

BIORENEWABLE SYSTEMS (BRS)

BRS 221: Engineering Principles of Biorenewable Systems

3 Credits

Application of engineering principles critical to agricultural and biorenewable systems. BRS 221 Engineering Principles of Biorenewable Systems (3) This course provides an overview of engineering principles to students in non-engineering majors, but who are likely to encounter challenges that require quantitative solutions. Problem solving skills are extremely important to technology. At the end of the course, students will be able to: solve problems related to biorenewable systems using a structured, logical method combining concepts from physics and math; recognize and apply unit factoring and dimensional analysis to problem solving; quantify physical relationships and apply engineering principles to evaluate basic engineering technology problems involving electrical systems, structural members, fluid mechanics, heat transfer, and psychrometrics. Hands-on examples are used throughout the course to tie the course material to applications in agricultural and biorenewable industries. Examples include residential wiring; sizing structural members made of wood, steel, and other materials; non-moving and flowing fluids in bioproduct and agricultural processing; heat transfer through wall, windows, and other materials likely to be found in construction and processing facilities; psychrometrics in environmental growth and drying facilities. This course provides the groundwork for topics explored in more detail later in the BioRenewable Systems curriculum.

Prerequisite: MATH 110 or MATH 140 ; PHYS 250 or PHYS 211

BRS 300: Introduction to Biorenewable Products

3 Credits

Overview of bioproducts and their related industry sectors, including forest products, biocomposites, biofuels, bioenergy, bio-based adhesives, biochemicals, and bioplastics. BRS 300 Introduction to Biorenewable Products (3) This course provides an overview of the nature and utilization of bioproducts, which are defined as products created from biologically derived, renewable industrial feedstocks. These materials are renewable and can be sustainably produced; as such, they will be increasingly utilized as society recognizes the opportunity cost of mining and using other non-renewable industrial feedstocks. The class focuses on overviewing the relevant industry sectors.

Prerequisite: CHEM 110; Concurrent: CHEM 110

BRS 391: Contextual Integration of Communication Skills for the Technical Workplace

2 Credits

To develop corporate communication skills in technically focused students in a contextual manner. A S M (A B E) 391 Contextual Integration of Communication Skills for the Technical Workplace (2) A B E/A S M 391 is the first half of a two-semester capstone experience in corporate focused leadership and communication skills training. The sequence is formatted into two 2-credit courses (second semester Junior for A B E/A S M 391 and first semester senior for the companion A B E/A S M 392 course). A key facet of this training is the contextual approach taken. All course modules are focused around the needs of industry and

corresponding technical course content — a complete contextual approach. To meet the needs of the student, the course will reflect clear understanding of leadership and communication but also appreciate critical aspects of the technical content of student's work and of the industries within which the students will ultimately work. The primary focus for 391 is communication skills (oral and written) with a secondary focus on leadership and career skills. The course provides the student with interaction with individuals from industry (company visitors, industry trips, and recruiting opportunities). Students will be evaluated through writing and speaking projects, professional presentations, written worksheets in class and out, creation of portfolios and reports, in class group and individual exercises, computer graphics presentation assignments, library assignments, interaction with industry executives (reports), and leadership journals.

Prerequisite: Junior level standing in B E or BRS

Cross-listed with: BE 391

General Education: Writing/Speaking (GWS)

BRS 392: Contextual Integration of Leadership Skills for the Technical Workplace

2 Credits

B E/BRS 392 is the second half of a two-semester experience in corporate-focused leadership and communication skills training. The sequence is formatted into two 2- credit courses (second semester junior for B E/BRS 391 and first semester senior for the B E/BRS 392 course). A key facet of this training is the contextual approach taken. All course modules focus on leadership and communication needs of industry within its corresponding technical content - thereby representing a complete contextual approach. To meet the needs of the student, the course will reflect clear understanding of leadership and communication but also appreciate critical aspects of the technical content of student's work and of the industries within which the students will ultimately work. The primary focus of BE/BRS 392 is on leadership, with communication, ethics, sustainability and career issues the secondary focus. The course provides students with interactions with individuals from industry (company visitors, industry trips, and recruiting opportunities). Topics developed for B E/BRS 392 include personal development, ethical decision-making, corporate social responsibility, strategic group management, facilitation, and diversity. Students may be evaluated through writing and speaking projects, professional presentations, written worksheets in class and out, creation of portfolios and reports, in-class group and individual exercises, interaction with industry executives (reports), and leadership journals.

Prerequisite: BRS 391, junior level standing in B E or BRS

Cross-listed with: BE 392

General Education: Writing/Speaking (GWS)

BRS 393: Industry Tour

1-2 Credits/Maximum of 2

A week-long tour of bioproducts and agricultural systems industries. BRS 393 Bioresources Industry Tour (1) This is a week long course, in which students will travel to tour relevant manufacturing facilities. Roughly half of the time (2.5 days) will be dedicated to the bioproducts industry, and the remaining time will be focused on agricultural systems. Bioproducts and agricultural systems are the two key components of the BioRenewable Systems major.

Prerequisite: Junior standing in BRS or B E

BRS 402: Foundations of Sustainable Business

3 Credits

Emphasis on understanding business strategies for enhancing sustainable operations, including issues related to the natural environment and corporate social responsibility. ERM 402 / BRS 402 Foundations of Sustainable Business (3) This course will provide students with an understanding of how environmental and sustainability issues are impacting business strategies and ultimately profits. We will also examine the external stakeholders, such as environmental groups, policy-makers, and "green" consumers, that impact business management. Business students will benefit by a better understanding of environmental/sustainability issues that impact their operations and strategies. Non-business students will benefit by understanding how business decisions can impact the natural environment. An emphasis will be on a thorough understanding of making a business case for sustainability. We will also discuss the triple bottom line and its use. Some Specific Issues to Cover: 1. How are organizations shifting business models to work with sustainability trends? 2. How can we make a business case (justification) for being "green"? 3. Can firms differentiate themselves by being responsible/sustainable? Do consumers and other stakeholders care? 4. Thorough understanding of stakeholders and how they impact operations. 5. How can the "business" side of the world work with the "environmental" side? 6. Use of packaging as an example of where parts of the supply chain are working together to be more sustainable. 7. How "waste" in its many forms can be seen as a surrogate for unsustainable practices. 8. Pros and cons of metrics used to measure sustainability. 9. Impacts of business operations on the environment.

Prerequisite: AG BM 101 or ECON 102 or ECON 104 and 7th semester standing

Cross-listed with: ERM 402

BRS 411: Biobased Fiber Science

4 Credits

Theoretical and practical aspects of structure-property relationships for biobased industrial fibers, including fiber biological and chemical constitution and fiber-water relationships. BRS 411 Biobased Fiber Science (4) This course investigates fundamental aspects of biobased industrial fibers (also known as biofibers), and ties their underlying biological and chemical structure to macroscale properties. Bioproducts are defined as products created from biologically derived, renewable industrial feedstocks (wood, cotton, grasses, and bast fibers including jute, hemp, kenaf, etc.). The course begins with a look at the worldwide production of biofibers, and considers implications relating to sustainability. Elements of underlying biological and chemical structure are then investigated, including an introduction to relevant aspects of polymer science. The interaction of biofibers with water is a practical issue that bears great significance; this is the focus of the last third of the course. Students will learn principles of psychrometrics (water-temperature-environment relationships) including measurement of relative humidity and fiber moisture content. Final course subjects include industrial techniques for drying fibers, energy implications of these processes, and troubleshooting of biofiber industry issues relating to moisture.

Prerequisite: CHEM 110 , BRS 300

BRS 417: Processing and Manufacturing Systems for Bioproducts

4 Credits

Description of systems and processes used in the manufacture of bioproducts. This course reviews major bioproducts and details how they are manufactured industrially. The focus of the course is wood processing, since wood is by far the leading source of industrially manufactured bioproducts at this time. Beginning at log grading, wood processing is covered in detail with respect to major industrial and commercial practices. Primary wood processing is covered, which details how logs are converted to cants, boards etc., including time dedicated to the function of required manufacturing machinery. The grading of lumber is considered. The manufacturing of common solid wood products is described, as well as how the raw materials of wood are produced and subsequently converted into valued-added bioproducts including those made from veneer, chips, strands, other refined particles and lignocellulosic fibers. Adhesive formulations as binder systems and composites are covered, including those made from other bioproducts.

Prerequisites: BRS 221 and BRS 300

BRS 422: Energy Analysis in Biorenewable Systems

3 Credits

Energy management, energy conversions, renewable energy alternatives, engineering economic analyses, national and international perspectives on energy resources. BRS 422 Energy Analysis in Biorenewable Systems (3) This course focuses upon first understanding the various forms of energy in common use today and then analyzing the energy equivalents of various forms of energy. Forms of energy to be studied most extensively include electricity, fossil fuels, and renewable energy sources. Principles and applications of engineering economic analyses will be emphasized because these principles are needed to evaluate the feasibility of converting from one energy form to another. Specific application areas of emphasis include buildings, motors, and lights. For each application area, there will be discussion of the alternatives available for using energy in a more efficient and economical manner. The infrastructure systems needed for providing electricity and natural gas to a specific location will be described as well as typical rate structures for the energy provided. Alternatives to the conventional energy systems will be identified and the course will conclude with discussion of energy strategies throughout the 21st century. Local, national, and international perspectives on energy resources will be infused throughout this course.

Prerequisite: BRS 221

BRS 423: Deterioration and Protection of Bioproducts

3 Credits

Timber, wood, and bioproduct deterioration from fungi, insects, fire; treatment of bioproducts for in-service protection.

Prerequisite: BRS 300; Concurrent: BRS 411

BRS 426: Safety and Health in Agriculture and Biorenewable Industries

3 Credits

Managing occupational safety and health in production agriculture, bioproducts and related operations. BRS 426 Safety and Health in Agricultural and Biorenewable Industries (3) BRS 426 explores management aspects of occupational safety and health specifically as it pertains to both the agricultural and biorenewable systems industry

sectors. Employers are increasingly demanding students have training in safety and health. Topics to be covered include principles of safety and health, hazard analysis, hazard prevention and control, human behavior and safety, training and education, safety and health regulations, agricultural emergencies and developing a written safety program.

Prerequisite: 5th semester standing

BRS 428: Electric Power and Instrumentation

3 Credits

Principles and application of electric circuits for power distribution, motors, automatic controls, and instrumentation used in agricultural and biorenewable industries. BRS 428 Electric Power and Instrumentation (3) Nearly every facet of our modern society relies on electricity and electronics. Whether engaged in product development, manufacturing, production, testing, or management, graduates of technical programs benefit from a fundamental understanding of electrical/electronic systems. This course prepares students to analyze electrical/electronic systems applicable to agricultural and biorenewable industries. Upon completion of this course, the student will be able to: demonstrate correct use of common electronic measurement tools including multimeters, oscilloscopes and others; demonstrate sound electrical construction techniques including cable preparation, soldering, circuit board construction, and others; demonstrate sound troubleshooting skills for electrical and electronic systems; understand common elements of power distribution systems; understand simple measurement and control circuits represented by schematics or ladder diagrams; understand and apply various sensors to measure temperature, pressure, strain, force, proximity, speed etc.; understand the application of dataloggers, programmable logic controllers, and computer software to collect data and/or control simple processes; understand the function of common circuit components such as resistors, capacitors, inductors, diodes, op-amps, transistors, and transformers in simple circuits; understand basic maintenance and safety requirements for facility electrical systems.

Prerequisite: BRS 221

BRS 429W: Biorenewable Systems Analysis and Management

3 Credits

BRS 429W is a capstone course for the BioRenewable Systems major. The course covers systems analysis and optimization techniques including an introduction to systems theory, qualitative and quantitative analysis, linear programming, waiting line models, PERT/CPM, minimal spanning tree, calculus methods, simulation modeling for decision making, inventory, and energy audits. All topics are presented in the form of case studies that require the students to solve problems in realistic production and processing scenarios. The course also provides a writing-intensive structure. The course targets BRS students in their last semester because it integrates knowledge and experiences acquired in prior BRS, business, and agricultural science courses.

Prerequisite: BRS 422
Writing Across the Curriculum

BRS 437: Bioproduct Marketing and Sales

4 Credits

Business-to-business bioproduct sales and marketing fundamentals and market overview of key forest industry sectors including biorefinery value chain outputs. BRS 437 Bioproduct Marketing and Sales (4)

This course covers business-to-business (B2B) bioproduct marketing fundamentals and a market overview of key forest industry sectors (solid wood, composite panels, and engineered wood products) including biorefinery value chain outputs (environmental services, energy, fuels, and co-products) and personal selling of bioproducts. Students will apply B2B market principles and concepts toward an understanding of bioproducts industries and markets. Personal selling techniques will be developed and applied to enhance understanding of the industrial sales function within bioproduct firms. Marketing research for decision-makers will be examined.

Prerequisite: BRS 300, AG BM101 or ECON 102

BRS 490: BioRenewable Systems Colloquium

1-2 Credits/Maximum of 2

Presentations and discussions of solutions to problems within the biorenewable systems industries.

Prerequisite: BRS 300, Prerequisite or concurrent A S M 391

BRS 494: Undergraduate Research

1-12 Credits/Maximum of 12

Supervised student activities on research projects identified on an individual or small group basis.

BRS 494H: Honors Thesis

1-6 Credits/Maximum of 6

Independent study directed by a faculty supervisor that culminates in the production of a BioRenewable Systems honors thesis.

Prerequisite: junior or senior standing in the Schreyer Honors College and permission of a BioRenewable Systems honors advisor
Honors

BRS 495: Internship

1-18 Credits/Maximum of 18

Supervised off-campus, nongroup instruction including field experiences, practica, or internships. Written and oral critique of activity required.

BRS 496: Independent Studies

1-18 Credits/Maximum of 18

Creative projects, including research and design, which are supervised on an individual basis and which fall outside the scope of formal courses.

BRS 497: Special Topics

1-9 Credits/Maximum of 9

Formal courses given infrequently to explore, in depth, a comparatively narrow subject which may be topical or of special interest.

BRS 499: Foreign Studies

1-12 Credits/Maximum of 12

Courses offered in foreign countries by individual or group instruction.

International Cultures (IL)