

Biorenewable Systems (BRS)

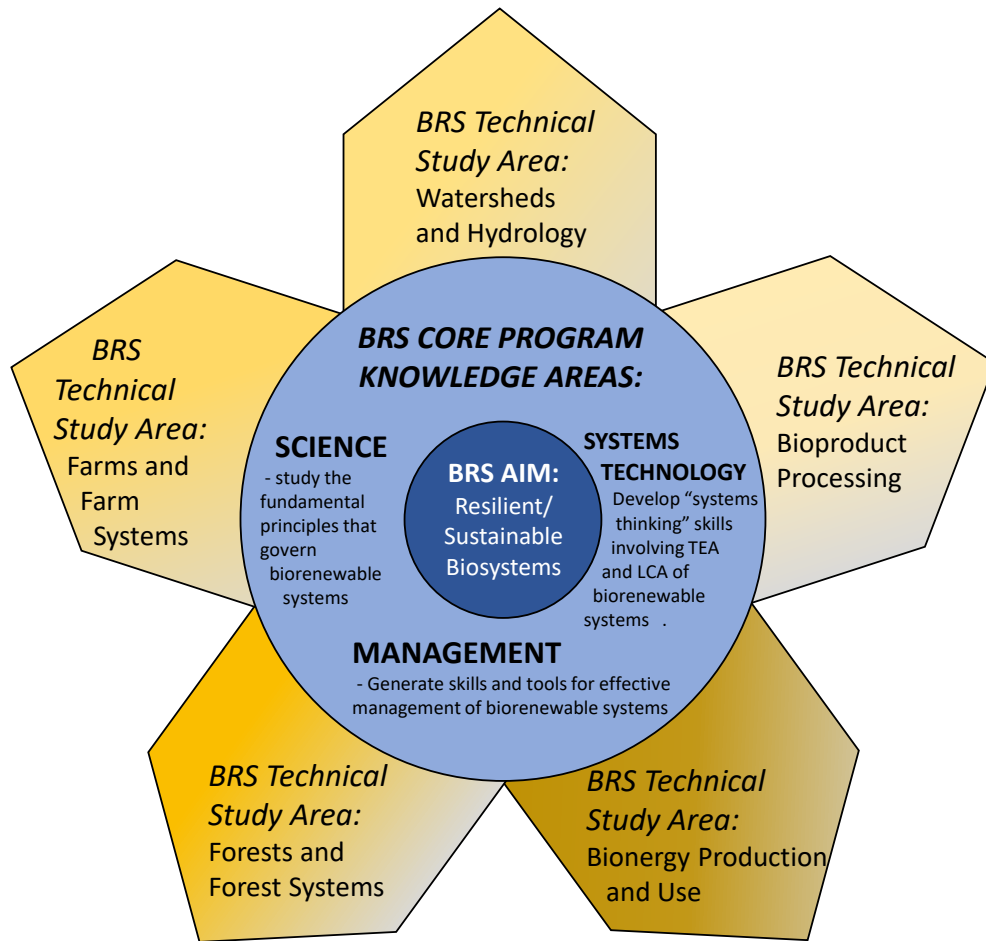
Graduate Program Handbook

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Pennsylvania State University
Graduate Program in Biorenewable Systems (BRS)
Department of Agricultural and Biological Engineering
Agricultural Engineering Building, Room 105
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University Park, PA 16802

This program handbook consists of the text of the Graduate Bulletin for BioRenewable Systems (BRS), maintained by the Penn State Graduate School, plus important additions and clarifications provided by the Department of Agricultural and Biological Engineering, which administers this graduate program. *In general, departmental additions and clarifications are given in the font "Verdana", whereas bulletin text is in the font "Times".*



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PROGRAM DESCRIPTION

Graduate Program Head	Suat Irmak
Program Code	BRS
Campus(es)	University Park (Ph.D., M.S.)
Degrees Conferred	Doctor of Philosophy (Ph.D.) Master of Science (M.S.) Dual-Title M.S. and Ph.D. in Biorenewable Systems and International Agriculture and Development Dual-Title M.S. and Ph.D. in Biorenewable Systems and Operations Research
The Graduate Faculty	View

Biorenewable systems are the structures and processes that create and support biologically-based products capable of being continuously replaced through sound technology and management. The BioRenewable Systems (BRS) degree is offered as a resident instruction, research-based M.S., and Ph.D. programs. The degree requires a thesis at both levels.

The BRS graduate program encompasses renewable biologically-based materials, products, and processes that fully integrates scientific research with the principles of systems technology, business, management, marketing, leadership development, and entrepreneurship. Toward that end, the academic requirements for BRS are closely related to the disciplinary focus of agricultural and biological sciences, technological innovation and application, and business, management, and leadership within the continually evolving biobased sectors. This multidisciplinary aspect makes BRS unique from other fields of science and management. To promote and fulfill this uniqueness, continuation of courses in science, business, management, and technology at the graduate level is encouraged and expected.

Excellent facilities, including equipment and instrumentation, are available for research in the designated areas. Collaborative arrangements allow access to a large variety of other resources:

- Materials Research Institute;
- Penn State Institutes of the Energy and Environment;
- Huck Institute of the Life Sciences
- Housing Research Center;
- USDA Pasture Systems and Watershed Management Research Lab;
- a mushroom research and demonstration facility; and
- a 1,500-acre agricultural research center for cooperative work with agronomic and horticultural production systems as well as animal production systems.

Economic systems throughout the world are transforming as production and processing shifts from non-renewable based materials to more sustainable and renewable biologically-based systems. Toward that end, the agricultural/biological enterprise is uniquely positioned to play a pivotal role as the producer and supplier of resources and personnel to maintain the competitiveness of emerging biobased industries. At the national level, the National Academy of Sciences, and agencies such as the U.S. Department of Agriculture, Department of Energy, and the National Science Foundation, envision biobased materials, processes, and energy production as significant components of this biobased economic transformation.

The BRS graduate program leverages science, engineering, and wood products expertise to conduct novel research on bio-based systems and develop well-educated and well-qualified graduates who, in turn, will help traditional forest- and agriculturally-anchored industries transition into production, processing, and recovery systems based on emerging biobased products.

The BRS degree program augments, broadens, and strengthens the ABE Department's and the College's research enterprise through enhanced collaborations in bioproducts, bioenergy, biofuels supply chains, nanotechnology, and green products while adding complementary components in topics such as bioproducts packaging, green adhesives, biobased composites, chemistry and structure of biomaterials, biofuels supply chains, marketing/management, entrepreneurship, etc.

Objectives of the Program

The overall goal of the BRS Graduate Program is to be a world renowned research-oriented graduate program in renewable biologically-based materials, products, and processes that fully integrates the principles of systems technology, science, and management of resilient/sustainable biosystems. Toward that end, the major objectives are:

- Offer M.S. and Ph.D. graduate degrees that integrate science and technology with business, management, marketing, entrepreneurship, and leadership;*
- Provide advanced educational and research experiences that prepare graduates to lead the development and advancement of the growing biobased economy via industrial, governmental, and academic positions;*
- Develop and maintain a high-quality graduate degree program for students who otherwise might have wanted to apply to the Agricultural and Biological Engineering (ABE) graduate program but who do not have an undergraduate engineering but are qualified for an advanced degree in BioRenewable Systems;*
- Offer a competitive graduate degree program for students specifically interested in science and business-related aspects of biobased products and materials such as wood and wood-based products, bioenergy, and sustainable/renewable biological systems;*
- Promote advanced, interdisciplinary research addressing the science, technology, and business approaches to sustainable and safe bioenergy, biomaterials, and bioproducts and their supply chains, including the integration of marketing, management, entrepreneurship, and leadership; and*
- Enhance economic development by offering a continuing supply of well-educated and qualified future employees to both existing stakeholders from the agricultural and forest products industries and to an emerging, growing, and broader stream of biorenewable systems stakeholders in companies such as: chemical, pharmaceutical, cosmetics, materials and energy recovery, biobased packaging/processing for food and other products, sustainable systems including safety, and bioenergy.*

ADMISSION REQUIREMENTS

Applicants apply for admission to the program via the [Graduate School application for admission](#). Requirements listed here are in addition to Graduate Council policies listed under [GCAC-300 Admissions Policies](#).

The language of instruction at Penn State is English. English proficiency test scores (TOEFL/IELTS) may be required for international applicants. See [GCAC-305 Admission Requirements for International Students](#) for more information.

All applicants must provide [official transcripts from all post-secondary institutions attended](#), a statement of purpose written by the applicant, and at least three letters of recommendation. Admission into the BRS Graduate Program is based upon a thorough review of all applicant qualifications, and the best-qualified applicants will be accepted up to the number of students for which program resources are available. GRE scores will not be accepted.

Master of Science (M.S.)

Completion of a relevant undergraduate Bachelor degree program is required for admission to the M.S. degree program; relevant programs span a diverse set of academic disciplines, including but not limited to: Agricultural Sciences, Biology, Chemistry, Business, Engineering, and Environmental Sciences. Students with junior-senior GPA of at least 3.00 (4.00 base) will be competitive in the admission process.

In general, for admission to the Graduate School, an applicant must hold either (1) a baccalaureate degree from a regionally accredited U.S. institution or (2) a tertiary (postsecondary) degree that is deemed comparable to a four-year bachelor's degree from a regionally accredited U.S. institution. This degree must be from an officially recognized degree-granting institution in the country in which it operates.

To qualify for admission, all international applicants must take and submit scores for the TOEFL (Test of English as a Foreign Language) or the IELTS (International English Language Testing System), with the exceptions noted below. The minimum acceptable score for the TOEFL is 550 for the paper-based test, 213 for the computer-based test, or a total score of 80 with a 19 on the speaking section for the internet-based test. The minimum composite score for the IELTS is 6.5.

International applicants exempt from the TOEFL/IELTS requirement include those who have received a baccalaureate or a graduate degree from a college/university/institution in any of the following:

American Samoa, Anguilla, Antigua and Barbuda, Australia, Bahamas, Barbados, Belize, Bermuda, British Virgin Islands, Canada (except Quebec), Cayman Islands, Dominica, England, Ghana, Grenada, Guyana, Jamaica, Kenya, Liberia, Montserrat, New Zealand, Nigeria, Northern Ireland, Puerto Rico, Republic of Ireland, Scotland, Singapore, South Africa, St Kitts and Nevis, St Lucia, Trinidad and Tobago, Turks and Caicos Islands, Uganda, United States, U.S. Virgin Islands, and Wales

Doctor of Philosophy (Ph.D.)

The program requirement for acceptance to graduate study toward a Ph.D. degree in BRS is typically an M.S. degree with research thesis in BRS or related discipline such as: Agricultural Sciences, Biology, Chemistry, Business, Engineering, and Environmental Sciences, or with a B.S. degree in Agricultural Systems Management (ASM) or BRS or equivalent. Outstanding students interested in direct admission from a B.S., B.A., or M.B.A. program to the Ph.D. Program should contact the Graduate Program Coordinator for further clarification and details. Direct admission will be based on critical evaluation of the student's:

- potential to conduct publishable research,
- academic record,
- an additional language (other than the student's mother tongue),
- performance on standardized tests,
- statement of purpose, and
- reference letters.

Students who apply directly to the Ph.D. program with a B.S. degree and are deemed by the admissions committee not to meet the standards for admission to the Ph.D. program may be considered either for admission into the M.S. program or for admission to the Ph.D. program [on a provisional basis](#). The student will remain in provisional status in the Ph.D. program until completing the suggested provisional courses with a minimum grade-point average of 3.00:

For provisional status to change, the specific courses must be completed within the first two semesters of study.

Graduate Record Examination (GRE). Students are not required to submit GRE general aptitude test scores (i.e., verbal, quantitative, and analytical) to be considered for admission.

To qualify for admission, all international applicants must take and submit scores for the TOEFL (Test of English as a Foreign Language) or the IELTS (International English Language Testing System), with the exceptions noted below. The minimum acceptable score for the TOEFL is 550 for the paper-based test, 213 for the computer-based test, or a total score of 80 with a 19 on the speaking section for the internet-based test. The minimum composite score for the IELTS is 6.5.

International applicants exempt from the TOEFL/IELTS requirement include those who have received a baccalaureate or a graduate degree from a college/university/institution in any of the following:

American Samoa, Anguilla, Antigua and Barbuda, Australia, Bahamas, Barbados, Belize, Bermuda, British Virgin Islands, Canada (except Quebec), Cayman Islands, Dominica, England, Ghana, Grenada, Guyana, Jamaica, Kenya, Liberia, Montserrat, New Zealand, Nigeria, Northern Ireland, Puerto Rico, Republic of Ireland, Scotland, Singapore, South Africa, St Kitts and Nevis, St Lucia, Trinidad and Tobago, Turks and Caicos Islands, Uganda, United States, U.S. Virgin Islands, and Wales

DEGREE REQUIREMENTS

Master of Science (M.S.)

Requirements listed here are in addition to Graduate Council policies listed under [GCAC-600 Research Degree Policies](#).

All candidates for the M.S. degree must:

- prepare and complete a thesis
- complete a minimum of 30 credits at the 400, 500, 600, or 800 level (including a minimum of 18 credits at the 500 and 600 level, combined, and a minimum of 6 credits of research)
- obtain a minimum grade-point average of 3.00.

Only courses in which grades of C or better are earned may be counted toward the requirements of the master's degree. Each program must include:

Required Courses		
BRS 500	Research Methods	3
BRS 502	Human Behavior and ethics in Management and Technology (or other Ethics course from a list of approved courses maintained by the program office, unless previously taken)	3
BRS 504	Biorenewable Systems Analysis	3
BRS 590	Colloquium (1 credit/semester for 3 semesters)	3
Electives		
Two courses from list of electives maintained by the program office (see below)		6
At least one 5XX statistics course		3
Additional 4XX or 5XX Course or BRS 600 Thesis Research		3
Culminating Experience		
BRS 600	Thesis Research	6

The following ethics courses may substitute for BRS 502:

- *BIOET 401Q: Science, Ethics, Policy, and Law*
- *BIOET 533: Ethical Dimensions of Renewable Energy and Sustainability Systems*
- *BUS 515: Business Ethics and Corporate Governance*
- *INTAF 511: Ethical Dimensions in Food and Agricultural Governance*
- *LEAD 863: Ethical Dimensions of Leadership*
- *LHR 460: Ethics in the Workplace*
- *MBADM 815: Ethical and Responsible Business Leadership*
- *PHIL 432: Medical and Health Care Ethics*
- *PHIL 433: Ethics in Science and Engineering*
- *PHIL 573: Ethics and the Responsible Conduct of Biomedical Research*

- *PHS 806: Public Health Ethics*
- *STS 589: Ethics and Values in Science and Technology*

Approved Electives:

• <i>BRS 501 Biobased Polymers</i>	3
• <i>BRS 511 Advanced Structural BioComposites</i>	3
• <i>BRS 550 Applied Bioproducts Marketing</i>	3
• <i>BRS 551 Sustainable Business Strategies</i>	2
• <i>ABE 559 Biological Systems Simulation</i>	3
• <i>FOR 880 Bioenergy Feedstock</i>	3
• <i>ABE 888 Conversion Technologies for Bioenergy Production</i>	3
• <i>ABE 884 Biomass Energy Systems</i>	3
• <i>ABE 855 Biomass Harvest and Logistics</i>	3
• <i>ASM 426 Management of Safety and Health Issues in Production, Agriculture and Related Businesses <u>or</u></i>	3
• <i>ENVSE 450 Environmental Health and Safety</i>	3
• <i>EME 801 Bioenergy Markets, Policy, and Regulation</i>	3

Not that, if BRS 551 is used as an elective, it is a 2 credit course. Thus one additional credit of research (BRS 600) or other course will be needed to meet total credit requirements for the degree program.

In addition to the above listed course requirements, every graduate student must fulfill the Scholarship and Research Integrity (SARI) requirement. SARI requirement consists of two parts: (1) completion of BRS 500 with a grade of B or better and (2) completion of online training program at: <http://www.research.psu.edu/training/sari/program>, in Physical Sciences and Engineering or Social and Behavioral Sciences. The online SARI requirement must be completed within one year from date of enrollment in the program of study.

All courses must be approved by the student's M.S. Advisory Committee as having significance and value for the degree program. All requirements for the M.S. degree, whether satisfied on University Park campus or elsewhere, must be met within eight years from the first semester of graduate study.

M.S. Advisory Committee: An initial Adviser will be assigned to each entering graduate student by the Department Head, in consultation with the Graduate Program Coordinator and the faculty member agreeing to serve as adviser. To the extent practical and commensurate with potential funding source(s), research interests of the student and assigned Adviser will be compatible. New graduate students are highly encouraged to visit with various faculty members concerning opportunities for thesis research activities. After the student has decided on the preferred research area, s/he should inform the Graduate Program Coordinator or Department Head—by the middle of the first semester of study—of the preferred faculty member to serve as permanent Adviser. Each student should schedule at least a one-hour meeting each week with the permanent adviser to ensure adequate communications.

An M.S. Advisory Committee must consist of at least three faculty, all of whom are members of the Graduate Faculty. The chair (or Co-chair) of the Advisory Committee will be a BRS Graduate Faculty member and will serve as the student's thesis Adviser. Students are encouraged to have one member of the committee from outside the BRS Graduate Program in a field related to the thesis problem. If a student selects a minor, then one member of the committee must be a graduate faculty member of the minor department.

M.S. Research Proposal: Each M.S. degree student must prepare a written and oral research proposal, presented to and approved by their M.S. Advisory Committee. The written document must be provided to their advising committee at least 1 week prior to the proposal presentation. This should occur shortly after the completion of the student's first semester of study.

Final Oral Exam: Each M.S. degree student must complete a Final Oral Examination, which consists primarily of presenting and defending their near-final version of thesis draft. However, the examination may cover the entire field of BioRenewable Systems. The M.S. degree student must provide their thesis to their committee no later than two weeks prior to their Final Oral Examination date. The Graduate Program Coordinator must be notified of the exam by a copy of the scheduling letter sent to the Advisory Committee; no scheduling form is required. Otherwise, the guidelines for this examination are basically the same as the guidelines for the Ph.D. Final Oral Examination; see that section for further information.

Schedule for M.S. Requirements: Many of the M.S. degree requirements are listed in approximate chronological order in Table 1. It is the student's responsibility to ensure that these and all other requirements are met in a timely manner. It is expected that M.S. students should complete the degree in a timely manner consistent with the research and funding program developed.

Table 1 - SUGGESTED SCHEDULE FOR M.S. DEGREE.

Timing	Requirement (responsibility of M.S. student to ensure completion)	Suggested Completion Dates
End of first semester.	Submit to Adviser a list of courses to comprise graduate plan of study, assemble Advisory Committee in consultation with adviser, Transfer credit from undergraduate or post-baccalaureate program, if appropriate.	Departmental M.S. Committee Appointment Form
Each January and July.	Complete semiannual progress report form.	Departmental BRS Graduate Semiannual Progress Form
End of first semester, following BRS 500*	Submit plan of study and thesis project proposal to Advisory Committee for approval.	Departmental M.S. Thesis Proposal Review and Evaluation Form
Within one year from the date of enrollment in the program of study.	SARI: Online tutorial and certificate	Send completion certificate to Graduate Administrative Assistant.
Beginning of semester or summer session in which degree is expected.	Apply to graduate, Pay thesis fee.	Online form in LionPath
Early in last semester	Submit draft thesis to Adviser. Follow Thesis Format Guidelines of PSU Graduate School	Several months prior to defense date.
AFTER the thesis has been approved by Advisor and no later than two weeks prior to thesis defense date.	Schedule Final Oral Examination and communicate date/time to Graduate Administrative Assistant and distribute copies of thesis to Advisory Committee members and Graduate Program Coordinator.	Departmental M.S. Thesis Defense Form
After Final Oral Exam	Submit final copy of thesis to Graduate School for approval by committee and Department Head	Approval done online using eTD system

After Final Oral Exam if practical; otherwise, as close to it as is practical. Present departmental seminar based on results of thesis research; schedule through the Seminar Chair

Two weeks prior to departure.	Departure meeting with the Director of Graduate Studies or other faculty member
Prior to departure.	Prepare manuscript(s) for publication based on thesis research activity. Disassemble research apparatus and clean as necessary; return equipment and supplies to designated areas. Clean office, desk, and file space; empty all drawers and shelves and remove posters. Return departmental keys, books, software, supplies, etc.

*Not all students will be prepared to complete the research proposal for BRS 500 during their first semester; Advisers have the discretion of delaying BRS 500 and completion of the research proposal until the end of the 2nd or 3rd semester. In these cases, the student (1) should submit a plan of study to their committee at the end of the first semester and (2) work closely with the Adviser to ensure timely completion of the program of study.

Table 2 shows coursework for a student enrolled in M.S. program of study in BRS. The proposed schedule in Table 2 allows full-time students to complete the courses in three semesters plus a summer session. A student's actual course schedule should be developed in conjunction with the student's advisor, and will depend on a variety of factors such as course availability, background and interests of the student, and research project schedule.

Table 2 – Example of a Course Schedule for M.S. Program of Study in BRS.

<u>Year 1</u>			
	<u>Course Number</u>	<u>Course Title</u>	<u>Credits</u>
Fall	BRS 500	Research Methods in BioRenewable Systems	3
	BRS 502	Human Behavior and Ethics in Mgmt. & Tech.	3
	BRS 504	BioRenewable Systems Analysis	3
	BRS 590	Colloquium	1
		Total Credits	10
	<u>Course Number</u>	<u>Course Title</u>	<u>Credits</u>
Spring	BRS 501	Biobased Polymers	3
	BRS 511	Advanced Structural BioComposites	3
	BRS 590	Colloquium	1
		Total Credits	7
<u>Year 2</u>			
	<u>Course Number</u>	<u>Course Title</u>	<u>Credits</u>
Fall	STAT 500	Applied Statistics	3
	ABE 559	Biological Systems Simulation	3
	BRS 590	Colloquium	1
		Total Credits	7
			Total Course Credits
			24

Note: Students will also enroll in research credits (BRS 600). Total credit load per semester is expected to be 12 credits for students on assistantship support.

Doctor of Philosophy (Ph.D.)

Requirements listed here are in addition to Graduate Council policies listed under [GCAC-600 Research Degree Policies](#).

Official entrance into a Ph.D. program occurs upon successful completion of the Ph.D. Qualifying Examination. Ph.D. degree requirements include successful completion of the following:

- approved graduate course work,
- Ph.D. language and communication requirements,
- a comprehensive examination, and
- defense, approval, and submission of a dissertation.

No University-level (Graduate Council) minimum number of courses completed or credits earned are specified for the Ph.D.; the student's Ph.D. committee will recommend the minimum requirements as appropriate for each individual student's program of study and dissertation research. Unless previously taken for the M.S., each Ph.D. student must complete:

Required Courses		
BRS 500	Research Methods	3
BRS 502	Human Behavior and ethics in Management and Technology (or other Ethics course from a list of approved courses maintained by the program office, unless previously taken)	3
BRS 504	Biorenewable Systems Analysis	3
BRS 590	Colloquium (1 credit/semester for 4 semesters)	4
BRS 602	Supervised Experiences in College Teaching (at least 1 credit)	1-3
	Communications or International Language/Culture	3
In addition the candidate must complete 6 credits of BRS 5XX (excluding BRS 500 and 590-596) or select from a list maintained by the program office		6

The candidate is expected to develop a program of study and submit it to the appointed Ph.D. committee for consideration and approval. All requirements for a Ph.D. degree, whether satisfied on this campus or elsewhere, must be completed within eight years after passing the qualifying examination.

The following ethics courses may substitute for BRS 502:

- *BIOET 401Q: Science, Ethics, Policy, and Law*
- *BIOET 533: Ethical Dimensions of Renewable Energy and Sustainability Systems*
- *BUS 515: Business Ethics and Corporate Governance*
- *INTAF 511: Ethical Dimensions in Food and Agricultural Governance*
- *LEAD 863: Ethical Dimensions of Leadership*
- *LHR 460: Ethics in the Workplace*
- *MBADM 815: Ethical and Responsible Business Leadership*
- *PHIL 432: Medical and Health Care Ethics*
- *PHIL 433: Ethics in Science and Engineering*
- *PHIL 573: Ethics and the Responsible Conduct of Biomedical Research*
- *PHS 806: Public Health Ethics*
- *STS 589: Ethics and Values in Science and Technology*

Except as specified above, no particular courses, total number of courses or total credits are required by the BRS program. For Ph.D. students that have completed an M.S., the typical coursework load is about 36 credits.

It is recommended that each Ph.D. student not holding an M.S. degree will satisfy the intent of the M.S. degree coursework requirements specified elsewhere in this document. For these students, the typical coursework total is anticipated to be higher than 36 credits. Students who completed the core courses as part of a PSU MS degree in BRS shall propose an alternate set of courses for their individual program, which must be approved by their advisor and thesis committee.

The student's Dissertation committee will determine the minimum requirements in such supporting areas as science, technology, and business. The candidate is expected to develop a program of study and submit it to the Dissertation committee for consideration and approval at the qualifying exam.

In addition to the above listed coursework requirements, every graduate student must fulfill the Scholarship and Research integrity (SARI) requirement. The SARI requirement consists of two parts (1) completion of BRS 500 with a grade of B or better, and (2) completion of an online training program at <http://www.research.psu.edu/training/sari/program>, in Physical Sciences and Engineering or Social and Behavioral Sciences. The online SARI requirement must be completed within one year from the date of enrollment in the program of study. Table 2 shows coursework (beyond M.S.) for a student enrolled in Ph.D. program of study in BRS. The example schedule in Table 2 allows full-time Ph.D. students to complete the courses in four semesters.

Research credits (BRS 600) are in addition to coursework credits. The Dissertation committee will determine the minimum research credits but typically the total number is 24 credits beyond the M.S. All requirements for a Ph.D. degree, whether satisfied on University Park campus or elsewhere, must be completed within eight years after passing the Qualifying Examination.

Table 3 – Example of a Course Schedule for Ph.D. Program of Study in BRS (Beyond M.S.).

<u>Year 1</u>			
<u>Fall</u>	<u>Course Number</u>	<u>Course Title</u>	<u>Credits</u>
	STAT 501	Regression Methods	3
	BRS 500*	Research Methods in BioRenewable Systems	3
		Technical selection in specialty area(s)	3
	BRS 590	Colloquium	1
		Total Credits	10
<u>Spring</u>	<u>Course Number</u>	<u>Course Title</u>	<u>Credits</u>
	STAT 502	Experimental Design	3
		Business/Management elective	3
		Technical selection in specialty area(s)	3
	BRS 590	Colloquium	1
		Total Credits	10
<u>Year 2</u>			
<u>Fall</u>	<u>Course Number</u>	<u>Course Title</u>	<u>Credits</u>
	ABE 559**	Biological Systems Simulation	3
		Elective course in communication (from selection list)	3
		Business/Management elective	3
	BRS 590	Colloquium	1
		Total Credits	10
<u>Spring</u>	<u>Course Number</u>	<u>Course Title</u>	<u>Credits</u>
		Technical selection in specialty area(s)	3
		Business/Management elective	3
	BRS 602	Supervised College Teaching	1
	BRS 590	Colloquium	1
		Total Credits	8
Overall Total Course Credits			38

*If not already completed. Note that the student will also register for Research Credits (BRS 600) that will increase the total credit load per semester. Students on an assistantship are normally expected to enroll in a total of 12 credits per semester while taking courses.

Qualifying Examination

The Ph.D. Qualifying Examination Committee will administer the Qualifying Examination. This committee will consist of four BRS graduate faculty members, including the Adviser, the ABE Department Head (or annually appointed designee), the BRS Graduate Program Coordinator, and one faculty member selected by the student. In cases where a member serves two roles on the committee, an additional member will be appointed by the Graduate Program Coordinator. The Qualifying Examination will consist of developing a Ph.D. research proposal following the completion of [BRS 500](#), presenting the proposal, and defending/discussing the proposed research with the Committee. The Qualifying Examination will be completed by the student soon after s/he has completed at least 18 credits but before the end of the third semester. Successful completion of the Qualifying Examination does not mean that the student's Ph.D. research

proposal is approved. Rather, final approval of the candidate's research proposal will be the responsibility of the Ph.D. committee.

Each Ph.D. student will submit to each Qualifying Committee member a detailed written proposal for the Ph.D. research a minimum of two weeks prior to the exam. This proposal should contain justification, objectives, related literature, methodology, practical significance, resources required, bibliography, proposed program of study and a statement of possible funding sources to which the proposal could be submitted.

The student will present a 20-minute seminar to the Qualifying Committee. The seminar is open to all in the Department and participants may ask questions of the potential Ph.D. candidate concerning the proposed study, science and technical aspects, business, leadership, and entrepreneurial implications, and other related items. The total seminar time will be limited to approximately 30 minutes. Upon completion of this seminar, the graduate faculty members, and members of the Committee (may) hold a discussion period (no longer than approximately 15 minutes) regarding the student, the proposed research, and the seminar. The student will not be present during this discussion period. Following this discussion, the Qualifying Committee and the student will undertake the remainder of the exam.

The Qualifying Committee will review the written proposal and discuss in detail (up to 2 hours) with the student the proposed research and related topics. The Qualifying Committee will assess the student's understanding of the research process, the student's technical expertise related to biorenewable systems and the proposed research, suitability of the proposed research relative to the BRS graduate program expectations of Ph.D. candidates, the student's understanding of needed resources and other pertinent topics. The Qualifying Committee will also judge the ability of the student to communicate and will complete a "Report on Departmental Assessment of English Competency" (see "English Competency Requirements" section below). The Committee will select, based on the student's performance, one of the following: 1) recommendation that the student become a Ph.D. Candidate, 2) recommendation that the student become a Ph.D. candidate but must undertake additional activities as prescribed by the Qualifying Committee, 3) recommendation that the student undertake additional activities as prescribed by the Qualifying Committee and retake the Qualifying Examination, or 4) rejection of the student as a Ph.D. Candidate. A student will not be allowed to take the Qualifying Examination more than twice.

English Competency Assessment:

The Graduate Council and the BRS graduate program of study require candidates for the Ph.D. degree to demonstrate high-level competence in the use of the English language; including reading, writing, listening, and speaking. To fulfill this requirement, the BRS graduate program requires that all Ph.D. students undergo an assessment of English competency. The assessment will include the student's ability to read and comprehend, write, speak, and give presentations so as to effectively participate in scientific and technical discussions. The assessment will be conducted during the Ph.D. Qualifying Examination by the Ph.D. Qualifying Examination Committee and will consist of three parts:

Writing—As part of the Ph.D. Qualifying Examination, the student will prepare a detailed research proposal on the topic chosen for his/her Ph.D. dissertation (see "Qualifying Examination" for further details about proposal). The written document will be judged for its organization, logical arguments in support of the hypotheses, inclusion of relevant details,

and appropriate style in the use of language, grammar, punctuation, and spelling. The "Literature Section" of the written proposal containing analysis of pertinent literature will be used to evaluate the student's reading comprehension of the technical literature.

Presentation—As part of the Ph.D. Qualifying Examination, the student will present a 20-minute seminar to the Committee. The seminar is open to all in the Department. The presentation will be judged for its organization, clarity, appropriateness to the audience, appropriate use of visual aids, and effectiveness of delivery. The quality of the formal presentation should be comparable to papers presented at technical sessions of professional society meetings.

Oral Discussion—The main purpose of the Oral Discussion part of the English Competency Test is to evaluate the oral skills of the student to participate in scientific and technical discussions with other technical professionals. The Oral Discussion will follow the formal presentation of the research proposal by the student. The examination committee will conduct a discussion with the student on various aspects of the research proposal and on the scientific and technical issues surrounding the research area.

At the end of the Qualifying Examination, each member of the Committee will present an assessment of the student's English competency in the three categories: writing, presentation, and oral discussion. These assessments will be used to certify attainment of English competency or to recommend measures for improving English competency. A "Report on Departmental Assessment of English Competency" form will be completed by the Committee, shared with the student, and placed in the student's Departmental records.

If the expected level of English Competence is not demonstrated, the student must enroll in course(s) to improve English competency. The committee will recommend suitable course(s) which may include selections from the following or additional remedial courses noted in the Report on Departmental Assessment of English Competency (i.e., these courses do not count toward fulfillment of the requirements for the graduate degree):

Writing Skills

- *ESL 116G – ESL/Composition for Academic Disciplines*

Presentational Skills

- *CAS 100A – Effective Speech*
- *CAS 211 – Informative Speaking*

Oral Language Skills

- *ESL 114G – American Oral English for Academic Purposes*
- *ESL 115G – American Oral English for ITAs*

If the student completes and passes the recommended course(s) with a B- grade or higher, then the student will be certified as having attained English competency. Otherwise, the student will have to retake the course (or another comparable course). Students judged as not making sufficient progress towards achieving competency in English will have their funding terminated.

Ph.D. Committee

The Ph.D. committee must meet all of the [Graduate Council requirements](#), and:

1. the chairperson and at least one other member must be BRS Graduate Faculty members,
2. at least one member must be from a department other than ABE and s/he should be a Graduate Faculty member of a program other than BRS,
3. at least one member must represent any minor department(s) if the student selects a minor(s), and
4. the Ph.D. committee can be appointed only after the Qualifying Examination has been passed.

An initial Adviser will be assigned to each entering graduate student by the Department Head, in consultation with the Graduate Program Coordinator and the faculty member agreeing to serve as adviser. To the extent practical and commensurate with potential funding source(s), research interests of the student and assigned Adviser will be compatible. New graduate students are highly encouraged to visit with various faculty members concerning opportunities for dissertation research activities. After the student has decided on the preferred research area, s/he should inform the Graduate Program Coordinator or Department Head—by the middle of the first semester of study—of the preferred faculty member to serve as permanent Adviser. Each student should schedule at least a one-hour meeting each week with the adviser to ensure adequate communications.

PH.D. Language and Communication Requirement

The purpose of the communication requirement is to strengthen the student's professional communication skills. The candidate must take a minimum of one three-credit course and receive a grade of B or better. Course selections must be approved by the academic adviser prior to registration. Courses used to satisfy this requirement must include the substantial practice of writing and/or speaking.

The selected course must be approved by the Adviser prior to registration and must meet the expectations of the Dissertation committee. A course used to satisfy this requirement cannot be a course taken as remedial for the Qualifying Examination. Examples of courses to consider are:

- AEE 450 Program Design and Delivery (3)
- AEE 530 Teaching and Learning in Agricultural Science (3)
- AGCOM 462W Advanced Agricultural Writing (3)
- CAS 450W Group Communication Theory and Research (3)
- CAS 452W Organizational Communication Theory and Research (3)
- CAS 471 Intercultural Communication Theory and Research (3)
- ENG 417 The Editorial Process (3)
- ENG 418 Advanced Technical Writing and Editing (3)
- ENG 474 Issues in Rhetoric and Composition
- ENG 511 Thesis Workshop and Professional Writing (3)
- ENG 584 Studies in Rhetoric (3)
- HI ED 546 College Teaching (3)
- Any 3-credit 4XX foreign language course (Excluding 49X; and must not be candidate's native language).

Comprehensive Examination

When a Ph.D. candidate has substantially completed the course work, including the communication requirements, s/he is required to take a Comprehensive Examination covering the major, minor, and related areas of study. The Comprehensive Examination will be both written and oral. The nature and details of the Comprehensive Examination will be determined by the student's Ph.D. committee. In general, the student will be required to demonstrate ability to synthesize information acquired through formal coursework and to use technical literature to find information required for solving biorenewable systems problems. A favorable vote of at least two-thirds of the committee is required for passing. If a candidate fails, the committee will determine whether another examination may be taken.

The Comprehensive Examination should be scheduled through the Graduate Program Assistant and the Graduate School at least three weeks prior to the selected date. All candidates are required to have a minimum grade point average of 3.00 for graduate work completed at the University at the time the Comprehensive Examination is given and may not have deferred or missing grades. The student must be registered as a full-time or part-time student for the semester in which the Comprehensive Exam is taken. The Comprehensive Examination must be taken at least three months before the Final Oral Examination. If a period of six years has elapsed between the passing of the Comprehensive Examination and the completion of the program, the student is required to pass a second Comprehensive Examination before the Final Oral Examination can be scheduled.

The Comprehensive Examination will consist of 1) The completion of a written examination provided by each of the Dissertation committee members prior to the oral examination; 2) A presentation of the candidate's research; 3) An oral examination that may cover content in the written examination research presentation or relevant subject matter.

Results of the examination are reported online, directly to the Office of Graduate Enrollment Services.

Final Oral Examination

Upon recommendation of the Adviser, a Ph.D. candidate who has satisfied all other requirements for the degree will be scheduled to take a Final Oral Examination. The student must be a registered full-time or part-time degree student for the semester in which the Final Oral Examination is taken. This examination is open to the public and the student should notify all departmental faculty and graduate students. The examination is related largely to the dissertation, but may cover the candidate's entire field of study without regard to courses that have been taken either at Penn State University or elsewhere. The defense of the dissertation should be well-prepared including any appropriate visual aids. One of the aims of the preparation should be to synthesize the important conclusions in a time-efficient presentation, leaving ample time for questions and discussion. A favorable vote of at least two-thirds of the committee is required for passing. If a candidate fails, the committee will determine whether another examination may be taken.

The oral presentation portion of the examination is open to the public, and the student should reserve a suitable venue with the Graduate Program Assistant and notify the department faculty and graduate students in advance.

The scheduling form is completed online, with the help of the Graduate Administrative Assistant and must be submitted at least two weeks prior to the scheduled exam date.

Results of the exam are reported directly to the Graduate School.

Criteria for evaluation of the final oral examination: The following criteria are used to evaluate the final oral examination are listed in the Program Assessment Form at the back of this document.

Schedule for Ph.D. Requirements:

Many of the Ph.D. degree requirements are listed in approximate chronological order on the following page. It is the student's responsibility to ensure that these and all other requirements are met in a timely manner. It is expected that Ph.D. students should complete the degree in a timely manner consistent with the research and funding program developed.

Table 4 - SUGGESTED SCHEDULE FOR Ph.D. DEGREE

<i>Suggested Completion Dates</i>	<i>Requirement (responsibility of Ph.D. student to ensure completion)</i>
<i>End of first semester.</i>	<i>Submit to Adviser a list of courses to comprise graduate plan of study.</i>
<i>End of first semester.</i>	<i>Recommend to Graduate Coordinator faculty members to serve on Qualifying Exam Committee.</i>
<i>End of first semester.</i>	<i>Transfer credit from undergraduate or post-baccalaureate program, if appropriate.</i>
<i>End of first semester, following BRS 500*</i>	<i>Prepare dissertation research project proposal for Adviser.</i>
<i>Each January and July.</i>	<i>Complete semiannual progress report form.</i>
<i>Completed immediately following at least 18 credits but before the end of the third semester (target date: first semester following BRS 500)</i>	<i>Schedule and complete Ph.D. Qualifying Examination</i> <i>Form Dissertation advisory committee</i>
<i>After completion of Qualifying Exam</i> <i>End of first semester, following BRS 500*.</i>	<i>Submit plan of study and dissertation project proposal to Dissertation committee for approval (copy to Graduate Program Coordinator).</i>
<i>Upon substantial completion of the coursework and at least 3 months prior to Final Oral Exam</i>	<i>Schedule and complete Comprehensive Examination</i>
<i>Beginning of semester or summer session in which degree is expected.</i>	<i>Apply to graduate in LionPATH.</i>
<i>Beginning of semester or summer session in which degree is expected.</i>	<i>Pay dissertation fee</i>
<i>Early in last semester.</i>	<i>Submit draft dissertation to Adviser.</i>
<i>AFTER the dissertation has been approved by Adviser for distribution and at least one week prior to dissertation defense date.</i>	<i>Schedule Final Oral Examination and distribute copies of dissertation to Dissertation committee members and Graduate Program Coordinator.</i>
<i>After Final Oral Exam if practical; otherwise, as close to it as is practical.</i>	<i>Present departmental seminar based on results of dissertation research; schedule through the Seminar Chair</i>
<i>After Dissertation committee signs and prior to Graduate School deadline.</i>	<i>Submit original copy of dissertation to Department Head for signature, then to Graduate School.</i>
<i>Two weeks prior to departure.</i> <i>Prior to departure.</i>	<i>Departure meeting with Department Head.</i> <i>Prepare manuscript(s) for publication based on dissertation research activity.</i>
<i>Prior to departure.</i>	<i>Disassemble research apparatus and clean as necessary; return equipment and supplies to designated areas. Clean office, desk, and file space; empty all drawers and shelves and remove posters.</i>
<i>Prior to departure.</i>	<i>Return departmental keys, books, software, supplies, etc. to Administrative Assistant.</i>
<i>Prior to departure.</i>	<i>Provide one electronic copy of dissertation to Adviser.</i>

**Not all students will be prepared to complete the research proposal for BRS 500 during their first semester; Advisers have the discretion of delaying BRS 500 and completion of the research proposal until the end of the 2nd or 3rd semester. In these cases, the student (1) should submit a plan of study to their committee at the end of the first semester and (2) work closely with the Adviser to ensure timely completion of the program of study.*

DUAL-TITLES

A BRS graduate student may also pursue a dual title degree in one of two areas:

BioRenewable Systems and International Agricultural Development (BRS-INTAD). This program is especially suited to students who are carrying out a research project that has an international agriculture component, and/or those who are interested in pursuing a career in international agricultural development.

BioRenewable Systems and Operations Research (BRS-OR). This program is suited to students who are carrying out a research project related to systems analysis, manufacturing, and related topics that have an Operations Research component.

Students in a dual title program must satisfy the requirements of both the BRS and the dual title program, which may or may not require additional coursework. Students interested in a dual title degree program should consult the Graduate School Bulletin, the dual title program website, and the department's dual title program coordinator for information on admission, course selection and degree requirements.

Dual Title M.S. and Ph.D. in Biorenewable Systems and International Agriculture and Development

Admission Requirements

Requirements listed here are in addition to requirements listed in [GCAC-208 Dual-Title Graduate Degree Programs](#).

Students must apply and be admitted to the graduate program in BioRenewable Systems and The Graduate School before they can apply for admission to the dual-title degree program. After admission to their primary program, students must apply for admission to and meet the admissions requirements of the INTAD dual-title program. Refer to the Admission Requirements section of the [INTAD Bulletin page](#). Doctoral students must be admitted into the dual-title degree program in INTAD prior to taking the qualifying examination in their primary graduate program.

Degree Requirements

To qualify for the dual-title degree, students must satisfy the degree requirements for the degree they are enrolled in BioRenewable Systems. In addition, students must complete the degree requirements for the dual-title in INTAD, listed on the [INTAD Bulletin page](#).

The qualifying examination committee for the dual-title Ph.D. degree will be composed of Graduate Faculty from BioRenewable Systems and must include at least one Graduate Faculty member from the INTAD program. Faculty members who hold appointments in both programs' Graduate Faculty may serve in a combined role. There will be a single qualifying examination, containing elements of both BioRenewable Systems and INTAD. Dual-title graduate degree students may require an additional semester to fulfill requirements for both areas of study and,

therefore, the qualifying examination may be delayed one semester beyond the normal period allowable.

In addition to the [general Graduate Council requirements for Ph.D. committees](#), the Ph.D. committee of a BioRenewable Systems and INTAD dual-title Ph.D. student must include at least one member of the INTAD Graduate Faculty. Faculty members who hold appointments in both programs' Graduate Faculty may serve in a combined role. If the chair of the Ph.D. committee is not also a member of the Graduate Faculty in INTAD, the member of the committee representing INTAD must be appointed as co-chair. The INTAD representative on the student's Ph.D. committee will develop questions for and participate in the evaluation of the comprehensive examination.

Students in the dual-title program are required to write and orally defend a dissertation on a topic that is approved in advance by their Ph.D. committee and reflects their original research and education in BioRenewable Systems and INTAD. Upon completion of the doctoral dissertation, the candidate must pass a final oral examination (the dissertation defense) to earn the Ph.D. degree. The dissertation must be accepted by the Ph.D. committee, the head of the graduate program, and the Graduate School.

Dual-Title M.S. and Ph.D. in Biorenewable Systems and Operations Research

Admission Requirements

Requirements listed here are in addition to requirements listed in [GCAC-208 Dual-Title Graduate Degree Programs](#).

Students must apply and be admitted to the graduate program in BioRenewable Systems and The Graduate School before they can apply for admission to the dual-title degree program. After admission to their primary program, students must apply for admission to and meet the admissions requirements of the OR dual-title program. Refer to the Admission Requirements section of the [Operations Research Bulletin page](#). Doctoral students must be admitted into the dual-title degree program in OR prior to taking the qualifying examination in their primary graduate program.

Degree Requirements

To qualify for the dual-title degree, students must satisfy the degree requirements for the degree in which they are enrolled (BioRenewable Systems). In addition, students must complete the degree requirements for the dual-title in OR, listed on the [Operations Research Bulletin page](#).

Students in the Master's dual-title program are required to write and orally defend a thesis on a topic that is approved in advance by their M S Advisory Committee and reflects their research and education in BioRenewable Systems and Operations Research. Upon completion of the Master's thesis, the student must pass a final oral examination (the thesis defense) to earn the Master's degree. The thesis must be accepted by the student's M S Advisory Committee, the head of the graduate program, and the Graduate School. The student's thesis supervisor must be a member of the Graduate Faculty recommended by the chair of the program granting the degree

and approved by the Operations Research committee as qualified to supervise thesis work in operations research.

Students in the doctoral dual-title program are required to write and orally defend a dissertation on a topic that is approved in advance by their Ph.D. committee and reflects their original research and education in BioRenewable Systems and Operations Research. Upon completion of the doctoral dissertation, the candidate must pass a final oral examination (the dissertation defense) to earn the Ph.D. degree. The dissertation must be accepted by the Ph.D. committee, the head of the graduate program, and the Graduate School. The qualifying examination committee for the dual-title Ph.D. degree must include at least one Graduate Faculty member from the Operations Research program. The chair and at least two members of the Ph.D. committee of an Operations Research dual-title Ph.D. student must be members of the Operations Research Graduate Faculty.

Minor

A graduate minor is available in any approved graduate major or dual-title program. The default requirements for a graduate minor are stated in Graduate Council policies listed under [GCAC-600 Research Degree Policies](#) and [GCAC-700 Professional Degree Policies](#), depending on the type of degree the student is pursuing:

- [GCAC-611 Minor - Research Doctorate](#)
- [GCAC-641 Minor - Research Master's](#)
- [GCAC-709 Minor - Professional Doctorate](#)
- [GCAC-741 Minor - Professional Master's](#)

Minors in Agricultural and Biological Engineering

A student pursuing a master's degree in BRS may earn a minor in ABENG by completing at least 9 credits of 4XX or 5XX ABE courses. No more than a total of 3 of the minimum credits may be earned in 49X or 59X courses.

A minor in ABENG for a Ph.D. student must consist of no less than 15 credits of 4XX or 5XX ABE courses. No more than a total of 6 of the minimum credits may be earned in 49X or 59X courses. If the student received a master's minor in the same field as is being proposed for a Ph.D. minor, the 15 credits taken must be above and beyond those used for the master's minor. At least one faculty member from the minor field must be on the candidate's Dissertation committee.

Minors in other fields may also be available, as per regulations of the department offering that minor.

STUDENT AID

Graduate assistantships available to students in this program and other forms of student aid are described in the [Tuition & Funding](#) section of The Graduate School's website. Students on graduate assistantships must adhere to the [course load limits](#) set by The Graduate School.

COURSES

Graduate courses carry numbers from 500 to 699 and 800 to 899. Advanced undergraduate courses numbered between 400 and 499 may be used to meet some graduate degree requirements when taken by graduate students. Courses below the 400 level may not. A graduate student may register for or audit these courses in order to make up deficiencies or to fill in gaps in previous education but not to meet requirements for an advanced degree.

- BRS 500: Research Methods 3 Credits
- BRS 501: Biobased Polymers 3 Credits
- BRS 502: Human Behavior and ethics in Mgmt & Tech 3 Credits
- BRS 504: Biorenewable Systems Analysis 3 Credits
- BRS 511: Structural BioComposites 3 Credits
- BRS 550: Applied Bioproducts Marketing 3 Credits
- BRS 551: Sustainable Business Strategies 2 Credits
- BRS 568: Applied Biomanufacturing Laboratory 3 Credits
- BRS 590: Colloquium 1-6 Credits/Max of 12
- BRS 595: Internship 1-9 Credits/Max of 12
- BRS 596: Individual Studies 1-9 Credits
- BRS 597: Special Topics 1-9 Credits/Max of 15
- BRS 600: Thesis Research 1-15 Credits
- BRS 601: Ph.D. Dissertation Full-Time 0 Credits
- BRS 602: Supervised Experiences in College Teaching 1-3 Credits/Max of 6
- BRS 610: Thesis Research Off Campus 1-15 Credits

LEARNING OUTCOMES

These learning outcomes guide the design and delivery of the graduate program in BRS. All graduates are expected to demonstrate mastery of these outcomes.

Master of Science (M.S.)

1. Know: Graduates will demonstrate knowledge of sustainable, renewable biologically-based system including their life-cycle assessment and technoeconomic analyses.
2. Think: Graduates will be able to critically and creatively conceptualize and evaluate biorenewable industry problem formulations, analyses, and solutions.
3. Apply/Create: Graduates will demonstrate proficiency in biorenewable industry problem formulation, planning, organization and implementation of appropriate methods of analyses and solutions.
4. Communicate: Graduates will be able to effectively communicate technical knowledge, including ideas, data analysis, findings, or decision justification in written and oral presentation appropriate to the audience.
5. Professional practice: Graduates will be able to apply analytical skills for effective decision making in the biorenewable resource industries. Graduates will demonstrate a knowledge of ethics, equity, diversity and inclusivity and the application of these concepts and principles to the profession.

Doctor of Philosophy (Ph.D.)

1. Know: Graduates will demonstrate knowledge of sustainable, renewable biologically-based systems, including their life-cycle assessment and technoeconomic analyses.
2. Apply/Create: Graduates will demonstrate knowledge of one or more of the following: technologies and systems analysis, science, safety, marketing, business, or management principles and methodologies as they pertain to biorenewable systems.
3. Apply/Create: Graduates will be able to communicate, both orally and in-writing, business and/or technical concepts within the context of biorenewable industries. Graduates will be able to analyze and interpret data and demonstrate an ability to draw sound conclusions from data.
4. Think: Graduates will be able to independently analyze and critique motivations for conducting research, the research process, research results, and the implications of research and its results to our world.
5. Communicate: Graduates will be able to actively listen, convey accurately and clearly ideas and results both orally and in writing, and engage in positive, effective deliberation.
6. Professional practice: Graduates will be prepared to become leaders in our society by being able to apply the skills acquired to engage in effective decision making in the operations and/or management of biorenewable resource industries. Graduates will demonstrate a knowledge of ethics, equity, diversity and inclusivity and the application of these concepts and principles to the profession.

OTHER DEPARTMENTAL POLICIES AND GUIDELINES

Statistical Consulting Services

The Statistical Consulting Center (<http://scc.stat.psu.edu/>) is an educational and service unit in Penn State's Department of Statistics. Faculty, staff and graduate and undergraduate students from Statistics, Computer Science/ Engineering, and Management Science/Information Services provide advice, project management, data management, and statistical analysis for the University and private research community. The Center provides walk-in, short term, and longer term consulting services to graduate students, staff, and faculty. Short-term services include two free consultation meetings; whereas longer term services are on an arranged-fee basis.

It is recommended that each student consult with the Statistical Consulting Service during the planning of experiments and prior to data collection, to assure that adequate consideration has been given to statistical analysis.

Thesis Guidelines and Specifications

A degree candidate must demonstrate ability to do independent research and competence in scholarly exposition by the preparation of a thesis on a topic related to the major subject. The thesis should represent a significant contribution to knowledge, be presented in a scholarly manner, reveal an ability on the part of the candidate to do independent research of high quality and indicate considerable experience in using a variety of research techniques. In conformance with the Family Educational Rights and Privacy Act, students are hereby notified that their thesis and other research work may be made publicly available through libraries and other means.

The thesis is to be developed by the student with the supervision, support, and criticism of the Advisor. The draft thesis is to be submitted first to the Advisor. The student and the Advisor may agree to prior review of the thesis, either section-by-section or in its entirety, or both. After the thesis has been approved by the Advisor, the student distributes a copy to each member of the Dissertation committee. This draft should be complete in every respect including figures, tables, and bibliography; the content and style should be correct and polished.

Graduate students should allow a minimum of five working days before the Final Oral Exam for Dissertation committee members to review the thesis. Some members may require more time. Time for thesis reviews can often be reduced considerably if the graduate student notifies the committee members in advance of the date when copies will be submitted for review.

Acknowledgments. A student is highly encouraged to acknowledge the funding source(s) in the acknowledgments section of the thesis. In all cases, the Penn State College of Agricultural Sciences should be recognized for the contributions it has made to the student's thesis research activities. If the student or the student's research is additionally supported by a contract or grant activity, then it is highly appropriate to acknowledge the source of the external support. An example appropriate statement to acknowledge the support is "Thank you to <Department Head's name> for providing financial support from the Penn State College of Agricultural Sciences throughout my graduate study" or, more simply, "The

support received from the Penn State College of Agricultural Sciences is gratefully acknowledged.”

Units. All these must be in SI Units. Customary units may be included in parentheses for special applications.

Thesis Typing. The Information Technology Services (ITS) offers PSTT (Penn State Thesis Template) found at <http://www.gradsch.psu.edu/current/thesis.html> . The thesis is to be completed at the student’s expense. Departmental microcomputers may be used for thesis preparation under the following conditions:

- The equipment may be used only by the student.
- The student will readily relinquish the use of the equipment when needed by students or others for extension, research, or teaching purposes.
- The printers are not to be used for multiple copies.

Submission of Thesis. The thesis must meet the Graduate School's format and other requirements. The Office of Theses and Dissertations at: <http://www.gradsch.psu.edu/current/thesis.html> publishes a “Thesis Guide” <http://www.gradschool.psu.edu/current-students/etd/thesisdissertationguidepdf/> and provides thesis writers workshops several times each semester. In addition to Graduate School requirements, the student must provide one CD or an electronic copy to the Thesis Office and his/her Advisor.

(Advisors and the Dissertation committee may require additional copies, in bound or other formats. The cost of any additional copies required by the sponsor of the research project will be covered by the project funds.)

A graduate student must present a departmental seminar at the termination of each degree program, based on his/her thesis project. Seminars should be scheduled through the Seminar Chair, be during the regular seminar time slot, and be after the Final Exam or at least as close to the end of the degree program as is practical.

Graduate students must attend all department seminars each semester unless they have course conflicts and are encouraged to suggest topics and speakers to the seminar committee. Seminar attendance after passing the Final Oral Exam is optional.

If a student has a regularly scheduled course during the seminar period, then the student must inform the Graduate Program Coordinator at the beginning of the semester prior to the first scheduled seminar. A student may miss up to three seminars per semester without any penalty. If the number of missed seminars exceeds three, this absence will be noted on the student’s progress report and the department may withdraw funds for travel to conferences and/or other departmental support. No remedial action will be required if the student provides evidence of attending seminars elsewhere at PSU; equal in number to the missed seminars during the same semester. The substitute seminars must be part of an organized series or a special event and cannot be seminars given as part of a graduate committee event.

Participation in Departmental Activities

All graduate students are invited and encouraged to attend department meetings, retreats, seminars, socials, and all other activities. However, at the discretion of the Department Head, some departmental activities may be for only the faculty.

Graduate students are also invited and encouraged to become involved with departmental committees. Graduate students may not serve on the Graduate Applications Subcommittee to avoid any conflict of interests. Graduate student members of committees shall have full voting rights.

Student Organizations

There are several student organizations responding to the needs of graduate students. The largest group is the Graduate Student Association (GSA) which is a university-wide group consisting of representatives from each department. GSA provides a liaison between graduate students and University Administration and acts as both a lobbying group for student issues (such as insurance and taxes) and as a social organization providing such opportunities as happy hours and the summer rental of garden plots. The Engineering Graduate Student Council (EGSC) performs a similar function by providing a communication link to the College of Engineering. EGSC often sponsors panel discussions and brown-bag lunches while also having input on various college advisory committees. Representatives for both groups are elected from within the department near the end of each spring semester.

The diversity among graduate students is reflected by the number of ethnic and social groups available to students. Among the many groups are Friends of India (FOI), Women in Science and Engineering (WISE), and the Black Caucus. The Penn State Outing Club has many divisions including canoeing, hiking, biking, skiing, and equestrian.

Post-Graduation Employment

Assistance finding employment is available at the department, College, and University levels. The Agricultural Sciences Careers Fair is held each fall and attracts about 50 employers. University-wide career fairs are held each September and April in Bryce Jordan Center. Career Services (<http://studentaffairs.psu.edu/career/>) provides assistance in the following areas:

- *Drop-In & Career Counseling*
- *Nittany Lion Career Network*
- *Job Search and Career Fairs*
- *Workshops & Events*
- *Career Information Center*
- *Education Credentials Services*

Student Petitions

A graduate student has the right to submit a petition concerning any academic and/or administrative policy related to the graduate degree program. A petition needs to be approved by the Advisor and the Dissertation committee and then sent to the Graduate Program Coordinator who will forward the petition as appropriate. The Department Head, in

consultation with the Graduate Studies Committee, will make the final decision on petitions relating to policies and requirements promulgated by the department. In all cases, a petition must be submitted as early as possible so that the student has time to develop alternative plans if the petition is denied. Problems that develop between a student and member(s) of the Dissertation committee can be arbitrated on a confidential basis by the Department Head and/or Dean of the Graduate School, as appropriate.

Administrative Policies

Assistantship Responsibilities

A graduate student on a 1/4-time assistantship is expected to work a minimum of 10 hours per week on activities that are in compliance with the overall departmental objectives as determined by the Advisor. Students on 1/2-time or full-time assistantships are expected to work on a similar basis for a minimum of 20 hours or 40 hours per week, respectively. These work requirements may include thesis research activities.

To allow for obtaining a broad base of experiences and professional growth, each graduate student is encouraged to seek involvement with the Advisor and/or Dissertation committee members to gain teaching (classroom or extension) experiences as a part of the graduate education. This experience is expected for all Ph.D. candidates. In addition, each Ph.D. candidate should seek involvement with his/her Advisor to write and submit a research proposal for external funding. Each graduate student should discuss the opportunities for participation in teaching and proposal preparation with his/her Advisor and the Department Head.

The Test of Spoken English (TSE) is required of graduate students whose native language is not English before such students can be appointed to graduate teaching assistantships. Students who score less than 220 on the TSE will not be permitted to hold teaching assistantships.

Work Related Injury

The University covers its employees with Worker's Compensation Insurance as a protection for injuries or illness compensable under the Pennsylvania Worker's Compensation Act.

An employee has an obligation to report any work-related injury, regardless of how minor, to his or her supervisor. The employee will be provided with a "Workers' Compensation Employee Notification" form and a copy of the "Healthcare Provider Panel" list. Any treatment for the first 90 days from first treatment must come from a "Panel" provider to ensure that the University will pay for medical treatment. If the injury results in an immediate medical emergency, initial medical assistance may be obtained from a hospital or health care provider of the employee's choice. However, subsequent treatment must be from a "Provider Panel" participant.

Additional information on this topic can be obtained from the Risk Management Office/Privacy Office, 227 West Beaver Avenue, Suite103 Rider Building, State College, PA 16801, phone 814-865-6307.

Health Insurance

The Student Insurance Office is responsible for administering two health insurance plans for graduate students. A graduate student who is on a Graduate Assistantship or Graduate Fellowship is automatically enrolled in the Penn State Graduate Assistant and Graduate Fellow Health Insurance Plan, and the Vision and Dental Plans, which also provides coverage for eligible dependents. Penn State will provide a subsidy of 80% of the annual premium cost for the graduate assistant or fellow and deduct the student's 20% contribution from the monthly paycheck. Health insurance subsidy for eligible dependents is 70% of the annual premium expense. To enroll a spouse and/or dependents for Medical, Dental, and Vision benefits, graduate students must complete the "Online Dependent Enrollment Form within the initial website listed below.

Graduate students not on an assistantship or fellowship may enroll in the Penn State Student Accident and Sickness Insurance Plan. All international students and their accompanying dependents (spouse and/or children) must have health insurance coverage. This may be fulfilled in one of two ways:

- *Purchase the Penn State Student Accident and Illness Plan*
- *Acquire a comparable health insurance plan and provide the University with documentation that provides proof of insurance by submitting a waiver application to the Student Insurance Office.*

Further details regarding student health insurance are available at the University Health Services Office, 302 Student Health Center, phone 814-865-7467, or visit: <https://studentaffairs.psu.edu/health-wellness/health-insurance>.

Publication and Presentation

Publication and presentation of knowledge created through research is an essential experience in graduate education. Future employers in academia, government and industry use a student's publication and presentation records as important metrics in evaluating the quality of applicants. The experience and skills developed by preparing and submitting a manuscript, engaging in scholarly debate during the review process, and producing a polished final publication are important for a student's career. Similarly, the ability to provide a clear, accurate and compelling scholarly presentation will be needed throughout one's professional life. In addition, student and faculty productivity in publishing and presenting research results are important to the success of the department. Publication and/or presentation may also be a requirement associated with some sources of student funding.

To prepare graduate students for success in obtaining and excelling in future positions, it is expected that students will prepare and submit publications appropriate for their specific field of study. These may include peer reviewed journal articles, conference papers or extension publications. Students are also expected to present their research at a conference or venue appropriate for their field. Specific expectations for number of publications and presentations will be established by the student, advisor, and advisory/doctoral committee. For example, an M.S. student may be expected to submit 1-2 peer reviewed journal articles and provide 1 technical conference presentation. A Ph.D. student may be expected to submit 3-4 peer reviewed journal articles and provide 1-2 conference presentations. Students should discuss expectations with their advisor at the start of the degree program and, once an advisory/doctoral committee is formed, discuss again so that the expectations

are clear. Expectations should be revisited at least yearly during committee meetings and be included in student's progress reports. The student, advisor and committee should establish and follow a research plan that will enable the student to achieve the publication and presentation goals. Students are also expected to support the publication process after graduation. This may include leading the preparation of new publications, aiding in the development of a response to reviewer comments, revising manuscripts and reviewing proofs. In the event that a student graduates having obtained publishable research but does not submit a publication on that research after a period of 6 months, the student's advisor(s) and collaborator(s) may submit a manuscript based on, or that includes, the research. Authorship will be determined based on the level of effort and intellectual contributions of those involved. The student will be notified in writing of the intent to publish and authorship status. Reasonable expenses for publication of manuscripts based on these (i.e., page charges) are considered legitimate departmental expenses and will be paid by the department. However, expenses for thesis preparation are considered personal expenses and must be paid by the student.

Research Data, Software, Designs, and Manuscripts

All research data, patents, designs, computer software, creations, slides, pictures, reports, etc. obtained by graduate students on assistantship support are the property of the ABE Department. All research data and other requested materials must be submitted to the Advisor before the student leaves Penn State University. The student must also archive all research data using a university archive service such as ScholarSphere available at the university library. If any patents or copyrights are awarded to the inventions or designs of any graduate student's thesis research, then both the student and Advisor are credited. They can receive a percentage of the profits or royalties realized from the patents or copyrights.

Professional Ethics

Penn State policy AD-47 sets forth statements of general standards of professional ethics to serve as a reminder of the variety of obligations assumed by all members of the academic community, including graduate students. The handling of inquiries into questions of ethics is covered in RA-10. RA-13 deals with the co-authorship of scholarly reports, papers, and publications. These policies are available from the departmental administrative assistant.

Academic Integrity

Academic integrity is the pursuit of scholarly activity in an open, honest, and responsible manner. Academic integrity is a basic guiding principle for all academic activity at The Pennsylvania State University, and all members of the University community are expected to act in accordance with this principle. Consistent with this expectation, students should act with personal integrity, respect other students' dignity, rights, and property, and help create and maintain an environment in which all can succeed through the fruits of their efforts. Academic integrity includes a commitment not to engage in or tolerate acts of falsification, misrepresentation, or deception. Such acts of dishonesty violate the fundamental ethical principles of the University community and compromise the worth of work completed by others. Students should read and become familiar with The Pennsylvania State University Policies AC47 General Standards of Professional Ethics; AD67 Disclosure of Wrongful Conduct and Protection from Retaliation; and AD88 Code of Responsible Conduct.

Academic Integrity Guidelines for the College of Agricultural Sciences can be found at <http://agsci.psu.edu/students/resources/academic-integrity> .

A lack of knowledge or understanding of the University's Academic Integrity policy and the types of actions it prohibits and/or requires does not excuse one from complying with the policy. Penn State and the College of Agricultural Sciences take violations of academic integrity very seriously. Faculty, alumni, staff, and fellow students expect each student to uphold the University's standards of academic integrity both in and outside of the classroom.

Disability Statement

Penn State welcomes students with disabilities into the University's educational programs. If you have a disability-related need for reasonable academic adjustments in this course, contact the Office for Disability Services (ODS) at 814-863-1807 (V/TTY). For further information regarding ODS, please visit the Office for Disability Services Web site at <http://equity.psu.edu/ods/> .

In order to receive consideration for course accommodations, you must contact ODS and provide documentation (see the documentation guidelines at <http://equity.psu.edu/ods/guidelines>). If the documentation supports the need for academic adjustments, ODS will provide a letter identifying appropriate academic adjustments. Please share this letter and discuss the adjustments with your instructor as early in the course as possible. You must contact ODS and request academic adjustment letters at the beginning of each semester.

Leave of Absence

A graduate student may request a leave of absence as described in Penn State policy GSAD-906 when they, or an immediate family member, experiences a significant life event that has the potential to disrupt progress towards the student's degree. Significant life events may include, but are not limited to, illness/injury and recovery of the graduate student, illness/injury and recovery of an immediate family member requiring care by the graduate student, birth or adoption of a child and bereavement for the death of an immediate family member. Active-duty service members or activated reserve-component members of the U.S. Armed Forces and/or spouses/domestic partners of active-duty members or activated reserve-component members who are ordered by their military service to relocate or deploy and, as a result, are unable to complete a schedule of courses for a given semester may also request a leave of absence.

In the case of foreseeable events (e.g., impending birth of a child), the student should inform their adviser and department head as soon as the circumstances and dates of needed leave are known. Three months' notice would be ideal. For unforeseeable events, notification should be made as soon as possible once the need arises. Please see full details included in policy GSAD-906.

Travel to Professional Meetings

Graduate students registered full-time will be provided with \$300.00 support plus surface transportation to attend one national ASABE Meeting (or comparable professional meeting) while pursuing a graduate degree. Each full-time graduate student will be encouraged to

attend additional ASABE National Meetings with this level of support when he/she is senior author of a paper that he/she is presenting. Surface transportation will be provided, as resources allow, for all graduate students to the ASABE National Meetings regardless of how many times they have attended previously. Support for graduate students to attend other national professional meetings may be provided with the recommendation of the Advisor. This travel support is provided to graduate students from general departmental funds to further stimulate professional growth and development. Budget constraints may dictate that this travel support be reduced at times.

Office and Key Assignments

Office space is assigned to graduate students on a space-available, priority basis; assignments are made by the Graduate Program Coordinator. Priority of office space is given in the order of: 1) graduate students with assistantship support; 2) full-time graduate students without assistantship support; 3) full-time graduate students on provisional admittance; and 4) part-time graduate students.

Nearly every graduate student desk has a desk-top bookshelf. To preserve the high-quality of the desk-top bookshelves, please do not fasten anything to the bookshelves with tape, glue, thumbtacks, staples, nails, etc. These bookcases were made from high-quality, cabinet-grade oak plywood and they will be attractive for many years if they are properly cared for today. Upon request, a small bulletin board will be provided to each graduate student for mounting items rather than fastening them to the bookshelf. Keys are available for most desks.

Door keys will be assigned to graduate students by the Administrative Assistant; assigned keys will unlock exterior doors and doors to graduate student offices and many labs. If a graduate student needs access to other facilities, an appropriate key will be assigned. All door keys require a \$5.00 refundable deposit.

Graduate students must return keys assigned to them upon completion of their graduate program. Keys are not to be loaned to anyone and it is unlawful to duplicate them. GRADUATE OFFICE DOORS ARE TO BE KEPT LOCKED WHENEVER NO ONE IS PRESENT IN THE ROOM.

Recycling

Each graduate student is expected to participate in recycling, per Policy AD34 University Recycling Program. Recycling Guidelines are posted on departmental bulletin boards.

Smoking

For the consideration of health, comfort, and safety of all people in the department, SMOKING IS NOT ALLOWED IN ANY FORM IN ANY AREA of the Agricultural Engineering Building or in any University vehicles.

Regulatory Compliance

Human Research Subjects. University policy requires institutional review and approval of all activities that involve using human subjects in research. A human subject is defined as an

individual about whom an investigator (whether professional or student) conducting research obtains (1) data through intervention or interaction with the individual, or (2) identifiable private information. Contact the Office for Research Protections, The 330 Building, Suite 205, University Park, PA, or phone 814-865-1775 or e-mail ORProtections@psu.edu, for more details.

Vertebrate Animals. Approval by the University's Institutional Animal Care and Use Committee (IACUC) is required prior to the involvement of a vertebrate animal in any University activity. This policy applies to non-human vertebrate animals, live or dead, and parts thereof, excluding established cell lines, biological fluids, and conventional foods. Contact the Office for Research Protections, The 330 Building, Suite 205, University Park, PA, or phone 814-865-1775 or e-mail ORProtections@psu.edu, for more details.

Biohazardous Materials. All University research and teaching activities involving biohazardous materials shall be reviewed and approved by the University Biosafety Committee prior to the use of any such reagent. Included are carcinogens, toxins, infectious agents, recombinant DNA, and human body fluids or tissue. Contact the Office for Research Protections, The 330 Building, Suite 205, University Park, PA, 814-865-1775, ORProtections@psu.edu, or Office of Environmental Health and Safety, 6 Eisenhower Parking Deck, 814-865-6391, for more details.

Hazardous Materials. All hazardous materials must be properly handled, including proper waste disposal. Contact the Office of Environmental Health and Safety, 6 Eisenhower Parking Deck, 814-865-6391, for more details.

Purchasing

Materials, supplies, equipment, and travel required for conducting research contributing to a departmental research program will be supported by the department with state and federal funds and special grants.

All purchases made for extension, research, and teaching activities, whether related to thesis research or not, must be approved in advance by the Advisor and should be made using a Penn State Purchasing Card whenever practical. The policy of the department with respect to purchases is as follows:

- *A graduate student must obtain approval of the Advisor before ordering or picking up material.*
- *The signed receipt must be attached to a yellow reconciliation form and submitted to the Administrative Assistant.*
- *These receipts are kept on file by the Administrative Assistant to be checked against the monthly bills.*

Supplies and Support Services

Requests for supplies and support services, especially including the assistance of secretaries and technicians, are to be channeled through the Advisor. Supplies and services are restricted to work in support of research activities with approval of the Advisor. However, expenses related to coursework and thesis preparation are considered personal expenses and must be paid by the student.

Graduate students are expected to write manuscripts for publication based on thesis or technical projects and to participate with faculty in the preparation of grant proposals. Related expenses are considered legitimate departmental expenses and, with Advisor approval, necessary supplies and support services will be made available.

Computers and Access Accounts

The department has a microcomputer lab in Room 309 that is available for graduate student use when not needed for classes. All lab computers are directly connected to the university network backbone for full Internet capabilities.

All students will be assigned an access account by the university. Account IDs and passwords can be obtained by showing proper identification (student ID or driver's license) at any public computer laboratory on campus, 12 Willard, or Accounts office in 230 Computer Building. The access account provides electronic mail support and Netnews privileges. All microcomputers in the department support electronic mail and Internet access programs.

Microcomputers in rooms FRL 303 are available for coursework, research, and any university-related use. In addition, they can be used for professional development materials such as thesis, resumes, letters, etc. However, use of laser printers for personal use, including professional development items, will cost 10 cents per page, payable to the Administrative Assistant.

No software may be placed on any departmental computer without permission of the computer systems manager and/or Advisor. Commercial software on these computers may not be copied at any time. Graduate students can be allocated storage space on a server by requesting it from the systems administrator. Personal files should be kept on a CD or USB drive, since all personal files and unofficial software will be removed periodically.

Occasionally, instructors will reserve the computer lab for a particular class period. During these times, the class has priority on the lab computers. However, in many cases the instructor will allow use of open computers during that time. Please check with the instructor who reserved the lab if you desire to use a computer during that time.

Graduate students have access to the computer lab after regular work hours. It is the student's responsibility to lock the doors in the computer room when leaving during the hours of 5:00 p.m. to 8:00 a.m. and during weekends and holidays.

Fabrication Lab

Students are expected to fabricate experimental equipment needed for their thesis research if the equipment is not otherwise available. Students must follow all guidelines and policies, found at <http://abe.psu.edu/research/facilities/fabrication-lab>. Please note the following:

- The Fabrication Lab is intended only for extension, research, and teaching activities.*
- All graduate students must attend and satisfactorily complete workshops of instruction on the proper, safe use of facilities and tools. Upon completion of this course, the graduate student will be extended the privilege of Fabrication Lab access. See Fabrication Lab Supervisor for more details. Faculty and staff are expected to complete the workshops as well.*

- *Eye protection (safety spectacles or cover goggles) and disposable hearing protection are available free of charge to all graduate students upon their initial employment. This equipment is considered the property of the individual student. It is recommended that an individual wearing prescription glasses use the cover goggles on top of prescription glasses.*
- *Each graduate student shall use the personal protective equipment when working with any of the tools, equipment, and facilities in the Fabrication Lab. Safety instructions, more specialized safety equipment, and reminders are mounted on or near the tools, equipment, and facilities. If there is ever any doubt concerning the safe, proper use of any of the tools, equipment, or facilities, please check with the Fabrication Lab Supervisor.*
- *A graduate student may not permit people outside the department to use any departmental equipment, facilities, or supplies.*
- *In cases of extensive or complex fabrication, personnel may help with the work, or the work may be contracted out. Use of personnel must be arranged by the Advisor in advance. Graduate students should not use general Lab supplies (steel, plastic, pipe, wood, etc.) without prior approval of the Fabrication Lab Supervisor and Advisor.*

Use of University Vehicles

University vehicles are for OFFICIAL USE ONLY. Operators of university vehicles must abide by all highway laws. Special courtesy to other drivers should be exercised at all times, since one is representing the department, University and Commonwealth when driving a university vehicle. Only University students and employees may be passengers in university vehicles unless others have been authorized to participate in official business. An operator should check with the Department Head or the Advisor to determine whether a non-employee has been authorized to ride.

Requirements to operate university vehicles include that the drivers have a driver's license that is valid in Pennsylvania and be an employee of the University. Only those graduate students who are receiving an assistantship, fellowship, or wages from Penn State are employees. Students operating University vehicles must check with the Fabrication Lab Supervisor concerning procedures for signing out vehicles, purchasing fuel, and maintaining vehicle records.

GRADUATE FACULTY

Ramaswamy Anantheswaran (swamy@psu.edu)

Ph.D., Cornell University

Professor of Food Science

Food Engineering and Modeling

Florence Becot (ffb5072@psu.edu)

Ph.D., Ohio State University

Nationwide Insurance Early Career Professor

Agricultural health and safety

Rachel Brennan (rbrennan@enr.psu.edu)

Ph.D., University of Illinois at Urbana-Champaign, 2003

Associate Professor

Ecological wastewater treatment, bioremediation of soil and groundwater contaminants

Jeffrey M. Catchmark (jmc102@psu.edu)

Ph.D., Lehigh University, 1995

Professor

Cellulose synthesis and organization, nanofabrication and nanocharacterization, molecular and catalytic motors and sensors, plasmonics

Stephen Chmely (sc411@psu.edu)

Ph.D., Vanderbilt University, 2010

Assistant Professor

Biorefining; lignin valorization; new materials and products from biomass; chemical catalysis

Dan Ciolkosz (dec109@psu.edu)

Ph.D., Cornell University, 2000

Assistant Research Professor

Bioenergy

Christine Costello (cxc693@psu.edu)

Ph.D., Carnegie Mellon University, 2010

Assistant Professor

Industrial ecology; ethical decision making; life cycle analysis

Ali Demirci (axd29@psu.edu)

Ph.D., Iowa State University, 1992

Professor

Microbial food safety engineering; industrial microbiology/fermentation

Eileen E. Fabian (efw2@psu.edu)

Ph.D., Cornell University, 1995

Professor

Environmental biophysics, ventilation systems, air quality

Shirin Ghatrehsamani (spg5994@psu.edu)

Ph.D., University of Florida

Assistant Professor

Robotics and automation of agriculture

Long He (luh378@psu.edu)
Ph.D., Yanshan University, 2010
Assistant Professor
Mechanization & Automation for Specialty Crops, Precision Agriculture

Paul H. Heinemann (hzh@psu.edu)
Ph.D., University of Florida, 1985
Professor
Systems modeling; mushroom production, odor, and air emissions; advanced sensors for food quality evaluation

Magni Hussain (msh5334@psu.edu)
Ph.D., Penn State University, 2023
Assistant Research Professor
AI, automation, robotics and advanced controls

Sibel Irmak (sji5137@psu.edu)
Ph.D., Cukurova University, 2003
Research Professor
Value-added products from biomass, catalysts, biodegradable biofilms

Suat Irmak (sfi5069@psu.edu)
Ph.D., University of Florida, 2003
Professor and Department Head
Soil & Water Resources Engineering, Climate Science and Evapotranspiration and Surface Energy Balance

Jude Liu (jxl79@psu.edu)
Ph.D., University of Manitoba, 2005
Associate Professor
Machine development for biomass harvesting and processing, and bioenergy utilization.

Michael L Mashtare Jr (mmashtare@psu.edu)
Ph.D., Purdue University, 2013
Assistant Professor
Environmental soil chemistry, emerging contaminant fate and transport, SoTL

Lauren McPhillips (lxm500@psu.edu)
Ph.D., Cornell University, 2016
Assistant Professor
Water quality; stormwater management; green infrastructure; urban ecohydrology; biogeochemistry

Judd Michael (jhm104@psu.edu)
Ph.D., Pennsylvania State University, 1994
Professor
Sustainable enterprises, packaging, entrepreneurship, business management

Heather Preisendanz (heg12@psu.edu)
Ph.D., Purdue University, 2011
Associate Professor
Fate and transport of emerging contaminants; water quality; best management practices; green stormwater infrastructure

Cibin Raj (craj@psu.edu)
Ph.D., Purdue University, 2013
Assistant Professor
Storm water management, watershed analysis, application of computational methods in watershed analysis, ecohydrological impacts of climate and land use change

C. Alan Rotz (car18@psu.edu)
Ph.D., Penn State University, 1977
Adjunct Professor (USDA-ARS Pasture Systems and Watershed Management Research Unit)
Farm production systems; farm environmental impact

Howard M. Salis (hms17@psu.edu)
Ph.D., University of Minnesota, 2007
Associate Professor
Synthetic Biology, Genetic compiler, Metabolic Engineering

Robert D. Shannon (rds13@psu.edu)
Ph.D., Indiana University, 1993
Associate Professor
Wetland and aquatic biogeochemistry; pollution of aquatic systems

Juliana Vasco-Correa (jpv5237@psu.edu)
Ph.D., Ohio State University, 2017
Assistant Professor
Bioproducts systems analysis; biologically based processing

Tammie Vieth
Ph.D., Virginia Polytechnic Institute
Adjunct Associate Professor, USDA ARS Research Scientist
Farm and watershed modeling of water-quality, and multi-objective optimization

Hojae Yi (huy1@psu.edu)
Ph.D., Seoul National University, 2003
Assistant Research Professor
Mechanics of Food and Biological Materials; Mechanics of Particulate Materials and Systems

Yimin Zhu (yuz30@psu.edu)
Ph.D., SUNY at Stony Brook, 2005
Assistant Professor
Lignin chemistry and engineering, organic chemistry, chemical biology

LEARNING OUTCOMES ASSESSMENT FORMS (USED FOR PROGRAM ASSESSMENT DURING EXAMINATIONS)

BioRenewable Systems (BRS) Masters Program Assessment Form

M.S. Thesis Proposal Review and Evaluation

Student name: _____

Date: _____

Form to be completed by the student's Thesis committee, as appropriate, and given to the department's Graduate Studies Committee administrative support staff.

Criterion 1: Demonstrated ability to apply knowledge of biorenewable industries and knowledge of a specialized field to the design of an original research proposal.

Criterion 2: Demonstrated a well-defined and sound science and/or experimental methodology to the solution of new problems.

Criterion 3: Demonstrated ability to articulate the proposed methodology and analysis to the advisory committee.

Note: in the table below D-Deficient; A-Acceptable; S-Superior

Faculty name (print above, sign below)	Criterion 1			Criterion 2			Criterion 3		
	D	A	S	D	A	S	D	A	S

Please provide comments or recommendations for any Criterion that received a score of D below or on other side.

Revised: Fall, 2016; Summer, 2017

BioRenewable Systems (BRS) Masters Program Assessment Form

M.S. Thesis Oral Examination

Student name: _____

Date: _____

Form to be completed by the student's Thesis committee, as appropriate, and given to the department's Graduate Studies Committee administrative support staff.

Criterion 1: Demonstrated ability to create new knowledge and solution methodology(ies).

Criterion 2: Demonstrated ability to understand the implications of new findings and their possible generalization.

Criterion 3: Quality of thesis.

Criterion 4: Demonstrated ability to articulate and defend results to the advisory committee.

Note: in the table below D-Deficient; A-Acceptable; S-Superior

Faculty name (print above, sign below)	Criterion 1			Criterion 2			Criterion 3			Criterion 4		
	D	A	S	D	A	S	D	A	S	D	A	S

Please provide comments or recommendations for any Criterion that received a score of D below or on other side.

Revised: Fall, 2016; Summer, 2017

BioRenewable Systems (BRS) Doctoral Program Assessment Form

Qualifying Exam

Student name: _____

Date: _____

Form to be completed by the student's Qualifying committee, as appropriate, and given to the department's Graduate Studies Committee administrative support staff.

Criterion 1: Demonstrated ability to apply knowledge of biorenewable systems and knowledge of a specialized field to the design of an original research proposal.

Criterion 2: Demonstrated a well-defined ability to approach the solution of new problems by the methodical and logical application of sound scientific methods.

Criterion 3: Demonstrated ability to articulate and defend scientific reasoning to the Qualifying committee.

Note: in the table below D-Deficient; A-Acceptable; S-Superior

Faculty name (print above, sign below)	Criterion 1			Criterion 2			Criterion 3		
	D	A	S	D	A	S	D	A	S

Please provide comments or recommendations for any Criterion that received a score of D below or on other side.

Revised: Fall, 2016; Summer, 2017

BioRenewable Systems (BRS) Doctoral Program Assessment Form

Comprehensive Exam

Student name: _____

Date: _____

Form to be completed by the student's Qualifying committee, as appropriate, and given to the department's Graduate Studies Committee administrative support staff.

Criterion 1: Demonstrated ability to apply in-depth knowledge of a specialized field to the design and execution of an original research question.

Criterion 2: Demonstrated well-defined ability to approach the solution of new problems by the methodical and logical application of sound scientific methods.

Criterion 3: Presentation of a set of experimental and/or theoretical results in support of one of more hypotheses and/or objectives

Criterion 4: Presentation of a well thought through research roadmap and timeline for completion of research.

Criterion 5: Demonstrated ability to articulate and defend approach and results to the doctoral committee.

Note: in the table below D-Deficient; A-Acceptable; S-Superior

Faculty name (print above, sign below)	Criterion 1			Criterion 2			Criterion 3			Criterion 4			Criterion 5		
	D	A	S	D	A	S	D	A	S	D	A	S	D	A	S

Please provide comments or recommendations for any Criterion that received a score of D below or on other side.

Revised: Fall, 2016; Summer, 2017

BioRenewable Systems (BRS) Doctoral Program Assessment Form

Dissertation Defense

Student name: _____

Date: _____

Form to be completed by the student's Qualifying committee, as appropriate, and given to the department's Graduate Studies Committee administrative support staff.

Criterion 1: Creation of new knowledge and/or development of new solutions/solution methodology(ies).

Criterion 2: Demonstrated ability to understand and communicate the implications of the new knowledge and findings and their generalization.

Criterion 3: Demonstrated ability to understand and communicate potential new short and long-term research hypotheses and/or objectives.

Criterion 4: Quality of dissertation.

Criterion 5: Demonstrated ability to articulate and defend results to the doctoral committee.

Note: in the table below D-Deficient; A-Acceptable; S-Superior

Faculty name (print above, sign below)	Criterion 1			Criterion 2			Criterion 3			Criterion 4			Criterion 5		
	D	A	S	D	A	S	D	A	S	D	A	S	D	A	S

Please provide comments or recommendations for any Criterion that received a score of D below or on other side.

Revised: Fall, 2016; Summer, 2017

OTHER FORMS

As a graduate student, you may need to utilize one of the following departmental forms during your degree program. These forms are available from the Graduate Records Officer for the department.

- *Semi Annual Progress Report Form – Use every 6 months to record your degree progress*
- *Petition Form – Use to request special permission to modify any of the degree requirements listed in this handbook.*
- *Graduation Checklist – Use during your final semester to make sure you have done all of the things that are required by the department before you leave the university.*

***PLEASE NOTE THAT ALL THESE FORMS ARE ALSO AVAILABLE ON CANVAS UNDER
“RESOURCES FOR ABE GRADUATE PROGRAM”***