

# Agricultural and Biosystems Engineering

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## Department Information

- **Department Chair:**  
Leon Schumacher, Ph.D.
- **Graduate Coordinator:**  
Igathinathane Cannayen, Ph.D.
- **Department Location:**  
Agricultural and Biosystems Engineering Building
- **Department Phone:**  
(701) 231-7261
- **Department Web Site:**  
[www.ndsu.edu/aben/](http://www.ndsu.edu/aben/) (<http://www.ndsu.edu/aben/>)
- **Application Deadline:**  
International applications are due May 1st for fall and October 1 for spring. Domestic applications must be received at least one month prior to the start of the semester.
- **Credential Offered:**  
Ph.D., M.S.
- **English Proficiency Requirements:**  
TOEFL ibt 79; IELTS 6.5; Duolingo 105

The Department of Agricultural and Biosystems Engineering (ABEN) offers graduate study leading to the Master of Science (M.S.) and Doctor of Philosophy (Ph.D.) degrees. The program emphasizes solving engineering problems for agricultural production, food and biofuels processing, and environmental resources management. Advanced work may involve specialized training in the following areas: irrigation and drainage engineering; agricultural hydrology; soil and water resources management; livestock waste management; air quality, process engineering for food and biofuels, and other bioproducts; agricultural machine systems; precision agriculture; machine vision and intelligent sensors for biological systems; and post-harvest handling and storage of biomass feedstocks and other biological materials.

Student research and academic programs are tailored to individual student needs and interests. Interdisciplinary approaches to agricultural and biosystems engineering programs are fostered.

The ABEN graduate program is open to all qualified graduates of universities and colleges of recognized standing. To receive full standing admission to the program, the applicant must meet the Graduate College's admission requirements and have a baccalaureate degree in engineering or have taken the equivalent of the basic undergraduate engineering courses.

The following fundamental courses (or their equivalent) must be taken prior to receiving a M.S. or Ph.D. degree from the North Dakota State University (NDSU) ABEN department. If the courses (or their equivalent) were not taken prior to matriculating at NDSU, they should be taken in addition to other coursework required for the graduate degree. Note that students are responsible for paying the tuition for undergraduate courses.

- Mathematics through Differential Equations (NDSU: MATH 266 Introduction to Differential Equations)
- Statics (NDSU: ME 221 Engineering Mechanics I) and Dynamics (NDSU: ME 222 Engineering Mechanics II); these two may be substituted by a calculus-based Physics I class
- Thermodynamics (NDSU: ME 350 Thermodynamics and Heat Transfer); may be substituted with ABEN 644 Transport Processes, which may also count toward graduate degree
- Fluid Mechanics (NDSU: CE 309 Fluid Mechanics or ME 352 Fluid Dynamics)
- Physics II/Electricity and Magnetism (NDSU: PHYS 252 University Physics II)

The major adviser may appeal to the ABEN graduate committee (not the student's supervisory committee) for substitutions or waivers of these requirements.

## Financial Assistance

Research assistantships are available and dependent on the grant funding of faculty research programs. Applicants are considered based on scholarship and potential to undertake advanced study and research. Students are eligible for an assistantship when accepted into the Graduate College.

## M.S. Degree

The M.S. degree program requires completion of 30 semester credit hours beyond the baccalaureate degree as detailed below. A Plan of Study (PoS) is developed with the adviser by the end of the first semester of work. An oral examination covering the research-based paper or thesis and the student's understanding and ability to apply the subject matter to the research is required. Students typically require two years to complete the M.S. degree. A cumulative GPA of 3.0 or higher is required.

Code	Title	Credits
<b>Didactic Course Work (601-689, 691; 700-789, 791; 800-889 and 891)</b>		<b>16</b>
ABEN 790	Graduate Seminar	
Additional Credits (as needed to complete 30 total credits)		
ABEN 798	Master's Thesis	6-10
<b>Total Credits Required</b>		<b>30</b>

Code	Title	Credits
<b>Accelerated M.S. in Agricultural and Biosystems Engineering</b>		
Students pursuing an accelerated master's degree in ABEN must complete the following requirements:		
Didactic Course Work (601-689, 691; 700-789, 791; 800-889 and 891)		20-24
ABEN 798	Master's Thesis	6-10
ABEN 790	Graduate Seminar	1-3
Total Credits		30

A maximum of 15 graduate credits earned in the accelerated degree program may be used towards the undergraduate and graduate degree.

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Minimum of 6 credits of NDSU ABEN courses numbered 601-689, 691; 700-789, 791

## Ph.D. Degree

Ph.D. candidates are encouraged to indicate their research interests when applying for admission and to select an adviser before entering the program. Typically, 3-4 years are required to complete the Ph.D. program after the completion of an M.S. degree.

The degree requirements are in accordance with the NDSU Graduate College requirements. The student's academic adviser is usually assigned during the acceptance process. Prior to the end of the first academic year, the student and academic adviser will arrange for appointment of a supervisory committee.

Code	Title	Credits
<b>Didactic credit (601-689, 691; 700-789, 791; 800-889 and 891)*</b>		<b>27</b>
<b>ABEN 899 and ABEN 790</b>		<b>30-45</b>
<b>Additional Credits (as need to complete 60 credits (post-master's) or 90 credits (post-bachelor's))</b>		
<b>Total credits</b>		<b>60-90</b>

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at least 15 credits of which must be 700-800 level and a minimum of 9 credits must be ABEN courses.

- 60 credits after the M.S. or 90 credits after the B.S.
- A minimum of 30 credits of NDSU ABEN dissertation and graduate seminar after the M.S. or 45 credits after the B.S.
- A minimum of 9 credits of NDSU ABEN courses numbered 601-689 or 700-789, 15 credits if entering with other than an ABEN B.S.
- It is expected that one or more journal articles will be submitted for publication prior to the award of the degree.

## Examinations

### Comprehensive examinations

Both a written and an oral examination will be taken after completion of the greater portion of the course work phase of the Ph.D. program. The written examination will test the student's understanding and ability to apply the subject matter related to the chosen research area(s). The format and sequence of the written and oral examinations are dependent on the academic adviser and the examining committee. The examination will be graded pass, fail or marginal pass. If the student does not pass the written component of the comprehensive examination, the student will receive another

opportunity to pass the examination. If the student does not pass the written examination second time, the student must wait one semester before taking the examination for the third time. Failure of the third attempt will prevent the student from proceeding further in the Ph.D. program.

The academic adviser also coordinates the oral examination. In this examination, the student will be required to provide a short presentation of the research progress to the date of the oral examination. The format of the examination is dependent on the academic adviser and the examining committee. This examination is to assess the student's ability to communicate the research problem, and how he/she is applying scientific and engineering principles to solve the research problem. The committee may further use this examination to ascertain the student's level of understanding of subject matter as observed from the written examination. This examination is graded pass or fail. If a student fails the oral examination, the student is notified of the deficiencies and given a second opportunity to pass the examination. Should both attempts to pass an examination result in failure, the candidate may request to take the examination a third time. A request for a third examination requires the support of the supervisory committee, the department chair, and the Dean of the Graduate College after consultation with the Graduate Council. Failure of the third attempt will prevent the student from proceeding further in the Ph.D. program.

Successful completion of both written and oral examinations will formally admit the student into candidacy for the Ph.D. in Agricultural and Biosystems Engineering. At least one semester must elapse between admission to candidacy and final Ph.D. oral final examination on the dissertation.

#### **Final examination**

After the research work is completed, the student will write a Ph.D. dissertation following the guidelines of the Graduate College. The final oral Ph.D. examination will be arranged after the approval of the academic adviser. The student must distribute the complete Ph.D. dissertation to the examining committee members a minimum of one week before the final examination. The student will present the complete research work during this final examination. After passing the final examination, the student will complete all the appropriate suggested changes of the committee. The student will follow the procedures as defined by the Graduate College to complete the submission of the Ph.D. dissertation.

#### **Igathinathane Cannayen, Ph.D.**

Indian Institute of Technology, 1997

Research Interests: Biomass Harvest, Storage, Collection and Pre-Processing

#### **J. Paulo Flores**

Federal University of Rio Grande do Sul, 2008

Research Interests: Precision Agriculture, Applications of UASs/Drones in Agriculture, UASs/Drone Imagery Analysis, GIS Applications for Precision Agriculture

#### **Kenneth J. Hellevang, Ph.D.**

North Dakota State University, 1989

Research Interests: Post Harvest Technology, Structures

#### **Xinhua Jia, Ph.D.**

University of Arizona, 2004

Research Interests: Soil and Water Engineering, Hydrology

#### **Zhulu Lin, Ph.D.**

University of Georgia, 2003

Research Interests: Water and Soil Resources, Environmental Modeling

#### **Ewumbua Monono, Ph.D.**

North Dakota State University, 2015

Research Interests: Application of Engineering to the Science of Bioprocessing, Biofuels, Bioproducts, and Food Safety Engineering

#### **John Nowatzki, M.S.**

North Dakota State University, 1974

Research Interests: Agricultural Machine Systems, Precision Agriculture, Conservation Technology, Farm Equipment Energy Conservation, Energy Efficiency, Farm Chemical Application Technology, Wireless Technology on Farms

#### **Matthew Olhoft, M.S.**

North Dakota State University

Research Interests: Education, General Agriculture, Agricultural Mechanics, Leadership, Youth Organizations

#### **Scott W. Pryor, Ph.D.**

Cornell University, 2005

Research Interests: Biorenewable Products and Bioprocessing

#### **Thomas S. Scherer, Ph.D.**

University of Minnesota, 1986

Research Interests: Soil and Water Resources Management, Irrigation Systems

**Dean D. Steele, Ph.D.**

University of Minnesota, 1991

Research Interests: Irrigation and Environmental Engineering

**Xin (Rex) Sun, Ph.D.**

Nanjing Agricultural University, 2013

Research Interests: Precision Agriculture, Artificial Intelligence in Food and Agriculture, Precision Livestock Production, Meat Quality Non-destructive Detection Methods

**Zhao Zhang, Ph.D.**

Pennsylvania State University, 2015

Research Interests: Sensing and Automation in Agricultural and Precision Agriculture