TN Department of Education | College, Career and Technical Education

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Agricultural Fabrication and Biosystems Engineering

Primary Career Cluster:	Agriculture, Food, & Natural Resources
Course Contact:	CTE.Standards@tn.gov
Course Code(s):	C18H42
Prerequisite(s):	*Agricultural Power and Equipment* (C18H13)
Credit:	1
Grade Level:	12
Elective Focus - Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Agriculture, Food, & Natural Resources courses. In addition, this course satisfies a fourth year math credit requirement for graduation.
POS Concentrator:	This course satisfies one out of two required courses to meet the Perkins V concentrator definition, when taken in sequence in the approved program of study.
Programs of Study and Sequence:	This is the fourth and final course in the *Agricultural Engineering, Industrial, and Mechanical Systems* program of study.
Aligned Student Organization(s):	FFA: http://www.tnffa.org
Coordinating Work-Based Learning:	All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program. In addition, teachers who hold an active WBL certificate may offer placement for credit when the requirements of the state board's WBL Framework and the Department's WBL Policy Guide are met. For information, visit https://www.tn.gov/content/tn/education/career-and-technical-education/work-based-learning.html
Promoted Tennessee Student Industry Credentials:	Credentials are aligned with postsecondary and employment opportunities and with the competencies and skills that students acquire through their selected program of study. For a listing of promoted student industry credentials, visit https://www.tn.gov/education/career-and-technical-education/student-industry-certification.html
Teacher Endorsement(s):	048, 150, 448, and 950
Required Teacher Certifications/Training:	None
Teacher Resources:	https://tn.gov/education/article/cte-cluster-agriculture-food-natural-resources

Approved April 10, 2015; Amended April 15, 2016, Nov. 6, 2020

Course At A Glance

CTE courses provide students with an opportunity to develop specific academic, technical, and 21st century skills necessary to be successful in career and in life. In pursuit of ensuring every student in Tennessee achieves this level of success, we begin with rigorous course standards which feed into intentionally designed programs of study.

Students engage in industry relevant content through general education integration and experiences such as career & technical student organizations (CTSO) and work-based learning (WBL). Through these experiences, students are immersed with industry standard content and technology, solve industry-based problems, meaningfully interact with industry professionals and use/produce industry specific, informational texts.

Using a Career and Technical Student Organization (CTSO) in Your Classroom

CTSOs are a great resource to put classroom learning into real-life experiences for your students through classroom, regional, state, and national competitions, and leadership opportunities. Below are CTSO connections for this course, note this is not an exhaustive list.

- Participate in CTSO Fall Leadership Conference to engage with peers by demonstrating logical thought processes and developing industry specific skills that involve teamwork and project management.
- Participate in FFA career and leadership events (CDE/LDE) that align with this course including Agriscience Fair, Agricultural Issues, Agronomy, Agricultural Technology and Mechanical Systems, Employment Skills, Environmental & Natural Resources, and Land Evaluation.

Using Work-based Learning (WBL) in Your Classroom

Sustained and coordinated activities that relate to the course content are the key to successful work-based learning. Possible activities for this course include the following. This is not an exhaustive list.

- **Standards 1-4**| Have an industry representative as a guest speaker with one of the topics dealing with developing marketability employment skills to be successful in this career field.
- **Standards 5-9 |** Have the students work with a precision agricultural technician on a real project.
- **Standards 10-16** | Visit a local agricultural machinery dealer and have students see the different aspects of the business in operation and being maintained.
- **Standard 17**| Have students to do a project that is supervised or evaluated by an agricultural engineer, precision agricultural technician, or qualified technician.

Course Description

Agricultural Fabrication and Biosystems Engineering is an applied course that prepares students for further study or careers in engineering, environmental science, agricultural design and research, and agricultural mechanics and fabrication. Special emphasis is given to the many modern applications of geographic information systems (GIS) and global positioning systems (GPS) to achieve various agricultural goals. Upon completion of this course, proficient students will be able to pursue advanced training in agricultural engineering, industral, mechanical and related fields at a postsecondary institution.

Program of Study Application

This is the fourth and final course for the *Agricultural Engineering, Industrial, and Mechanical System*s program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Agriculture, Food, & Natural Resources website at https://www.tn.gov/education/career-and-technical-education/career-clusters/cte-cluster-agriculture-food-natural-resources.html.

Course Standards

Safety

1) Interpret current Occupational Safety and Health Administration (OSHA) guidelines pertaining to but not limited to general safety, electric safety, welding, and cutting. Distinguish between safety rules and safety requirements. Identify the benefits of knowing and applying basic safety procedures in both an agricultural laboratory and workplace. Apply safety knowledge to conduct a compliance review of the agricultural laboratory, including a written summary justifying the findings with recommendations for improving the safety of working conditions.

2) Review common laboratory safety procedures for tool and equipment operation in the agricultural laboratories, including but not limited to accident prevention and control procedures. Demonstrate the ability to follow safety and operational procedures in a lab setting and complete a safety test with 100 percent accuracy.

Occupational Research and Awareness

3) Gather and analyze information from multiple authoritative sources such as the United States Bureau of Labor Statistics to predict the occupational trends related to agricultural engineering, industrial, and maintenance system occupations. Recommend the top occupations that require high school graduation, some college, postsecondary certificate, two-year college degree, four-year degree, and advanced degree.

4) Evaluate local job postings, labor, and workforce data to analyze the knowledge, skills, and abilities necessary for employment in agricultural engineering, industrial, and mechanical systems occupations related to:
    a) education and training including admission requirement and tuition requirements,
    b) available positions,

c) salaries,
d) cost vs. benefits of education/training,
e) potential lifetime earnings,
f) employment benefits, and
g) possible need for relocation to advance.

Project Planning and Management

5) Design a project plan for an agricultural engineering, industrial, and maintenance project, outlining a strategy for working within a given set of parameters, constraints, and resources. Include at least the following components in the plan: budget, timeline, safety considerations, and strategies to minimize adverse environmental impacts.

Precision Measurements and Management Systems

6) Synthesize case studies and field experience to provide evidence of the impact of geographic information systems (GIS), global positioning systems (GPS), and unmanned aircraft systems (UAS) on agricultural demographics, precision agriculture, pasture management, water quality, watershed management, and waste pollution. Discuss the implications for industry and labor with the incorporation of these technologies into more and more facets of agricultural life.

7) Identify various GIS, GPS, and UAS applications and explain their uses in precision agriculture, including but not limited to the following: precision agriculture management zones, crop water and drought areas, crop imaging, land correlation to crop yields, yield map cleaning and management, drainage analysis and tile mapping, crop data analysis, soil darkness mapping, suitability modeling, and slope angle and accuracy.

8) Demonstrate the ability to make land use, management, development, and equipment recommendations for a specific plot of land in rural and urban settings. Provide graphical and textual evidence to support each recommendation.

9) Demonstrate the ability to trouble shoot and calibrate precision technologies to ensure the correct data or application method is operating properly. (e.g., GPS receivers, yield monitors, remote sensors, etc.)

Drainage and Irrigation Systems

10) Analyze, map, and disseminate geographic information systems (GIS) and global positioning systems (GPS) data portraying a drainage map of a specified region. Recommend engineering design changes to drainage and irrigation systems. Explain how the changes will improve the compliance with accepted soil erosion control practices.

11) Describe the relationships between concepts of hydrostatics, kinematics, and dynamics of fluid flows used for agricultural industry irrigation systems, including but not limited to pipes and open channels, using domain-specific language. Design an irrigation, animal waste flush, or misting system for plants or animals outlining all equipment and operational

requirements for the system including but not limited to: water pressure (psi) needed or flow rate, flow rates in gallons per minute (gpm), spray nozzle or discharge pattern, number of nozzles, number of zones required, size of pipe (may vary depending on length and presser requires), runoff containment, etc.

Structural Systems: Environmental Impacts, Efficiency, and Certifications

12) Research agricultural buildings and facilities that meet industry benchmarks for energy efficiency and environmental sustainability. Compare and contrast the costs and benefits of such structures. Make recommendations as the best energy efficiency and environmental practices to include in various building or facility remodeling plans. Explain the impacts such as but not limited to the decrease in operational cost, impact on the environment, etc.

13) Create a detailed construction plan for an agricultural facility suitable for a designated site, using natural systems and renewable energy where possible, and conserving energy and material resources in construction and maintenance while meeting building certification requirements. Include plans for recreating land or environments impacted by the construction (i.e., replacing displaced wetland with an artificial wetland).

14) Analyze the physical requirements of selected agricultural crops and food products from farm to the processing facility as they impact harvesting, storage, processing, and transport, including but not limited to density, shape, moisture content, stress levels, water potential, friction and flow of particulate solids, terminal velocity, thermal properties, and viscoelastic behavior of solids. Recommend i the appropriate harvesting, storage, processing, transportation and other handling equipment required for the range of crops and products. Provide cost comparison for each recommendation.

Agricultural Fertilizers and Chemicals

15) Compare safety storage and disposal plans for agricultural chemicals such as pesticides, fertilizers, and veterinary medicines. Outline specific procedures pertaining to responsible selection and storage, mixing, transport, application, and disposal of waste, in compliance with applicable regulatory standards. Calculate the cost associated with the installation or replacement of a safe fertilizer or chemical storage area used within the agricultural industry.

16) Analyze the chemical and physical properties of selected agricultural fertilizer and chemical application methods in relation to specific crops and determine the most efficient and effective method of application. Determine and explain the calibration procedures to ensure the correct dosage rate is applied in parts per million (ppm) or pounds per acre for liquid, solid, and gaseous applications.

Capstone Project

17) Participate in a team-driven agricultural engineering, industrial, and maintenance project approved by the instructor that includes research, planning, analysis, budget, construction,

testing, and evaluation phases to measure success and adherence to legal constraints. Prepare periodic verbal and written reports to demonstrate progress.

Standards Alignment Notes

References to other standards include:

- SAE: Supervised Agricultural Experience: All Agriculture students are encouraged to participate in a Supervised Agricultural Experience program to practice and demonstrate the knowledge and skills learned in their agriculture courses.
- AFNR: National Agriculture, Food, & Natural Resources (AFNR) Career Cluster Content Standards: Students engaged in activities outlined above should be able to demonstrate fluency in Standards ABS, CS, and FPP at the conclusion of the course.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.