

# Agricultural & Biosystems Engineering (ABEN)

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## **ABEN 110. Introduction to Agricultural and Biosystems Engineering. 3 Credits.**

Introduction to agricultural and biosystems engineering (ABEN) for students interested in pursuing the major and profession. Content emphasizes ABEN sub-disciplines through engineering problem solving and introductory design. 2 lectures. 1 laboratory. Prereq: MATH 103 or MATH 107.

## **ABEN 194. Individual Study. 1-3 Credits.**

## **ABEN 196. Field Experience. 1-15 Credits.**

## **ABEN 199. Special Topics. 1-5 Credits.**

## **ABEN 255. Computer Aided Analysis & Design. 3 Credits.**

Application and use of software for engineering design, analysis, and graphical communication. 2 lectures. F.

## **ABEN 263. Biological Materials Processing. 3 Credits.**

Quantitative analysis of processing systems for food, biofuels and bioproducts using principles of mass and energy balances, fluid flow, steam properties and heat and mass transfer. 2 lectures, 1 three-hour laboratory. Prereq: ABEN 255. Co-req: ME 221. S.

## **ABEN 291. Seminar. 1-3 Credits.**

## **ABEN 292. Global Practicum: Study Abroad. 1-15 Credits.**

Pre-Arranged study at accredited foreign institutions (study abroad), domestic institutions (National Student Exchange) or on approved study abroad programs. Pre-requisite: Sophomore standing and prior approval by International Student and Study Abroad Services and major department. Graded 'P' or 'F' (Undergraduate), or 'S' or 'U' (Graduate).

## **ABEN 294. Individual Study. 1-3 Credits.**

## **ABEN 299. Special Topics. 1-5 Credits.**

## **ABEN 358. Electric Energy Application in Agriculture. 3 Credits.**

Electrical distribution/services. Electrical control units, solid state and digital electronics, electromagnetic sensors, and sensing techniques with applications to food, agricultural, and biological systems. 2 lectures, 1 three-hour laboratory. Prereq: PHYS 252. F.

## **ABEN 377. Numerical Modeling in Agricultural and Biosystems Engineering. 3 Credits.**

Numerical modeling using finite element and other techniques. Engineering applications include modeling of stress/strain, heat, and mass transfer in physical, natural resource, and biological systems such as grain and food products. 3 lectures. Prereq: MATH 266, ME 223. S.

## **ABEN 379. Global Seminar. 1-6 Credits.**

NDSU instructed experience or field study in a foreign country. Conducted in English for residence credit. Pre-requisite: Prior approval by International Student and Study Abroad Services and major department. May be repeated. Standard Grading.

## **ABEN 391. Seminar. 1-3 Credits.**

## **ABEN 392. Global Practicum: Study Abroad. 1-15 Credits.**

Pre-Arranged study at accredited foreign institutions (study abroad), domestic institutions (National Student Exchange) or on approved study abroad programs. Pre-requisite: Sophomore standing and prior approval by International Student and Study Abroad Services and major department. Graded 'P' or 'F' (Undergraduate), or 'S' or 'U' (Graduate).

## **ABEN 394. Individual Study. 1-5 Credits.**

## **ABEN 397. Fe/Coop Ed/Internship. 1-4 Credits.**

## **ABEN 399. Special Topics. 1-5 Credits.**

## **ABEN 444. Transport Processes. 3 Credits.**

Topics covered include modes and equations of energy and mass transport processes, transport properties of biomaterials and porous media, formulations of and solutions to energy and mass transfer problems, and engineering design considerations. Prereq: MATH 266 and CE 309 or ME 352 and ABEN 263. {Also offered for graduate credit - see ABEN 644.}.

## **ABEN 452. Bioenvironmental Systems Design. 3 Credits.**

Study of psychrometrics, heat and mass transfer, and physiological requirements for livestock and bioproducts. Design of environmental modifications, livestock wastes and control systems. 3 lectures. Prereq: CE 309 or ME 350. F {Also offered for graduate credit - see ABEN 652.}.

## **ABEN 456. Biobased Energy. 3 Credits.**

Topics to be addressed include: benefits and limitations of biobased energy development; resource potential; biomass production, harvest, storage, and transportation issues; and conversion technologies (e.g. combustion, pyrolysis, gasification, starch and cellulosic ethanol production; biodiesel production; and anaerobic digestion). Prereq: Junior standing in science or engineering. {Also offered for graduate credit - see ABEN 656.}.

## **ABEN 458. Process Engineering for Food, Biofuels and Bioproducts. 3 Credits.**

Analysis and design of processing systems to preserve, purify and/or transform biological materials and products, especially through refrigeration, freezing, sterilization, aseptic processing, dehydration, extraction, distillation and chemical reaction. 3 lectures. Prereq: ABEN 263. F {Also offered for graduate credit - see ABEN 658.}.

**ABEN 464. Resource Conservation and Irrigation Engineering. 4 Credits.**

Engineering principles and design of systems for soil and water resource management and environmental protection. 3 lectures, 1 three-hour laboratory. Prereq: CE 309. {Also offered for graduate credit - see ABEN 664 .}.

**ABEN 473. Agricultural Power. 3 Credits.**

Theory, analysis, and testing of internal combustion engines, traction, power trains, hydraulic systems, vehicle dynamics, stability, and ergonomics in tractor design. Electrical power units including motors. Alternative energy systems. 2 lectures, 1 three-hour laboratory. Prereq: ME 350. F {Also offered for graduate credit - see ABEN 673 .}.

**ABEN 478. Machinery Analysis & Design. 3 Credits.**

Principles of design, development, and testing of agricultural machines and machine systems. Applications of computer aided design and FMEA. Prereq: ME 223. S {Also offered for graduate credit - see ABEN 678 .}.

**ABEN 479. Fluid Power Systems Design. 3 Credits.**

Fluid dynamics principles and fluid properties are applied to the study of function, performance, and design of system components and system for power transmission and control purposes. Prereq: ME 352. Cross-listed with ME 479. {Also offered for graduate credit - see ABEN 679.}.

**ABEN 482. Instrumentation & Measurements. 3 Credits.**

Application of instrumentation and sensor concepts to measurement and control of environmental, biological, and mechanical parameters. Includes sensor principles, signal conditioning, data collection, and data analysis methods. 2 lectures, 1 three-hour laboratory. Prereq: PHYS 252. S {Also offered for undergraduate credit - see ABEN 682.}.

**ABEN 484. Drainage and Wetland Engineering. 3 Credits.**

Drainage and wetland engineering principles, design, and water quality for agricultural and natural resources applications. Topics include soil, water, and plant relationships, water movement in soils, water quality (nitrogen and salinity), surface drainage, subsurface drainage and its modeling, and wetlands. Prereq CE 309 or SOIL 433. {Also offered for graduate credit - see ABEN 684.}.

**ABEN 486. Design Project I. 2 Credits.**

Capstone learning experience involving principles of design, project management, and evaluation. Student teams define a capstone project in their area of interest. 2 lecture/laboratory. Prereq: ABEN 263 and Senior standing.

**ABEN 487. Design Project II. 2 Credits.**

Continuation and completion of the capstone learning experience begun in ABEN 486. Communication in oral, written, and graphic forms is emphasized. 2 lectures/laboratories. Prereq: ABEN 486. S.

**ABEN 491. Seminar. 1-5 Credits.**

**ABEN 492. Global Practicum: Study Abroad. 1-15 Credits.**

Pre-Arranged study at accredited foreign institutions (study abroad), domestic institutions (National Student Exchange) or on approved study abroad programs. Pre-requisite: Sophomore standing and prior approval by International Student and Study Abroad Services and major department. Graded 'P' or 'F' (Undergraduate), or 'S' or 'U' (Graduate).

**ABEN 494. Individual Study. 1-5 Credits.**

**ABEN 496. Field Experience. 1-15 Credits.**

**ABEN 499. Special Topics. 1-5 Credits.**

**ABEN 644. Transport Processes. 3 Credits.**

Topics covered include modes and equations of energy and mass transport processes, transport properties of biomaterials and porous media, formulations of and solutions to energy and mass transfer problems, and engineering design considerations. {Also offered for undergraduate credit - see ABEN 444.}.

**ABEN 652. Bioenvironmental Systems Design. 3 Credits.**

Study of psychrometrics, heat and mass transfer, and physiological requirements for livestock and bioproducts. Design of environmental modifications, livestock wastes and control systems. 3 lectures. F {Also offered for undergraduate credit - see ABEN 452.}.

**ABEN 656. Biobased Energy. 3 Credits.**

Topics to be addressed include: benefits and limitations of biobased energy development; resource potential; biomass production, harvest, storage, and transportation issues; and conversion technologies (e.g. combustion, pyrolysis, gasification, starch and cellulosic ethanol production; biodiesel production; and anaerobic digestion). Prereq: Junior standing in science or engineering. {Also offered for undergraduate credit - see ABEN 456.}.

**ABEN 658. Process Engineering for Food, Biofuels and Bioproducts. 3 Credits.**

Analysis and design of processing systems to preserve, purify and/or transform biological materials and products, especially through refrigeration, freezing, sterilization, aseptic processing, dehydration, extraction, distillation and chemical reaction. F {Also offered for undergraduate credit - see ABEN 458.}.

**ABEN 664. Resource Conservation and Irrigation Engineering. 4 Credits.**

Engineering principles and design of systems for soil and water resource management and environmental protection. 3 lectures, 1 three-hour laboratory. {Also offered for undergraduate credit - see ABEN 464.}.

**ABEN 673. Agricultural Power. 3 Credits.**

Theory, analysis, and testing of internal combustion engines, traction, power trains, hydraulic systems, vehicle dynamics, stability, and ergonomics in tractor design. Electrical power units including motors. Alternative energy systems. 2 lectures, 1 three-hour laboratory. F {Also offered for undergraduate credit - see ABEN 473 .}.

**ABEN 678. Machinery Analysis & Design. 3 Credits.**

Principles of design, development, and testing of agricultural machines and machine systems. Applications of computer aided design and FMEA. S {Also offered for undergraduate credit - see ABEN 478 .}.

**ABEN 679. Fluid Power Systems Design. 3 Credits.**

Fluid dynamics principles and fluid properties are applied to the study of function, performance, and design of system components and system for power transmission and control purposes. Cross-listed with ME 679. {Also offered for undergraduate credit - see ABEN 479 .}.

**ABEN 682. Instrumentation & Measurements. 3 Credits.**

Application of instrumentation and sensor concepts to measurement and control of environmental, biological, and mechanical parameters. Includes sensor principles, signal conditioning, data collection, and data analysis methods. 2 lectures, 1 three-hour laboratory. S {Also offered for undergraduate credit - see ABEN 482.}.

**ABEN 684. Drainage and Wetland Engineering. 3 Credits.**

Drainage and wetland engineering principles, design, and water quality for agricultural and natural resources applications. Topics include soil, water, and plant relationships, water movement in soils, water quality (nitrogen and salinity), surface drainage, subsurface drainage and its modeling, and wetlands. {Also offered for undergraduate credit - see ABEN 484.}.

**ABEN 690. Graduate Seminar. 1-3 Credits.****ABEN 696. Special Topics. 1-5 Credits.****ABEN 747. Numerical Modeling of Environmental and Biological Systems. 3 Credits.**

Numerical methods of systems analysis will be taught through real-world case studies. Topics covered include simplification and mathematical description of real systems; the finite-difference methods for solving differential equations; and parameter estimation sensitivity analysis, and uncertainty analysis methods. S (even years).

**ABEN 750. Bioprocess Engineering. 3 Credits.**

Application of biological, biochemical, and engineering fundamentals for industrial bioprocessing. Topics include bioprocessing kinetics (enzymes, cell growth, substrate utilization, and product formation); bioenergetics; bioreactor selection and scale-up; and product recovery.

**ABEN 758. Applied Computer Imaging and Sensing for Biosystems. 3 Credits.**

Sensors and non-destructive sensing principles (e.g., computer vision, spectroscopy, imaging, fiber optic sensing) for bioproduction and processing applications. Data/signal acquisition, signal conditioning/analysis techniques, signal interpretation, and pattern recognition using statistical, neural networks, and fuzzy logic techniques.

**ABEN 765. Small Watershed Hydrology and Modeling. 3 Credits.**

Study and representation of hydrologic processes on small watersheds. Application of hydrologic models for surface flow, subsurface flow, nutrient and sediment transport, and water quality. Prereq: ABEN 664. F (odd years).

**ABEN 790. Graduate Seminar. 1-3 Credits.****ABEN 791. Temporary/Trial Topics. 1-5 Credits.****ABEN 793. Individual Study/Tutorial. 1-5 Credits.****ABEN 795. Field Experience. 1-15 Credits.****ABEN 796. Special Topics. 1-5 Credits.****ABEN 797. Master's Paper. 1-3 Credits.****ABEN 798. Master's Thesis. 1-10 Credits.****ABEN 899. Doctoral Dissertation. 1-15 Credits.**