinsic and intrinsic factors associated with food and food processing that relate to growth, survival, inhibition, detection, and recovery of foodborne pathogens and spoilage organisms; traditional and current approaches to microbiological food safety and quality. Prereq: 420. 429 or equivalent.

540 Food Product Development (3) Art, science and technology of developing and marketing new food products. 2 hours and 1 lab. Prereq: 340.

560 Advanced Meat Science (3) Physical and chemical changes that occur in conversion of muscle to meat; effect of postmortem treatments on meat quality, composition and palatability; packaging, preservation and quality control. 2 hours and 1 lab. Prereq: 460.

590 Special Topics in Food Technology and Science (1-3) Critical reviews of current research and production concerns of food industry. May be repeated. Maximum 9 hours.

593 Directed Studies (1-3) Research on non-thesis topics chosen by student and major professor. Supervised experience in food industry or governmental laboratories. May be repeated. Maximum 6 hours.

600 Doctoral Research and Dissertation (3-15) P/NP only.

601 Seminar (1) Reports and directed discussion on research topics from current literature. May be repeated. Maximum 3 hours. Satisfactory/No Credit grading only.

620 Food Toxicology (3) Basic and applied concepts in food toxicology: toxicological aspects of processed foods. Mode of action, prevention and control of food toxicants in food supply. Prereq: 410, 521, or consent of instructor.

640 Advanced Food Processing (3) Role of processing treatments in modification of food properties; texture, flavor and color characteristics. Prereq: Food Preservation, 510, 511, or consent of instructor.

Department of FORESTRY, WILDLIFE AND FISHERIES

http://fwf.ag.utk.edu/

George M. Hopper, Head and Graduate Liaison

Professors
Buehler, D.A., PhD ................................................. Virginia Tech
Dearnell, B.L, PhD ................................................... Colorado State
Hill, Sr., T.K., PhD .................................................... Auburn
Hopper, G.M., PhD ............................................... Virginia Tech
Ostermeier, D.M., PhD .............................................. Syracuse
Pelton, M.R., PhD ..................................................... Georgia
Rials, T.G., PhD ....................................................... Virginia Tech
Schorbaum, S.E., PhD .......................................... Colorado State
Speer, C.A., PhD ..................................................... Utah State
Strange, R.J., PhD .................................................... Oregon State
Wilson, J.L., PhD ..................................................... Tennessee

Associate Professors
Clatterbuck, W.W., PhD ...................................... Mississippi State
Fly, J.M., PhD ......................................................... Michigan
Hay, R.L., PhD ........................................................ Duke
Hodges, D.G., PhD .................................................... Georgia

Assistant Professors
Buckley, D.S., PhD ............................................... Michigan Tech
Franklin, J.A., PhD ................................................... Alberta (Canada)
Gray, M.J., PhD ....................................................... Texas Tech
Harper, C.A., PhD ................................................... Clemson
Muller, L.I., PhD ...................................................... Georgia
Wang, S., PhD ......................................................... Nanjing Forestry (China)
Young, T.M., MS ..................................................... Tennessee

Instructor
Minser, W.G., MS ................................................. Tennessee
Moschler, W., MS ................................................... Virginia Tech

Adjunct Faculty
Albright, R., PhD ................................................. Southern Illinois
Clark, J.D., PhD ....................................................... Arkansas
Eda, S., PhD .......................................................... Japan
Franzreb, K., PhD ................................................... Arizona State
Van Manen, F., PhD .............................................. Tennessee

Emeriti Faculty
Buckner, E.R., PhD ................................................ North Carolina State
Dimmick, R.W., PhD .............................................. Wyoming
Rennie, J.C., PhD .................................................... North Carolina State
Schneider, G., PhD ................................................... Michigan State
Stumbo, D.A., PhD ................................................ Minnesota

MAJORS

DEGREES

Forestry ............................................................ MS
Wildlife and Fisheries Science ................................ MS
Natural Resources ................................................... PhD

Graduate study leading to the Master of Science with majors in forestry and in wildlife and fisheries science and the Doctor of Philosophy with a major in natural resources is offered by the Department of Forestry, Wildlife and Fisheries.
The mission of the Department of Forestry, Wildlife and Fisheries is to advance the management, utilization, and appreciation of natural resources in Tennessee, the region and beyond through programs in teaching, research and extension.

**MASTER OF SCIENCE**  
**Forestry Major · Wildlife And Fisheries Science Major**

**ADMISSION**  
For admission, the student must have a bachelor’s degree from an accredited institution in forestry, wildlife, fisheries, or other natural resource area. Applicants must take the general Graduate Record Examination (GRE) with minimum scores required. Graduate Rating Forms or letters of recommendation from three individuals familiar with the applicant’s academic ability are required. The department also has an application that must be submitted at the time of application to the Office of Graduate Admissions.

**REQUIREMENTS**  
Both thesis and non-thesis options are available for the major in forestry; a thesis is required in the wildlife and fisheries science major.

**Thesis Option**
- Prior to research for the thesis, the student is required to develop a detailed written research proposal. Registration for 6 hours of thesis (Forestry 500 or Wildlife and Fisheries Science 500) is required.
- A graduate committee of no fewer than 3 faculty members must be selected by the second semester of residence. At least one member shall be from outside the department. In addition to the thesis requirement, a minimum of 24 hours of graduate coursework is required. This work must be approved by the student’s committee and no more than 10 hours of the minimum 30 can be below the 500 level. The committee may require additional coursework if the student’s progress or background indicates such need.
- All students are required to include Forestry 512 or Wildlife and Fisheries Science 512, Seminar, in their programs. This is required of each graduate student in residence fall semester.
- An oral examination covering the thesis and coursework is required.

**Non-Thesis Option (Forestry major only)**
- Thirty-five hours of graduate coursework of which 23 must be at the 500 level or above is required.
- A graduate committee of no fewer than 3 faculty members will be selected. At least one member shall be from outside the department. The committee will meet and schedule the student’s program during the first semester in residence.
- Three hours of Forestry 511 are required.
- Nine hours of coursework in the department must be at the 500 level or above, exclusive of Forestry 511.
- Final comprehensive written and oral examinations shall be taken upon completion of no fewer than 28 hours of approved study.

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**DOCTOR OF PHILOSOPHY**  
**Natural Resources Major**

The doctoral program with a major in natural resources emphasizes interdisciplinary research approaches toward the understanding and management of natural resources in a broad context. Areas of study include forest, wildlife, and fisheries biology; ecosystem function and structure; natural resource economics and policy; human dimensions of natural resource management; natural resource organization administration and management; wood sciences; and multidisciplinary natural resources management.

**ADMISSION**  
Applicants to the PhD program normally should have completed a master’s degree prior to beginning the doctoral program. Specific admission requirements include:
- A minimum grade point average of 3.0 on a 4.0 scale.
- A minimum composite score from the general Graduate Record Examination (GRE) on the verbal, quantitative, and analytical sections of 1650, with a minimum of 1100 on the verbal and quantitative sections.
- A statement of professional goals, natural resource management philosophy, and reasons for applying to the program.
- Three letters of reference from individuals capable of evaluating the applicant’s potential for graduate work in interdisciplinary natural resource management.

**REQUIREMENTS**  
A candidate for the doctoral degree must complete 72 semester hours of coursework beyond the bachelor’s degree. Forty-eight hours must be in graduate coursework approved by the student’s doctoral committee. Up to 24 hours of master’s-level coursework may be applied to the 48-hour requirement. A minimum of 6 hours must be taken in university courses at the 600 level, exclusive of dissertation hours. Specific requirements are:

**Research Methods and Analysis (9 credits in at least two of the subject areas)**
- Research/Experimental Design
- Statistics/Econometrics/Biometrics
- GIS/Remote Sensing

**Core Subject areas (33 credits to be determined by doctoral committee)**

**Professional Development (6 credits)**
- Teaching: All students will be expected to complete Forestry, Wildlife and Fisheries 601 and assist in teaching a course during their tenure in the program.
- Problem Solving: Forestry, Wildlife and Fisheries 610 will be required of all doctoral students. This course will include participation in an interdisciplinary team to address a significant national or regional natural resource issue.
- Professional Communications: All students will be required to complete Forestry, Wildlife and Fisheries 612 as part of their program of study. Part of the seminar requirement will consist of assisting in the development and conduct of Forestry, Wildlife and Fisheries 512.
Forestry, Wildlife and Fisheries 600 Doctoral Research and Dissertation (24 credits)

A doctoral committee consisting of at least four faculty members must be identified by the student and major professor. At least two of the committee members must be from the Department of Forestry, Wildlife and Fisheries and one member must be from an academic unit other than Forestry, Wildlife and Fisheries. Three of the committee members, including the major professor, must be approved by the Graduate Council to direct doctoral research. The committee should be formed during the first year of the student’s program.

All students are required to successfully complete an oral and written examination on all coursework completed as part of the PhD requirements. The exam is scheduled when the student has completed all or nearly all of the coursework. The PhD committee will determine the content, nature, and schedule of the comprehensive exam and certify the results.

During the first year, the student should develop a research prospectus that outlines the research problem to be addressed as part of his/her doctoral research. The prospectus is presented to the student’s committee and the committee will approve the research topic and approach.

All students are required to complete, present, and defend a dissertation. The student should provide each member of the committee a copy of the dissertation at least two weeks prior to the scheduled defense. All students are required to present a seminar on their dissertation as part of the degree requirements. The seminar can be part of the dissertation defense or presented before the formal defense.

Environmental Policy Minor

The department participates in a program designed to give graduate students an opportunity to develop an interdisciplinary specialization in environmental policy. See Department of Economics for program description.

GRADUATE COURSES

Forestry (396)

421 Forest and Wildland Resource Economics (3) Production functions, supply-demand and market analysis; non-market programs and projects; economic analysis and decision models; investment and financial analysis; managerial economics; taxes; forest products marketing. Prereq: 324 or consent of instructor.

422 Forest and Wildland Resource Policy (3) Policy formulation; criteria for policy determination; forest and wildland law and regulation; theory of conflict resolution; formal and informal resolution. Prereq: Senior standing or consent of instructor.

423 Wildland Recreation Planning and Management (3) Planning processes, master and site planning, site design projects; management strategies, methods of visitor and recreation site management; case studies. Weekend field trips. 2 hours and 1 lab. Prereq: 321 or consent of instructor.

433 Wood Adhesives and Glued Wood Products (2) Theory and practice of adhesive bonding of wood; wood substrate-adhesive interface for bonding; principles of adhesion; wood adhesives; gluing of solid wood and composite wood manufacturing practices; laboratory manufacture and/or testing of adhesives, adhesive bond strength and glued-wood product performance; day field trips. 1 hour and 2 labs. Prereq: 331 and 332, or consent of instructor.

500 Thesis (1-15) P/NP only.

502 Registration for Use of Facilities (1-15) Required for the student not otherwise registered during any semester when student uses university facilities and/or faculty time before degree is completed. May not be used toward degree requirements. May be repeated. Satisfactory/No Credit grading only.

511 Problem Analysis in Forest Resources (3) Problem identification, analysis and solution in forest resources management. Identify, analyze and prepare written report. Topic and report must have approval of graduate committee. Available only to students in non-thesis option for MS in Forestry.

512 Seminar (1) Current developments in forestry. Required of all graduate students in residence in fall. May be repeated. Maximum 2 hours. Satisfactory/No Credit grading only.

515 Forest Conservation Workshop (1-3) Relation of forest biology, ecology and management to conservation issues; integration of current conservation issues into classroom work and student projects; environmental education strategies. Not available to students in forestry or wildlife and fisheries science. May be repeated. Maximum 3 hours.

520 Advanced Forest Ecology (3) Physiological ecology and adaptations of trees; relationships between overstory structure, microclimate, and understory response; regeneration ecology; competition and effects of natural and human disturbance regimes at multiple scales; forest succession and stand dynamics. Prereq: Graduate standing in forestry or biological science, or consent of instructor.

525 Woodlot Management (3) Current technologies and management strategies concerning wise use of forest resources for private, non-industrial forest landowners necessary for decision-making and implementation. 6.5 hours and 1 lab weekly for 6 weeks. Prereq: 6 hrs of biological sciences or consent of instructor. Not available to students in forestry or wildlife and fisheries science.

530 Advanced Forest Resource Management (3) Analysis of forest management problems in public and private organizations. Classical forest regulation; linear and goal programming, as applied to resource management problems; advanced forest investment analysis; decision making methods for primary forest management activities; and methodologies for incorporating non-timber values in forest management operations. Prereq: Senior-level forest management or consent of instructor.

540 Genetics in Forestry (3) Genetic improvement of forest trees, selection of superior phenotypes; field testing for genetic variability; tree breeding; development of seed orchards; hybridization; tree cytology and tissue culture; use of biochemical variation; planning and conducting forest genetics research. Prereq: Silvicultural methods and Biology 220 or consent of instructor.

550 Recreation Planning for Forests and Associated Lands (3) Planning process for recreation development on forests and associated lands; analysis and critique of specific contemporary alternatives. Overnight field trips. Prereq: Senior level in forest recreation or consent of instructor.

570 Management and Policy of Forest Resource Organization (3) Theory and application of management as applied to natural resource organizations: institutional direction and culture, and strategic management. Development of policy as planning tool and as results from conflict resolution. Linkage between policy development and execution, and structure and management of organizations. Prereq: Forest administration and policy or consent of instructor.

580 Advanced Silviculture (3) Silvical characteristics, silvicultural practices and systems applied to commercially important hardwoods and softwoods. In-depth analyses of silvicultural principles involved and tools used, prescribed fire, pesticides, in regeneration and management; computer modeling of stand dynamics, structure, growth/yield. 2 hrs and 1 lab. Prereq: Undergraduate silviculture course or consent of instructor.

585 Advanced Forest Biometry (3) Application of sampling techniques to forest inventory; fixed and variable plot sampling; list sampling; Poisson sampling; regression estimators; multistage and multiphase sampling. Growth and yield predictors for even-aged and uneven-aged forests. Prereq: 326 and 329 or consent of instructor.

590 Advanced Topics in Forestry (1-3) Recent advances and concepts; research techniques and analysis of current problems. Prereq: Consent of instructor. May be repeated. Maximum 6 hours.

593 Independent Study in Forestry (1-4) May be repeated. Maximum 6 hours.

630 Forest Growth and Development (3) Forest stand dynamics, analysis of changes in species composition and forest stand structure (physical and temporal) during forest succession, response of stands to disturbances (anthropogenic and natural), modeling techniques to make predictions of future stand development. 2 hours and 1 lab. Prereq: Undergraduate silviculture course or consent of instructor.

Forest, Wildlife and Fisheries (398)

410 Wildlife Habitat Evaluation and Management (3) Ecological relationships between wildlife and habitat. Evaluation, modeling, and management of wildlife habitat. Effects of land-use practices on wildlife habitat. Weekend field trips. 2 hours and 1 lab. Prereq: 317 or consent of instructor. Applicable to majors in Forestry and in Wildlife and Fisheries Science.
COLLEGE OF AGRICULTURAL SCIENCES AND NATURAL RESOURCES

516 Planning and Management of Forest, Wildlife and Fisheries Resources (3) Integrated forest and wildland resource management through developing land management plans and analyzing case studies including conflict resolution. Applicable to majors in Forestry and in Wildlife and Fisheries Science. 1 hour and 2 labs. Prereq: Senior standing.

520 Natural Resource Issues at International Level (2) Identification and analyses of issues regarding forestry, wildlife, fisheries and wildland park resources beyond U.S. borders. Political, economic, social, and biophysical elements impacting natural resources in different parts of world: Northern Europe, Latin America, Asia, Africa, and South America. In-depth case study and class presentation required by student teams. Not available for students who have taken 420.

535 Environmental Impacts to Natural Ecosystems (3) Current environmental problems affecting natural ecosystems: climate change, acid deposition, air pollution, species declines, and introductions of exotic species. Management methodologies to mitigate environmental problems. Overnight field trips. Prereq: 416 or equivalent or consent of instructor. Applicable to majors in Forestry and in Wildlife and Fisheries Science.

540 Seminar on Integrated Resources Management in Biosphere Reserves (2) MAB program, UNESCO-sanctioned global conservation initiative. Analysis of integrated resources management practices that demonstrate concept of sustainable development. Environmental policy and application of science to management practice. Applicable to majors in Forestry and in Wildlife and Fisheries Science.

590 Advanced Topics in Forestry, Wildlife and Fisheries (1-3) Recent advances and concepts, research techniques, and analysis of current problems. Prereq: Consent of instructor. May be repeated. Maximum 6 hours.

600 Doctoral Research and Dissertation (3-15) P/NP only.


610 Seminar in Natural Resources (2) Selected issues in natural resources and natural resource management at regional, national, or international level. Development of interdisciplinary approach to addressing problems: evaluating current state of knowledge, developing alternative actions to address problems, and identifying criteria for evaluation of alternatives.

612 Seminar in Forestry, Wildlife and Fisheries (1) Current issues and developments in forestry, wildlife and fisheries. Required of all doctoral students in residence during fall. May be repeated. Maximum 3 hours.

Wildlife and Fisheries Science (993)

440 Wildlife Techniques (3) Methods of wildlife damage control, forest, farmland, wetland wildlife habitat management, identification of wildlife field sign, wildlife capturing techniques and management plan preparation. Weekend field trips. 1 hour and 1 lab or field. Prereq: Forestry, Wildlife and Fisheries 317 or consent of instructor.

442 Fisheries Techniques (3) Active and passive sampling techniques for fish and aquatic organisms; population estimation methods; fish handling and transport; food habits analysis; marking and tagging techniques; age determination and incremental growth analysis; stream assessment; equipment and instrumentation usage and maintenance; safety in sampling methods. Weekend field trip. 1 hour and 1 lab or field. Prereq: Forestry, Wildlife and Fisheries 317 or consent of instructor.

443 Fisheries Science (3) Quantification and management of freshwater fisheries: population estimation, age and growth, biological assessment, and stocking. 2 hours and 1 lab. Prereq: Forestry, Wildlife and Fisheries 317 or consent of instructor.

444 Ecology and Management of Wild Mammals (3) Biological and ecological characteristics of game mammals and endangered mammals. Current principles and practices of wild mammal management. 2 hours and 1 lab. One weekend field trip required. Prereq: Forestry, Wildlife and Fisheries 317 or consent of instructor.

445 Ecology and Management of Wild Birds (3) Biological and ecological characteristics of game birds, endangered birds, and bird pests. Current principles and practices of wild bird management. 2 hours and 1 lab. Prereq: Forestry, Wildlife and Fisheries 317 or consent of instructor.

500 Thesis (1-15) P/NP only.

502 Registration for Use of Facilities (1-15) Required for the student not otherwise registered during any semester when student uses university facilities and/or faculty time before degree is completed. May not be used toward degree requirements. May be repeated. Satisfactory/No Credit grading only.

512 Seminar in Wildlife and Fisheries Science (1) Current developments in wildlife and fisheries science. Required of all graduate students in residence in fall. May be repeated. Maximum 2 hours. Satisfactory/No Credit grading only.

515 Seminar in Avian Ecology and Management (1-2) Readings and discussion based on current literature on contemporary topics in avian ecology and management. Additional credit awarded for writing review paper on contemporary topic of interest to student. Prereq: Consent of instructor.

525 Endangered Species Management and Conservation of Biodiversity (2) Status, ecology and management of endangered wildlife and plant species. Historic aspects, policy implications and philosophical issues surrounding recovery efforts. Approaches to monitor and manage for biodiversity. Prereq: Graduate standing or consent of instructor.

530 Wildlife Diseases (2) Necropsy of birds and mammals. Recognition of various diseases and methods of preparing pathological materials in field and lab. Investigative procedures concerning wildlife diseases. Prereq: 1 yr biology, 444 or 445, or consent of instructor. (Same as Comparative and Experimental Medicine–Veterinary Medicine 530.)

535 Floodplain Ecosystems (3) Ecology, restoration and management of floodplain ecosystems: biotic and abiotic processes, social considerations, and wildlife and forest management. Lower Mississippi River Alluvial Valley. Prereq: Consent of instructor.

540 Predator Ecology (2) Dynamics of terrestrial vertebrate predator populations in human-altered and relatively unaltered environments. Prereq: 444 or 445 or consent of instructor.

545 Advanced Population Analysis (2) Detail characteristics, assumptions, goals, methods, and current technologies for fish and wildlife population analysis. Use of computers. Prereq: Animal Science 571 or Statistics 538 or consent of instructor.

546 Advanced Habitat Analysis (2) Habitat analysis as tool to evaluate habitat use and predict occurrences of animal and plant species: principles and goals of modeling, habitat analysis theory, GIS and statistical techniques. Use of computer programs. Prereq: Forestry, Wildlife and Fisheries 410 or Geography 411 or consent of instructor.

550 Fish Physiology (3) Mechanisms of gas transfer, circulation, excretion, osmoregulation, locomotion, and neural/hormonal control of these systems in fishes. Comparisons and contrasts with physiology of terrestrial animals. Practical applications of fish physiology to aquaculture, pollution assessment, and fisheries management. Prereq: Senior or graduate standing in life sciences.

555 Fish Culture (3) Principles, concepts and techniques of culturing economically important fish and shellfish species. 2 hours and 1 lab. Prereq: 443 or consent of instructor.

556 Recirculating Aquaculture (3) Growing fish in intensive, indoor systems with reconditioned water. Techniques of solids removal, nitrification, and gas balance. Practical experience with operating system. Prereq: 443 or consent of instructor.

560 Advanced Topics in Wildlife and Fisheries Science (1-3) Recent advances and concepts, research techniques and analysis of current problems. Prereq: 443, 444, 445, or consent of instructor. May be repeated. Maximum 6 hours.

593 Independent Study in Wildlife and Fisheries Science (1-4) May be repeated. Maximum 6 hours.

Department of PLANT SCIENCES

http://plantsciences.utk.edu/

G. Neil Rhodes, Head
Dennis R. West, Graduate Liaison

Professors

Albrecht, M.L. (Associate Dean), PhD ........................................ Ohio State
Allen, E.L., PhD ................................................................. Minnesota
Augé, R.M., PhD ............................................................... Washington State
Denton, H.P., PhD ......................................................... North Carolina State
Deyton, D.E., PhD ............................................................. North Carolina State
Hayes, H.C., PhD ............................................................... Illinois
Lockwood, D.W., PhD ....................................................... Purdue
McDaniel, G.L., PhD ........................................................ Iowa State
Miller, R.D., PhD ............................................................... Kentucky
Mueller, T.C., PhD ........................................................... Georgia
Rhodes, G.N., PhD ........................................................... North Carolina State
Samples, T.J., PhD .......................................................... Oklahoma State
Sams, C.E., PhD ................................................................. Michigan State
Stewart, C.N., PhD (Racheff Chair) ......................................... Virginia Tech
West, D.R., PhD ............................................................... Nebraska
associate professors

bates, g.e., phd ................................. georgia
cheng, z.m., phd ................................. cornell
gwathmey, c.o., phd ............................... california (davis)
hamilton, s.l., edd ................................. tennessee
menendez, g.l., ms ............................... tennessee
pantalone, v.r., phd ............................... north carolina state
robinson, d.k., phd ................................. north carolina state
rogers, s.m., mla ................................. georgia
stewart, c.e., mla ................................. georgia
wyatt, j.e., phd ................................. florida

assistant professors

craig, c.c., phd ................................. louisiana state
garton, s., phd ................................. minnesota
kingeman, w.e., phd ............................... georgia
mcelroy, s., ph.d. ................................. north carolina state
sorochar, j.c., phd ................................. michigan state
steckel, l.e., phd ................................. illinois
straw, r.a., phd ................................. tennessee
thompson, m.a., phd ............................... tennessee
zale, j.m., phd ................................. saskatchewan

instructor

flanagan, p.c., ms ................................. tennessee
ott, r.j., mba ................................. tennessee

emeriti faculty

ashburn, e.l., phd ................................. tennessee
coffey, d.l., phd ................................. purdue
fribourg, h.a., phd ................................. iowa state
sams, d.w., phd ................................. minnesota

majors  degrees

plant sciences ........................................... ms
plants, soils, and insects ............................ phd

the department of plant sciences offers two graduate degrees: the master of science with a major in plant sciences, and the doctor of philosophy with a major in plants, soils, and insects. for additional information, please visit our departmental homepage. inquiries may be directed to the chair, graduate committee, department of plant sciences, the university of tennessee, knoxville, tennessee 37996-4561, or uthort@utk.edu.

master of science program

plant sciences major

both thesis and non-thesis options are available for the major in plant sciences, each guided by a graduate committee consisting of the major professor and two or more other faculty members. studies are possible in a wide variety of commodities and subject areas, including fruits, vegetables, weeds, cereals, grains, turfgrass, woody ornamentals, and public horticulture. students may specialize in one or more disciplines, including plant protection, molecular biology, breeding, genetics, biotechnology, physiology, ecology, culture and management.

admission

students should have a bachelor’s degree from an accredited college or university, with evidence of ability to do work of graduate quality. applicants are expected to have a minimum cumulative grade point average of 2.7 on a 4.0 scale.

application must be made to both the office of graduate admissions and the plant sciences department. the departmental application requires three letters of reference (or three graduate rating forms) from persons capable of assessing the applicant’s suitability for graduate work in plant science, resume, and a statement of professional goals and reasons for applying to the program. applicants are also required to submit scores from the general graduate record examination (gre) to graduate admissions (please send photocopy to department). successful applicants will usually have a composite score on the verbal, mathematical and analytical sections of the gre of at least 1400. prior undergraduate course work in mathematics, biology and chemistry is recommended.

requirements

• approval of the academic program by the master’s committee.
• successful completion of 12 hours of course work in the major at the graduate level (400 or above), exclusive of plant sciences 500, 502, and 503. two of these hours must be plant sciences 504. six of these hours may be satisfied by botany 404, 412, 521, 522, animal science 571, environmental and soil sciences 434, 444, 516, ecology and evolutionary biology 431, 520, 560, information sciences 560, art 481, or geography 439.
• presentation of at least two departmental seminars.

please see the degree program requirements/master’s degrees section at the front of this catalog for additional information.

thesis option

• satisfactory preparation of a written thesis proposal and its oral defense to the student’s committee.
• successful completion of 30 hours of graduate credit, which must include 6 hours of 500. at least 14 of these hours must be numbered 501 or above.
• preparation of a written thesis and its oral defense.

non-thesis option

• successful completion of 34 hours of graduate credit, which must include 2-4 hours of plant science 503. at least 22 of these hours must be at the 500 level or above.
• completion of a project and preparation of a written report summarizing the project.
• passing written and oral examinations covering the project and course work.

doctor of philosophy

plants, soils, and insects major • horticulture, crop sciences, weed biology, plant improvement

concentrations

a phd in plants, soils and insects, with concentrations in horticulture, crop sciences, weed biology, and plant improvement, is offered under a multi-departmental doctoral program. three departments participate: plant sciences, entomology and plant pathology, and the soils faculty in biosystems engineering and environmental sciences. other concentrations within the psi major include environmental and soil sciences, entomology, plant pathology, integrated pest management and bioactive natural products. please see the plant sciences homepage for additional information, http://pssl.ag.utk.edu/, or contact a faculty member in the area of interest.
Students may select a formal concentration as a focus of study but this is not a requirement. We recognize that modern research approaches in plant sciences often overlap. Students may specialize in one or more approaches, including plant biotechnology, molecular biology, breeding, genetics, physiology, ecology, culture and management. Research may feature fruits, vegetables, turfgrass, weeds, woody ornamentals, cereals, grains, fiber, public horticulture or model plant systems.

ADMISSION
Submit application, fee, official transcripts, and scores from the general portion of the Graduate Record Examination to the Graduate Admissions Office. In your application, indicate that you are applying to the Plants, Soils and Insects doctoral program. Submit resume, three letters of reference (or three Graduate Rating Forms), photocopy of GRE scores and a short statement of professional goals and reasons for applying to: Plant Science PhD Program Coordinator, Department of Plant Sciences, 2431 Joe Johnson Drive, 252 PSB, the University of Tennessee, Knoxville, Tennessee 37996-4561. In your statement letter and application, please indicate your concentration of interest and intended major professor.

REQUIREMENTS
To obtain the doctorate, the student must meet the following requirements:

- The student and the major professor will select a minimum of three additional faculty, holding the rank of assistant professor or above, to serve on the student’s doctoral committee. The major professor and two committee members must be approved to direct doctoral research by the Graduate Council, and at least half of the committee must hold teaching appointments. At least one member of the committee must be from outside the department. The doctoral committee must be formalized by the end of the second semester of graduate study.
- Submission of an approved program of study by the end of the second semester of graduate study. A candidate for the doctoral degree must complete a minimum of 24 hours of graduate coursework numbered 503 or higher beyond the master’s degree. Candidates not having a master’s degree must complete a minimum of 48 hours of graduate coursework beyond the baccalaureate degree, 24 hours of which must be numbered 503 or higher. A minimum of 12 of the 24 hours, or 30 of the 48 hours, must be graded A-F. At least 9 hours of the student’s coursework must be from outside the PSI major, and a minimum of 6 semester hours must be taken in University of Tennessee courses numbered 601 or higher. In addition, 24 hours of course 600 Doctoral Research and Dissertation are required.
- Satisfactory preparation of a written dissertation proposal and its oral defense to the student’s committee. This must be completed during the first two semesters of graduate study and before enrollment in 600.
- Passing both written and oral sections of the comprehensive examination. The candidate will be tested on his/her knowledge of the proposed dissertation and related fields.
- Presentation of at least two departmental seminars (2 hours of PS 504), in addition to an exit seminar (no credit).
- Satisfactory preparation of a written dissertation and its oral defense to the student’s doctoral committee.

GRADUATE COURSES
Plant Sciences (791)
410 Nursery Management and Production (3) Modern management methods as applied to retail and wholesale nurseries and landscape contracting firms. Methods of producing liners, container and field-grown woody ornamental plants. 2 hours and 1 lab. Prereq: 220, 330, and Environmental and Soil Sciences 210, or consent of instructor.
427 Management and Administration of Public Horticulture Institutions (3) Management of resources in non-profit institutions, support organizations and communities. Theoretical framework and institutional mission; strategic planning and programming; financial accounting and budgeting; development and fund raising; personnel policies; volunteer development; marketing and publicity; legal issues; relationships between staff and governing boards; the use of information technology in management and governance systems; and conservation/preservation roles in community development. Prereq: 326.
429 Field Study of Public Horticulture Institutions (3) Extended 10-12 day field study of various public horticulture institutions: botanical gardens, arboretas, historical grounds, zoos, conservatories, cemeteries, and nature preserves. Travel journal and course portfolio required. Application and travel fee required. Prereq: 326.
431 Physiology and Ecology in Agroecosystems (3) Plant physiology and ecology applied to crop production and management. Plant physiology and ecology principles related to crop production practices from seedling to harvest and handling. Interaction of crops with environment and sustainable agroecosystems. 2 hours and one 2 hour lab. Prereq: 230.
432 Agricultural Pesticides (3) Regulation of pesticide development, manufacture, transportation, marketing and use. Structure, use, mode of action, degradation and environmental impact of pesticides used in agriculture, forestry and related areas. 2 hours and 1 lab. Prereq: 1 year biological sciences and 1 semester chemistry.
433 Field and Forage Crops (3) Agronomic principles of crop production and management. Crop improvement, cropping systems, tillage, fertilization, pest management, harvest and utilization of major field and forage crops. 2 hours and 1 lab. Prereq: 230.
434 Fruit and Vegetable Crops (3) Principles of production systems to counter environmental stresses and to increase productivity of warm and cool season vegetable crops, small fruit crops, and deciduous tree fruit crops. Storage of crops after harvest. 2 hours and one 2 hour lab. Prereq: 230.
435 Principles of Plant Breeding (3) Principles and techniques of photography related to plants and gardens. Equipment options and field shooting under various weather conditions and in different seasons. Prereq: Senior standing and consent of instructor.
436 Plant and Garden Photography (2) Principles and techniques of photography related to plants and gardens. Equipment options and field shooting under various weather conditions and in different seasons. Prereq: Senior standing and consent of instructor.
437 Management and Administration of Public Horticulture Institutions (3) Analysis of year-round operations and management of public gardens. Case studies; time and labor management, budget development and management, implementation of volunteer programs, information dissemination methods for public outreach, management of grounds and facilities using the University of Tennessee Institute of Agriculture Gardens as model. Prereq: 326.
440 Advanced Turfgrass Management (4) Principles and scientific basis of turfgrass culture: adaptation, ecology, physiology, soil fertility, and grass nutrition, climatic influences on grass culture; physiology of clipping and water management; design, construction, and management of golf courses; and physiological influences of pest infestation and control measures. Prereq: 340 or consent of instructor. 3 hours and 1 lab.
446 Horticultural Therapy (3) Application of horticulture as therapy for treatment, rehabilitation and/or training of individuals with disabilities. Prereq: Senior standing and consent of instructor.
450 Landscape Study (3) Methods of design, materials, and construction techniques for specialized components of landscape industry. Irrigation systems, outdoor lighting, garden ponds and water features.
451 Plant Tissue Culture (3) (Same as Botany 451; Entomology and Plant Pathology 451.)
453 Principles of Plant Breeding (3) Genetic principles and techniques used in crop improvement. Consideration of breeding methods for various types of plant reproduction systems and application. Discussion of heritability estimation, genetic advances through selection and theory upon which breeding methods are based. Prereq: 471 and Biology 240. 2 hours and one 2 hour lab.
460 Professional Practices in Landscape Architecture (3) Methods of design, materials, and construction techniques for specialized components of landscape industry. Irrigation systems, outdoor lighting, garden ponds and water features.
453 Principles of Plant Breeding (3) Genetic principles and techniques used in crop improvement. Consideration of breeding methods for various types of plant reproduction systems and application. Discussion of heritability estimation, genetic advances through selection and theory upon which breeding methods are based. Prereq: 471 and Biology 240. 2 hours and one 2 hour lab.
471 Statistics for Biological Research (3) Application of statistics to interpretation of biological research. Notation, descriptive statistics, probability, distributions, confidence intervals, t and chi-square tests, analysis of variance, mean separation procedures, linear regression and correlation. Prereq: Mathematics 125 or equivalent.

480 Advanced Landscape Design (3) Comprehensive application of landscape design skills to variety of project experiences: landscape planning and analysis, planting design, and materials estimating. Two 3-hour labs. Prereq: 280 and 380.

485 Computer Aided Landscape Design (3) Computer Aided Design (CAD) related to landscape design and construction. Site planning and construction of related landscape plan view and 3-D drawings. Operating system, use of Autocad and LANDCADD software. Two 3-hour labs. Prereq: 280, 380, Agriculture and Natural Resources 290.

494 Professional Horticultural Communications (3) Communication for public horticulturists through written, oral, and visual media. Communication skills using proper writing techniques and grammar for print media, brochure design using desktop publishing, slide show development, oral presentations, and video use for educational and informational presentations in ornamental horticulture. Prereq: Agriculture and Natural Resources 290 and senior standing.

500 Thesis (1-15) P/NP only.

501 Special Topics in Plant Sciences (1-3) Topics to be assigned. May be repeated. Maximum 6 hours. Prereq: Consent of instructor.

502 Registration for Use of Facilities (1-15) Required for the student not otherwise registered during any semester when student uses university facilities and/or faculty time before degree is completed. May not be used toward degree requirements. May be repeated. Satisfactory/No Credit grading only.

503 Non-Thesis Project (1-2) Library, field, or laboratory project under supervision of faculty member. Not for thesis candidates. May be repeated. Maximum 4 hours.

504 Seminar (1) Presentations and discussion of topics. May be repeated. Maximum 2 hours.

505 Seminar Preparation (1) Application of speaking, writing, and organizational skills in preparation and presentation of scientific material to both scientific and general audiences. Preparation of abstracts for scientific presentations. Required of all entering graduate students during their first year of graduate study. (Same as Environmental and Soil Sciences 501.)

507 Professional Development Seminar (1) Satisfactory/No Credit grading only. (Same as Agriculture and Natural Resources 507; Animal Science 507; Entomology and Plant Pathology 507; Food Science and Technology 507.)

510 Plant Disease Fungi (4) (Same as Entomology and Plant Pathology 510.)

521 Flowering Physiology (1) General phenomenology, photoperiodism, thermoperiodism, interactions of external factors, juvenility, and hormonal regulation. 3 hours weekly for 5 weeks. Prereq: Introductory plant physiology or equivalent.

522 Drought Physiology (1) Biophysical and biochemical aspects of plant water relations and drought physiology. 3 hours weekly for five weeks. Prereq: Introductory Plant Physiology or equivalent.

530 Integrated Pest Management (3) (Same as Entomology and Plant Pathology 530.)

532 Environmental Crop Physiology and Ecology (3) General and specific relations among environmental factors, crop organisms, and agricultural systems. Interrelationships of atmospheric gases in photosynthesis, evapotranspiration and foliar injury. Relationships of temperature stress, vernalization and bud dormancy to crop production. Influences of maturation ripening and senescence on post-harvest quality of fruit, vegetable, grain and forage crops. 2 hours and 1 lab. Prereq: Plant Sciences 431.

536 Ecology of Grazing Land Systems (3) Multi-university, field-oriented course. Components and functions of grazing lands and how these vary in different ecoregions; research needs, objectives and techniques in soil-plant-animal research; forage-livestock ecology and systems in grazing lands (cropland, pastureland, rangeland and forestland); role of forages in conservation practices, wildlife habitats, and sustainable agriculture; and industries involved with forages and livestock. Two-week field trip, inclusive report and examination. Prereq: Consent of instructor.

544 Protein Gel Electrophoresis (1) (Same as Entomology and Plant Pathology 544.)

545 Plant Microtechnique (1) (Same as Entomology and Plant Pathology 545.)

551 Organismal Plant Genetics (3) Discovery of genetics, polyploidy, extrachromosomal inheritance, apomixis, incompatibility systems, mutations, controlling elements, quantitative inheritance and heritability. Prereq: General genetics and 471 or equivalent.

571 Design and Analysis of Biological Research (3) (Same as Animal Science 571.)

592 Internship (1-2) Application of horticulture and design principles and practices in supervised, professional setting, approved by department. Satisfactory/No Credit or letter grade.

593 Problems in Plant Sciences (1-3) Independent study. Current topic related to technology, science or design. May be repeated. Maximum 6 hours.

600 Doctoral Research and Dissertation (3-15) P/NP only.

603 Special Topics in Crop Physiology and Ecology (1-3) Microclimatology of agroecosystems, crop dormancy and responses to stress, physiology of crop growth and reproduction. Interactions of physiology and germplasm in crop production, theory and application of quantitative methods in crop physiology and ecology research. May be repeated. Maximum 6 hours.

605 Special Topics in Plant Breeding and Genetics (1-3) Genotype by environment interactions, estimation of quantitative parameters, mutations, chromosome dynamics, polyploidy, genetic engineering, interspecific hybridization, linkage, screening methods, genome organization. May be repeated. Maximum 6 hours.

633 Plant Metabolism (3) Metabolism of chemical compounds of economic importance in crop production: plant growth regulators, naturally occurring plant metabolites, and herbicides. Prereq: Botany 521 or 522 and organic chemistry or biochemistry.

643 DNA Analysis (2) (Same as Entomology and Plant Pathology 643.)

653 Advanced Plant Breeding (3) Principles and methodologies targeting genetic gain for crop improvement. Concepts of qualitative and quantitative trait improvement. Parental germplasm, hybridization, population formation, inbreeding, genetic variance, heritability, selection methods, molecular genetic markers, genetically engineered crops. Prereq: 571 and general genetics, or equivalent, or consent of instructor.