

Biorenewable Resources and Technology

(Interdisciplinary Graduate Program)

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Over 160 ISU faculty affiliated members, 29 departments in all seven colleges and 20 research centers and institutes are involved in this highly interdisciplinary graduate program. A complete and up-to-date listing is maintained at: <http://www.biorenew.iastate.edu>.

Graduate Study

The graduate program in Biorenewable Resources and Technology (BRT) offers students advanced study in utilizing plant and crop-based resources in the production of biobased products (fuels, chemicals, materials, and energy). The BRT program was the first graduate program in biorenewable resources established in the United States. This multi-disciplinary program offers the degrees of master of science and doctor of philosophy in Biorenewable Resources and Technology, and a minor to students taking major work in other departments. The curriculum is designed to encourage students to obtain co-major degrees in Biorenewable Resources and Technology and a more traditional science or engineering discipline. A thesis is required for the master of science degree.

Prerequisite to major graduate work is a bachelor's degree or prior graduate training in engineering or a physical or biological discipline, including agricultural sciences.

Core Required Courses: 501, 506B & C, 590, and 591L or BRT 507

The core required courses (6 credits min. required) for the Biorenewable Resources and Technology graduate program include:

BRT 501	Fundamentals of Biorenewable Resources	3
BRT 506A	Biobased Products Seminar: Online (Certificate only)	1
BRT 506B	Biobased Products Seminar: Seminars and Research Symposium Attendance	R
BRT 506C	Biobased Products Seminar: Research Presentations	1
BRT 590	Special Topics	1-3
BRT 591L	Biorenewable Resources Laboratory (OR)	1
BRT 507	Entrepreneurship in Biorenewables	1
Total Credits		8-10

Students must complete "approved" core elective courses from at least three of the four bioeconomic development barrier areas: plant science, production, processing, and utilization. These are selected in consultation with the student's Program of Study (POS) committee. Additionally, students are to complete the determined amount of elective credits required for their degree, and in consultation with their POS committee, as well as research credits.

Graduates of the program will be equipped with skills to design, develop and/or manage cost effective and environmentally attractive technologies and systems for producing fuels, chemicals, materials, foods and energy from biorenewable resources.

Information on application procedures, specific requirements of the major and the online BRT Graduate Certificate can be obtained from the following Internet address: <http://www.biorenew.iastate.edu>

Courses primarily for graduate students, open to qualified undergraduates:

BRT 501. Fundamentals of Biorenewable Resources.

(Cross-listed with A E). (3-0) Cr. 3. S. *Prereq: Undergraduate training in an engineering or physical or biological discipline or degrees in agriculture or economics*

Introduction to the science and engineering of converting biorenewable resources into bioenergy and biobased products. Survey of biorenewable resource base and properties; description of biobased products; methods of biorenewable resource production; processing technologies for fuels, chemicals, materials, and energy; environmental impacts; economics of biobased products and bioenergy.

BRT 506. Biobased Products Seminar.

Cr. arr. F.S. *Prereq: Undergraduate training in an engineering or physical or biological discipline or degree in agriculture or economics*
Continual in-depth view of the multi-disciplinary nature of biorenewables research, programs, and people involved in this field of study. Seminar and/or research poster presentations.

BRT 506A. Biobased Products Seminar: Online.

Cr. 1. Repeatable, maximum of 3 times. F.S. *Prereq: Enrollment in BRT graduate certificate program; undergraduate training in an engineering or physical or biological discipline or degree in agriculture or economics*
Students are required to review five seminar videos from approved selection and write a critical summary of each seminar video. Not available for on-campus BRT students. Offered on a satisfactory-fail basis only.

BRT 506B. Biobased Products Seminar: Seminars and Research Symposium Attendance.

Cr. R. Repeatable, maximum of 5 times. F.S. *Prereq: Undergraduate training in an engineering or physical or biological discipline or degree in agriculture or economics*

Attendance at approved seminars on-campus related to biorenewable resources and technology. Enrollment in BRT 506B is required every semester student is registered as BRT graduate student, and until student enrolls in BRT 506A. Offered on a satisfactory-fail basis only.

BRT 506C. Biobased Products Seminar: Research Presentations.

(1-0) Cr. 1. Repeatable, maximum of 2 times. F.S. *Prereq: BRT 506B*
Research presentations throughout the semester as part of the course seminar series and during the course. Research Poster Symposium at the end of the semester. Typically taken in the last semester(s) when completing degree program.

BRT 507. Entrepreneurship in Biorenewables.

(Cross-listed with BR C). (1-0) Cr. 1. S. *Prereq: Graduate Standing or Permission of Instructor.*

Develop an understanding of the relationship between discovery research entrepreneurship and innovation in biorenewables. Understand critical techno-commercial analyses and intellectual property. Learn critical skills needed to found a company, including how to define key assets, write a business plan, leverage local resources, and secure funding.

BRT 511. Bioprocessing and Bioproducts.

(Dual-listed with BRT 411). (Cross-listed with A E, BIOE, BSE). (3-0) Cr. 3. F. *Prereq: A E 216, C E 326 or equivalent, MATH 160 or MATH 165, CHEM 167 or higher, BIOL 173 or BIOL 211 or higher, senior or graduate classification*
Sustainability, cleaner production. Taxonomy, kinetics, metabolism, microbial cultivation, aerobic and anaerobic fermentation. Antibiotics, food supplements, fermented foods, vitamin production. Biofuels, bioenergy and coproducts. Mass/energy balances, process integration, pretreatment, separation. Membrane reactors, bioelectrolysis, microbial fuel cells, nanotechnology, genetic engineering, mutagenesis.

BRT 515. Biorenewables Law and Policy.

(3-0) Cr. 3. F.S.
Evaluation of the biorenewables field as it relates to the areas of law and policy. Primary emphasis on the following topics: concerns that motivated the development and expansion of the biorenewables field, a history of the interactions between biorenewable pathways. U.S. law and policy and controversies that have arisen from these interactions and their effects.

BRT 535. Thermochemical Processing of Biomass.

(Cross-listed with M E). (3-0) Cr. 3. S. *Prereq: Undergraduate course work in thermodynamics and transport phenomena*
Introduction to thermal and catalytic processes for the conversion of biomass to biofuels and other biobased products. Topics include gasification, fast pyrolysis, hydrothermal processing, syngas to synfuels, and bio-oil upgrading. Application of thermodynamics, heat transfer, and fluid dynamics to bioenergy and biofuels.

BRT 590. Special Topics.

Cr. 1-3. Repeatable. F.S.SS. *Prereq: Permission of instructor*
Investigation of an approved topic on an individual basis. Course content and requirements to be designed and developed in consultation with the student's major professor or instructor, but in all cases a formal report should be written.

BRT 591L. Biorenewable Resources Laboratory.

(0-3) Cr. 1. Repeatable, maximum of 2 times. F.S.SS. *Prereq: Permission of student's major professor and instructor*

Special topics laboratory and research experience in biorenewable resources and technology that affords an experience beyond thesis-focused research. To be designed in consultation with the student's major professor and instructor. A laboratory report is required. For student in the BRT program, BRT 591L may be taken twice. For student in the BRT program, BRT 591L may be taken twice.

Courses for graduate students:

BRT 610. Food & Bioprocessing Enzymology.

(Cross-listed with FS HN). (2-3) Cr. 3. Alt. F., offered 2012. *Prereq: FS HN 311 or FS HN 411 or FS HN 502 or BBMB 404*

Properties of enzymes important in food processing including flavor, texture and color and in biofuels & bioprocessing. Quantitative evaluation of substrates, enzyme inhibitors, pH, pressure and temperature on enzyme activity.

Experimental determination of specificity and mechanisms important to food and bioprocessing biochemistry. Techniques to purify food and bioprocessing enzymes.

BRT 699. Research.

Cr. arr. Repeatable. F.S.SS. *Prereq: Permission of student's major professor*