Tuskegee University

College of Engineering (CE) &

College of Agriculture, Environment and Nutrition Sciences (CAENS)

Doctor of Philosophy (Ph.D.) in Agricultural and Environmental Sciences Engineering (AESE)

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Council of Deans: Dr. Olga Bolden-Tiller and Dr. Heshmat Aglan

Coordinators for Areas of Specialization:

- Environmental and Natural Resources Engineering
  Dr. Joseph E. Quansah and Dr. Shamim Begum
- Renewable Energy, Biomass and Bioenergy Conversion
  Dr. Ali Issam Alahmer and Dr. David Baah
- Food Science and Food Processing Engineering
  Dr. ByungJin Min and Dr. Shahryar Jafarinejad

Degree Offered:

Doctor of Philosophy (Ph.D.) in Agricultural and Environmental Sciences Engineering (AESE)

Program Summary

The multi- disciplinary, Doctoral (Ph.D.) program in Agricultural and Environmental Sciences Engineering (AESE) that builds upon and leverages faculty expertise, resources and academic strengths of the College of Agriculture, Environment and Nutrition Sciences (CAENS) and the College of Engineering (CE). The program is an integrative and collaborative effort between CAENS and CE and is designed to have interdisciplinary and multidisciplinary focus in terms of teaching, research, outreach, education and curricula development. The three major research and teaching thrust areas of the AESE Program are: 1) Environmental and Natural Resources Engineering (ENRE), 2) Renewable Energy, Biomass and Bioenergy Conversion (REBBC), and 3) Food Science and Food Processing Engineering (FSFPE). The AESE program will significantly contribute to the state, national and global agricultural,

engineering and environmental sustainability through quality graduate education, research, discovery, and engagement in the agricultural, life sciences, environmental, biological and natural resources engineering disciplines.

Primary candidates for the AESE program are Americans and international students, who have completed BS or MS degrees in Engineering, Agricultural, Environmental, and Natural Resource Sciences; Agricultural Systems Management, Technology and other Sciences related program, with a GPA of at least 3.0/4.0. Individuals with degrees in other science majors (such as chemistry, physics, biology, and computer science) may be admitted to the program conditionally. These individuals will be required to have prerequisite undergraduate courses in environmental engineering and sciences. Students, with Master's degree, enrolled in the AESE PhD program are expected to complete the program within three (3) years. On track AESE students after completion of minimum 30 credits, or students who are unable to attain PhD candidacy within two years will have the option to graduate with a Master's degree in AESE.

Areas of Specialization

- **Environmental and Natural Resources Engineering (ENRE)**

  ENRE addresses critical issues of environmental and natural resources management including water resources, environmental sustainability, climate change, agricultural management, and prepare engineers to design and develop new technologies including data science, geospatial information systems, modeling systems, artificial intelligence and innovative capabilities for protecting our natural resources through sustainable and technology based agricultural practices and low impact engineering solutions that protects soil, water and air resources, while optimizing agricultural production.

- **Renewable Energy, Biomass and Bioenergy Conversion (REBBC)**

  Students with REBBC specialization are trained in agricultural science and engineering technologies required for the development and/or analysis of innovative and efficient renewable energy processes and alternatives from sustainable agricultural and natural resources.

- **Food Science and Food Process Engineering (FSFPE)**

  FSFPE will prepare students to be proficient in all aspects of food science and food processing, and will include the development and design of innovative products, food process design, equipment and systems for food production, handling and packaging, safety, and distribution.

Management

The management entity of the AESE program includes the Council of Deans from College of Engineering (CE) and the College of Agriculture, Environment and Nutrition Sciences (CAENS), the Dean of Graduate Studies, the AESE Program Director and Co-Director, Program Thrust Area Coordinators, AESE Faculty Members and Student Advisory Committees.

Admissions Committee

The AESE leadership team – including the Program Director and Co-Director, Thrust Area Coordinators in collaboration with heads of the key departments involved in the AESE program, form the admissions committee. This committee has the responsibility of identifying and recruiting qualified graduate students for the program. Final admission approval will be granted by the AESE Council of Deans, based on the Directors' recommendations and will be communicated to the candidates by the Dean of Graduate Programs.

Admission Requirements

- Qualified applicants with master's degree (M.S. or MSE) or B.S. degree from accredited national and international universities and colleges with strong background in Engineering, Technology, Agricultural, Environmental, or Natural Resource Sciences, Agricultural Systems Management, Biology, Mathematics, Physics, Chemistry, Computer Science and related sciences will be admitted into the program**.**
- Completed application, statement of purpose and required supporting documents.
- Applicants for admission must have a minimum cumulative GPA of 3.0/4.0.
- Applicants for admission must have a minimum combined GRE score of 300.
- Official transcripts from all universities attended. (International students must have their transcript translated through the World Education Services – WES, where applicable).
- Three letters of recommendation from faculty/industry or others who have known the student in an academic or research capacity.
- Test of English as a Foreign Language (TOEFL) score, for international students from non-English/Anglophone countries. Acceptable scores should range between 85-120.
- International students who are granted admission into the AESE program must consult with the Office of International Programs, Tuskegee University, concerning legal documents to enter and/or stay in the United States for the duration of the program.

Advisory Committee

Faculty coordinators for the different specialization areas will be assigned as provisional advisors to new AESE students. Students will be expected to form their form their advisory committee by the end of their first year in the program. Students are required to have two major Professors/Advisors and at least two other faculty to form their Doctoral Advisory Committee. It is encouraged that one of the two major advisors come from both CAENS and CE. At least two of the committee members (Including the major Advisor) must be knowledgeable in the student's research area and be members of the AESE faculty. Student major advisors must be members of the AESE Faculty and have an active, on-going funded research program that is within the vision and mission of the program and the student's interest. As an integrated agriculture and engineering program, it is highly recommended that one of the two major advisors have an engineering degree/background.

The major advisors or co-advisors will report student progress to the program Director and Co-Director who will provide the AESE Deans Council with updates on each student's students' progress towards graduation. The Doctoral Advisory Committee shall serve as the Examination Committee. The AESE Program Director and Co-Director will be part of every student's final oral examination.

Academic Graduation Requirements

Students in the AESE program, with prior MS degree, are expected to complete classes and dissertation leading to a PhD within 2 to 3 years. If after becoming a PhD candidate, having completed all required course credits and candidacy examinations a student is unable to complete other the requirement for the PhD degree, the student may be awarded a master's degree, either with a thesis or a non-thesis option**.**

AESE student must complete:

- A minimum of 24 credit hours of formal graduate coursework beyond the MS degree, or 45 credit hours of formal coursework required beyond the BS level.
- A minimum of 18 credit hours of research leading to a dissertation.
- And publish at least one to two peer review publications of their research work by the time of their graduation.

Courses Requirement

Minimum of 24 credits hours beyond the MS degree or 45 credit hours beyond the BS level

A. Required Core Courses - 12 Credits Hours

1. *Mathematics and Statistics Courses (minimum of 3 credit hours)*
   - Three to six (3-6) credit hours of graduate level courses in mathematics or statistics.
2. *Computer Science or Engineering Programming Courses (minimum of 3 credit hours)*
   - Three to six (3-6) credit hours of graduate level courses in computer science, Information Systems & Computer Security or Machine Learning/Artificial Intelligence courses in Engineering
3. *CAENS and CE Core Courses (minimum of 6 credit hours)*
   - Three to nine (3-9) credit hours of graduate level (500 or 600 level) courses from CE
   - Three to nine (3-9) credit hours of graduate level (500 or 600 level) courses from CAENS

B. Concentration Courses - Minimum of 6 Credits Hours

- Six to nine (6-9) credit hours of graduate level (500 or 600 level) courses in an area of concentration from either CAENS or CE.

C. Elective Courses - Minimum of 6 Credits Hours

- Six to nine (6-9) credit hours of graduate level (500 or 600 level) courses for elective depending on a student's entry level of BS or Ms.

  Elective courses may be from courses listed in the AESE document, including others in CAENS, CE, Computer Science department, Information Systems and Computer Security PhD Program, for which a student's major advisor recommends.

D. Graduate Seminar (2 credits hours)

- All AESE PhD students are required to complete 2 credit hours of compulsory graduate seminar.

Transfer Credit

Students who have earned credits for graduate course work at other institutions may request and receive transfer credits to shorten their course load for the program. Number of credits hours can range from a minimum of 3 to 24, depending on the student's master's background and requirement for his area of research in the AESE program. Appropriate transferable graduate courses will be determined and approved by the student's major professors/mentors, AESE Program Director or Co-Directors, the Council of Deans and the Dean of Graduate School.

Qualifying Exams and Admission to Candidacy

Students are required to start the process of taking their written and oral qualifying examination to candidacy between their 3rd and 4th semester or immediately after the completion of required course work. The process and time line are as below:

- Completion of all course work with a minimum grade of B for all courses contributing to candidacy.
- Completion and passing of written qualifying exams.
- Oral presentation, passing and approval of PhD proposal by Advisory Committee, AESE Program Director, Deans of CAENS and CE.
- Submission to, and approval of application for admission to candidacy by Graduate School, signed Dean of Graduate School.

Additional Graduation Requirements

- **Publications**

All AESE students are required to at least complete and submit one to two peer review papers for publication at the time of their final oral defense. This will be enforced. Publication is part of the requirement for obtaining a PhD degree in AESE.

- **Industrial Internship**

All AESE students are encouraged to complete some form of internship or outside academic program during their studies at Tuskegee University. Ensure to take advantage to undertake some form of outside collaborative activity.

- **Teaching Requirement**

All AESE students are required to serve as Teaching Assistants and must teach at least parts of a course or administer lab activities approved by their co-advisors

Final Oral Examination

- Upon completion of all course and research work, the student, through his/her major professors/mentors, will request**, two weeks prior,** an approval for oral defense from the AESE program Director, the Deans of CAENS and CE, and the Dean of Graduate School. A draft copy of a student's PhD dissertation should be submitted with the oral defense date request form.
- The Examination Committee will consist of all members of the students' Advisory Committee, the AESE Program Director and Co-Director. The student must submit a complete draft of his/her dissertation/thesis to every member of the Examination Committee and the AESE Program Director and Co-Director at **least two weeks** prior to the date of the examination.

- The oral examination will focus mainly on the students' research activities and developed products. The approval of all members of the Examination and Advisory Committee is required for the student to pass the oral examination. A student must complete all corrections, enhancements and review suggestions in the final dissertation before final document can be submitted to graduate school.
- All members of the Examination Committee will have to approve the final dissertation document by signing, before it is forwarded to the AESE Program Director, the Deans of CAENS and CE, and the Dean of Graduate School for final signatures. The final oral presentation, examination and corrected dissertation must meet Tuskegee University degree requirements, as well as the standards and the quality of for the AESE Ph.D. program.

Submission of Dissertation

All AESE students must submit to the Dean of Graduate School a digital copy of their final dissertation signed by all members of the Examination Advisory Committee, the Director of the AESE Program and the Council of Deans. All hard copies and other deposit requirements by Graduate School must be followed.

Funding Support

Teaching and Research Assistantships and other fellowships may be available for students admitted to the program. This may depend on a student's research interest and the supporting faculty's resources. Continuation of the financial support depends on student's performance in course work, and research, and continued availability of funds.

**** For additional information please refer to the Graduate Handbook.***

Professionalism Policy on Academic and Research Integrity

All AESE students must follow professionalism and academic policies for the University, the CAENS, the CE, and the AESE doctoral program. These include:

Policy Compliance: Students must comply with all institutional, college, departmental and AESE program policies and procedures.

Academic Integrity: Students should conduct all academic and research work with honesty and integrity, including assignments, research data collection, data analysis and exams. Academic integrity should always be paramount in all activities.

Plagiarism: Students should avoid plagiarism, uncited sources and materials and the use of artificial intelligence and search engines such as ChatGPT, Google Gemini. Microsoft Copilot, Zapier Agents, DeepSeek, Meta AL. Zapier Chatbots, Grok etc. AI can be used in educational content, but not as a tool to extract research and dissertation content.

Time Management and Conduct: Students are encouraged to efficiently manage their time, meeting deadlines, maintaining respectful and professional appearance, ensuring good timely, respectful communication and collaborations with faculty, staff and students. Effective time management, balancing academic and personal demands are critical for on time completion of the program.

Plan of Work (POW): Students should have a well laid out plan of work to complete the PhD program ***within two to three years***. Adhere to class and research deadlines, arriving to classes on time, and meeting the academic and research expectations of the AESE PhD program.

Active Participation: Students in the AESE program are encouraged to actively participate in programs in CAENS and CE, including seminars, workshops, conferences, student associations, as part of professional development.

Stewardship: Students should be responsible stewards of institutional resources including laptops, office computers, printers, and other lab resources made available to them.

Conflict Resolutions – Doctoral research work can be intense, especially for a student and their advisors/mentors. In situations where a student may have any conflict or misunderstanding with their Advisors/Committee Members/Student Research interest, fellow students etc., the student should first try to resolve with their advisor. If it is not resolved, discuss it with the AESE program Directors. If it is still not resolved, the AESE program Director will further seek the assistance of the Deans of CAENS, CE and Graduate School to resolve the issue. In most cases, conflicts mostly arise from students not meeting their plan of work to complete research goals and objectives. Always remember that every PhD student is supported on a funded grant project that has research objectives that need to be executed.

Finally, you should enjoy the program and research activities you may be involved in. That is the only way you will stay self-motivated, hungry and enthusiastic enough to complete in time with quality and innovative outcome.

Required Course Offerings

❖ **Required Core Courses (12 credits)**

■ **Mathematics and Statistics Courses (minimum of 3 credit hours)** .

MATH 0504	Introduction to Applied Statistics	3 Credits	Fall
MATH 0561	Applied Mathematics I	3 Credits	Fall
MATH 0505	Advanced Calculus I	3 Credits	Fall

■ **CAENS and CE Core Concentration Courses (minimum of 6 credit hours***)* depending on area of specialization, with **at least 3 credits each from each college**

o ***Environmental and Natural Resources Engineering (ENRE)***

CENG 0570	Advanced Water and Wastewater Treatment	3 Credits	Fall
EVSC 0560	Hydrology and Water Resources Management	3 Credits	Spring
EVSC 0545	Remote Sensing: Principles and Applications	3 Credits	Fall

o ***Renewable Energy, Biomass and Bioenergy Engineering (REBBE)***

MENG 0542	Alternative and Renewable Energy/ EENG 542 - Renewable Energy	3 Credits	
PLSS 0522	Physiology of Plant Growth & Development	3 Credits	
PLSS 0565	Biotechnology	3 Credits	

o ***Food Science and Food Processing Engineering (FSFPE)***

FOSC 0571	Food Process Engineering Technology	3Credits	Spring
FOSC 0575	Manufacture of Specific Food Products	3 Credits	All Terms,
MENG 0514	Advanced Manufacturing -	3 Credits	

■ **Computer Science, Engineering Programming (minimum of 3 credits hours)**

COEG 0535	Machine Learning for Engineers	3 Credits	Spring
COEG 0545	Artificial Intelligence for Engineers	3 Credits	Fall
AGSC 0501	Applied Stat & Machine Learning	3 Credits	Spring
ISCS 0550	Data Mining & Machine Learning	3 Credits	Fall
ISCS 0539	Data Analytics	3 Credits	Spring
ISCS 0540	Big Data Analytics	3 Credits	Spring

❖ **Concentration Courses: (minimum of 6 credit hours)**

Six to nine (6-12) semester credit hours of graduate credits (500 or 600 level) in an area of concentration from either CAENS or CE, and depending on a student's entry level.

❖ **Elective Courses: (minimum of 6 credit hours)**

Six to nine (6-12) semester credit hours of graduate credits (500 or 600 level) for elective depending on a student's entry level of MS or BS. Elective courses may be from courses listed in the AESE document, including others in CAENS, CE and Computer Science department, and Information Systems & Computer Security PhD for which a student's major advisor recommends. Special problems/topics credits can be used as electives.

- **Required Graduate Seminar (2 Credits)**

  Students are required to complete 2 credit hours of graduate seminar class

AGSC 0600/AGSC 0604/CENG 0599 Graduate Seminar (I & II)	2 Credits Fall/Summer
MSEG 0606 Lit Search and Tech Writing	2 Credit
MSEG 0605 Research Ethics	1 Credit

- **Special Topics, Research and Dissertation**

  EVSC 0700/CENG 0700 Research and Thesis
  AGSC 0699/EVSC 0695/CENG 0595. Special Topics/Problem in Environmental Sciences /Chemical Engineering

- **Continuous Registration and Candidate for the Degree**

  If a student has completed all course and research requirements but has not yet been admitted to candidacy for the degree, they may enroll for ***Continuous Registration***. In this case, the student will be considered as enrolled fulltime.
  EVSC 0752/CENG 0752/FOSC 0752. Continuous Registration.

  If a student has completed all course and research requirements and has been admitted to the candidacy for the degree, they may enroll as ***Candidate for the Degree***. In this case also the student will be considered as enrolled full-time.
  FOSC/EVSC/CENG 0754 - Candidate for Degree Only

Elective Courses for the different AESE Areas of Specialization

Environmental and Natural Resources Engineering (ENRE)

COEG 0535 Machine Learning for Engineers	3 Credits	Spring
COEG 0545 Artificial Intelligence for Engineers	3 Credits	Fall
CENG 530 Advanced Process Dynamics and Control	3 Credits	
CENG 0540 Advanced Chemical Engineering Transport Phenomena	3 Credits	Fall
CENG 550 Advanced Chemical Engineering Thermodynamics	3 Credits	
CENG 565 Advanced Chemical Reaction Engineering	3 Credits	
CENG 570 Advanced Water and Wastewater Treatment -	3 Credits	
CENG 580 Advanced Separation Processes	3 Credits	
EVSC 0501 Biostatistics II	3 Credits	Fall
EVSC 0504 Environmental Science II	3 Credits	Spring
EVSC 0505 Issues in Wildlife Ecology &Natural Resource Mgt	3 Credits	/All Terms
EVSC 0517 GIS Applications	3 Credits	Spring
EVSC 0507 Introduction to Geographic Information Systems	3 Credits	Fall
EVSC 0509 Human Dimensions of Wildlife Management	3 Credits	/All Terms
EVSC 0545 Remote Sensing: Applications and Principles	3 Credits	Fall
EVSC 0555 Soil Chemistry	3 Credits	Fall

EVSC 0565 Air Quality	3 Credits	Spring
EVSC 0570 Agrometeorology	3 Credits	Fall
EVSC 0560 Hydrology and Water Resources Management	3 Credits	Spring
EVSC 0590 Soil/Environmental Microbiology	3 Credits	All Terms
EVSC 0610 Climate Change and Climate Modeling	3 Credits	Spring
EVSC 0695 Introduction to Agricultural Informatics	3 Credits	Spring
PLSS 0540 Integrated Pest Management	3 Credits	Fall
PLSS-0505 Issues in Wildlife Ecology/Nat	3 Credits	All Terms
PLSS 0521Soil and Water Conservation	3 Credits	Spring
PLSS-0525 Mineral Nutrients & Soil Fertility	3 Credits	Spring
PLSS - 626 Soil and Plant Testing	3 Credits	Spring
PLSS-0555 Soil Chemistry	3 Credits	All Terms
PLSS-0565 Biotechnology	3 Credits	All Terms
PLSS-0590 Soil Microbiology	3 Credits	All Terms
PLSS-0520 Plant Pathology	3 Credits	All Terms
EVSC 0509 Human Dim. Wildlife Management	3 Credits	All Terms
PLSS-0513 General Entomology	3 Credits	All Terms
PLSS-0540 Integrated Pest Management	3 Credits	Fall
PLSS-0531 Plant Breeding	3 Credits	Fall
PLSS-0532 Temp Subtrop/ Tropical Horticulture	3 Credits	All Terms
PLSS-0533 Vegetable Crop Production	3 Credits	All Terms

Food Science and Food Processing Engineering (FSFPE)

FOSC 0505 Methods of Food and Nutritional Analysis	3 Credits	Fall
FOSC 0506 Methods of Food & Nutritional Analysis Laboratory	3 Credits	All
FOSC 0507 Applied Food Microbiology	3 Credits	All
FOSC 0510 Food Chemistry I	3 Credits	All
FOSC 0661 Food Ingredient Chemistry	3 Credits	Fall
FOSC 0571. Food Process Engineering Technology	3 Credits	Spring
FOSC 0575 Manufacture of Specific Food Products	3 Credits	All Terms,
FOSC 0573. Product Research Innovation & Sensory Evaluation of Foods	3 Credits	Spring
FOSC 0652 Food Ingredient Chemistry	3 Credits	
FOSC-0510 Food Chemistry I	4 Credits	All Terms,
CENG 0590 Biochemical Engineering	3 Credits	Spring
CENG 0530 Advanced Process Dynamics and Control	3 Credits	
CENG 0540 Advanced Chemical Engineering Transport Phenomena	3 Credits	
CENG 550 Advanced Chemical Engineering Thermodynamics	3 Credits	
CENG 565 Advanced Chemical Reaction Engineering	3 Credits	
CENG 570 Advanced Water and Wastewater Treatment -	3 Credits	
CENG 580 Advanced Separation Processes	3 Credits	

Renewable Energy, Biomass and Bioenergy Engineering (REBBE)

CENG 0530 Advanced Process Dynamics and Control	3 Credits
CENG 0540 Advanced Chemical Engineering Transport Phenomena	3 Credits
CENG 0565 Advanced Chemical Reaction E	3 Credits
CENG 0580 Advanced Separation Processes	3 Credits
EENG 0542 Renewable Energy	
MENG 0542 Alternative and Renewable Energy	3 Credits
MENG 0514 Advanced Manufacturing	3 Credits
MENG 0532 Mechatronics and Automation	3 Credits
MENG 0518 Materials Characterization/cross listed with MSEG 0518	3 Credits
MENG 0516 Advanced Strength of Materials	3 Credits
MENG 0551 Advanced Heat Transfer	3 Credits
PLSS-0530 Plant Biotechnology	3 Credits

SPECIAL TOPICS, RESEARCH AND THESIS, CONTINUED REGISTRATION

EVSC 0700/CENG 0700 Research and Thesis
AGSC 0699/EVSC 0695/CENG 0595. Non-thesis Graduate Project
/Special Topics/Problem in Environmental Sciences/Chemical Engineering
EVSC 0752/CENG 0752/FOSC 0752. Continuous Registration.

FOSC/EVSC/CENG 0754 - Candidate for Degree Only

Detailed Course Descriptions can be found at https://catalog.tuskegee.edu/

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