

**Electrical Energy Applications in Agriculture – ABEN 358**  
**Agricultural and Biosystems Engineering**  
**Class #10569**

Fall, 2019

Lecture: 11:00 – 11:50 a.m., M&W (ABEN 201)

Laboratory: 2:00 – 4:50 pm, W (ABEN 210&215)

3 credits (2-lecture, 1 lab)

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Office hour: 2:00 – 3:00 pm, Monday

You can also make an appointment or drop by and see if I am in the office.

**Title:** Electrical Energy Applications in Agriculture

**PreReq:** Physics 252 or ECE 301

**Text:**

- Fundamentals of Electricity in Agriculture, Gustafson and Morgan, 3<sup>rd</sup> edition 2004, and
- Agricultural Wiring Handbook, 17<sup>th</sup> edition

**Student Outcomes:**

1. Demonstrate a basic understanding of electrical energy power systems. (ABET 1)
2. Construct schematic diagrams of electrical circuits and control systems (ABET 1)
3. Develop and implement PLC programs (ABET 1)

ABET is the Accreditation Board for Engineering and Technology. ABET is a specialized accreditation agency meaning it certifies specific programs at a college or university as compared institutional accreditation agencies that examine an entire college or university. Each accredited department must be reviewed one site at least once every six years. The method of accreditation has changed with the ABET 2000 initiative. Every department has a set of evaluation criteria it has developed and submits to ABET. These criteria form the evaluation basis for the department by the ABET reviewers. The Agricultural and Biosystems Engineering Department criteria developed for the last ABET accreditation visit, in 2012, are listed below. Please examine these criteria, especially the ones mentioned previously that apply to the ABEN 486-487 sequence.

*Educational Objective 1: Successfully address emerging engineering challenges in the design or evaluation of machine systems, processing systems, and natural resources and environmental systems affecting the production of food, feed, and other biobased products.*

- 1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics (ABET #1)*
- 2. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies. (ABET #7)*

*Educational Objective 2: Effectively use professional communication, critical thinking, and interpersonal skills as team leaders and team members:*

*3. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives (ABET #5)*

**Course Objectives:**

Students are expected to develop an understanding of:

- 1) Basic electrical principals (DC and AC) and
- 2) Electrical wiring
- 3) Electrical power generation and distribution system
- 4) Plan a farm electrical service (single- or three-phase)
- 5) Understand motors, standby electric power generation, electrical controls, lighting,
- 6) Solar and wind power principles
- 7) Solid state and digital electronics
- 8) Electrical safety
- 9) Basics of Programmable Logic Controller (PLC)

**Modes of Presentation:**

Lecture with Power Point  
Guest Speakers (possible)  
Problem solving/demonstrations

**Ref:**

- Gerrish, H. H., W. E. Dugger, and R. M. Roberts. 2009. Electricity and Electronics, 10<sup>th</sup> Edition,

**BLACKBOARD:** Blackboard will be used for announcements, class presentations, and temporary grade presentation

**Tentative Lecture Schedule (Subject to change):**

| <b>Date</b>      | <b>Topic</b>                                                              |
|------------------|---------------------------------------------------------------------------|
| 28-Aug           | Introduction and electrical energy application in agriculture             |
| <b>2-Sep</b>     | <b>Labor day holiday- No class</b>                                        |
| 4-Sep            | Basic terms and definitions/ electrical energy application in agriculture |
| 9-Sep            | Basic terms of electricity ( <b>class project concept due</b> )           |
| 11-Sep           | Resistive circuits                                                        |
| 16-Sep           | Resistive circuits                                                        |
| 18-Sep           | Reactive circuits, phase relations, and power factor                      |
| 23-Sep           | Reactive circuits, phase relations, and power factor                      |
| 25-Sep           | Basic electrical wiring (Branch circuit and grounding)                    |
| <b>30-Sep</b>    | <b>Test</b>                                                               |
| 2-Oct            | Power generation, transmission & distribution                             |
| 7-Oct            | Electrical power distribution system                                      |
| 9-Oct            | Electrical power distribution system                                      |
| 14-Oct           | Planning the residential electrical distribution system                   |
| 16-Oct           | Planning the residential electrical distribution system                   |
| 21-Oct           | Lighting systems                                                          |
| 23-Oct           | Solar and wind power systems                                              |
| 28-Oct           | Solar and wind power systems                                              |
| 30-Oct           | Electric motors                                                           |
| <b>4-Nov</b>     | <b>Test</b>                                                               |
| 6-Nov            | Electric motors                                                           |
| 11-Nov           | Standby power units                                                       |
| 13-Nov           | Electrical safety                                                         |
| 18-Nov           | Relay-based controls                                                      |
| 20-Nov           | Electrical controls                                                       |
| 25-Nov           | PLC/Sensors                                                               |
| <b>27-29-Nov</b> | <b>HOLIDAY!!!! Thanksgiving</b>                                           |
| 2-Dec            | PLC/Sensors                                                               |
| 4-Dec            | <b>Class project presentation and report due</b>                          |
| <b>9-13-Dec</b>  | <b>Dead Week</b>                                                          |
| 9-Dec            | <b>Review</b>                                                             |
| <b>16-20-Dec</b> | <b>Final exam week</b>                                                    |
| <b>19-Dec</b>    | <b>FINAL EXAM, 8:00-10:00 am @ABEN 201</b>                                |

### Tentative Lab Schedule: Subject to change

| Date   | Laboratory Topic                                                                     |
|--------|--------------------------------------------------------------------------------------|
| 4-Sep  | Introduction- and test equipment: VOM/Amp probe/Circuit tester                       |
| 11-Sep | <b>Big Iron</b>                                                                      |
| 18-Sep | Wiring and conductor sizing                                                          |
| 25-Sep | Wiring simulation and wiring I (3-way switch)                                        |
| 2-Oct  | Wiring simulation and wiring II (3-way and 4-way switch)                             |
| 9-Oct  | Demonstration panel                                                                  |
| 16-Oct | Three-Phase                                                                          |
| 23-Oct | Service entrance                                                                     |
| 30-Oct | Magnetic starters/controls/switches/ Overload protection-Fuses/Circuit breakers/GFCI |
| 6-Nov  | Magnetic starters/controls/switches/ Overload protection-Fuses/Circuit breakers/GFCI |
| 13-Nov | Sensors/PLC 1                                                                        |
| 20-Nov | Sensors/PLC 2                                                                        |
| 27-Nov | Sensors/PLC 3                                                                        |
| 4-Dec  | Sensors/PLC 3                                                                        |

These are tentative dates for tests and material to be covered, the actual dates and material may vary. **That is why attendance is important.** Any change in schedule will be notified ahead of time.

### Grading:

You will have the following categories of work in the course. Your lowest quiz score will be dropped. Your final grade in the course will be determined by a grade percentage ranging from 0 to 100%. The weighted grade percentage will be computed as follows: 1) divide the total points earned in each work category by the total points possible for that work category, 2) multiply the numbers from step (1) by the weight percentages for each respective work category, and 3) add the results. The weighted grade percentage will be converted to a letter grade using the following straight grading scale. Quiz, lab, and test raw scores will be posted on Blackboard for informational purposes only. **You are encouraged to develop your own spreadsheet to estimate your course grade based on your quiz, lab, and test scores.**

| Item                     | Weighted % of total grade |
|--------------------------|---------------------------|
| Homework                 | 10%                       |
| Quizzes                  | 10%                       |
| Class project            | 10%                       |
| Laboratory reports       | 10%                       |
| Tests (two 50 min exams) | 30%                       |
| Final Exam               | <u>30%</u>                |
| <b>Total</b>             | <b>100%</b>               |

**The cut off for letter grades are: => 90% = A; =>80% = B; =>70% = C; =>60% = D**

**Homework assignment policies:**

You are expected to complete all homework assignments and **hand them in for grading on time**. Assignments are **to be done step by step, typed or LEGIBLY handwritten in ink**. A handwritten assignment must be legible to receive full credit. Illegible and/or hard-to-follow solutions will not receive full credit. **Marks will be deducted if steps are not shown in the assignment**. Homework will be collected at the beginning of class on the due date. **No late submissions of homework are accepted**.

**Exams and quizzes policies:**

Students are expected to take the **tests at the appointed time and date** unless other arrangements are made with the instructor. The tests will be combinations of types of questions, which may include short answer, problems, multiple choice, and fill in the blank questions, depending on what works best for the material covered. **Quizzes may be given throughout the semester and may be either announced or unannounced**. **There are no make-ups for quizzes or tests, except in medical, family emergencies, or interview cases**. Missed tests, exams, and quizzes will receive zero points unless missed for an acceptable reason and with advance notification where possible. **The final exam will be comprehensive. Marks will be deducted if steps are not shown in word problem(s) in the test(s)**.

Class attendance is expected in accordance with NDSU University Senate Policy 333: Class Attendance Policy and Procedure (<https://www.ndsu.edu/fileadmin/policy/333.pdf>). All class materials will be posted on the BB. If you miss class, the instructor will provide handouts upon your return if asked; you are responsible for obtaining notes from a classmate.

Laboratory reports will be due one week after the laboratory exercise is completed. **Reports are to be typed or LEGIBLY handwritten in ink**. **Mark will be deducted for illegible and/or hard-to-follow handwritten lab report**.

**Resources needed by the Students:**

- Access to Blackboard for materials.
- The textbooks
- A calculator (preferably scientific)

**Important Notification****General:**

Information presented in the class will be a combination of material from the course book as well as other resources. It is imperative that students practice good attendance in order to properly learn the materials.

**Academic Honesty:** *All students taking any course in the College of Agriculture, Food Systems, and Natural Resources are under the Honor System (<http://www.ag.ndsu.edu/academics/honor-system-1>). The Honor System is a system that is governed by the students and operates on the premise that most students are honest and work*

*best when their honesty, and the honesty of others, is not in question. It functions to prevent cheating as well as penalize those who are dishonest. It is the responsibility of the students to report any violations of the honor pledge to the instructor, honor commission or the Dean of the College of Agriculture, Food Systems, and Natural Resources.*

*The academic community is operated on the basis of honesty, integrity, and fair play. [NDSU Policy 335: Code of Academic Responsibility and Conduct](#) applies to cases in which cheating, plagiarism, or other academic misconduct have occurred in an instructional context. Students found guilty of academic misconduct are subject to penalties, up to and possibly including suspension and/or expulsion. Student academic misconduct records are maintained by the [Office of Registration and Records](#). Informational resources about academic honesty for students and instructional staff members can be found at [www.ndsu.edu/academichonesty](http://www.ndsu.edu/academichonesty).*

***Students with special requirements:*** Any students with disabilities or other special needs, who need special accommodations in this course are invited to share these concerns or requests with the instructor as soon as possible. The instructor may ask for verification and that, plus other assistance, can be requested from Disability Services in the Lower Level of the NDSU Library (231-8463). <http://www.ndsu.edu/disabilityservices/>.

***Veterans and military personnel:*** Veterans or military personnel with special circumstances or who are activated are encouraged to notify the instructor as early as possible.

### **Use of Cell Phones, iPods, MP3 Players, and Other Electronic Devices:**

All participants in this class are subject to NDSU University Senate Policy 158: Acceptable use of Electronic Communications Devices (<http://www.ndsu.edu/fileadmin/policy/158.pdf>).

As a courtesy to other students and the instructor, all cell phones, iPods, MP3 players, and other electronic devices except handheld calculators should be turned off or placed in a vibrate-only mode during class time. Initiating phone calls, text message, or other types of messages during class time - including those to friends, family, classmates, coworkers, or supervisors—is unacceptable unless there is a genuine emergency. Examples of emergencies include weather-related school closing announcements; fire, bomb, or other threats to public safety and well-being; and other incidents in which the NDSU system is or could be activated to provide broadcast messages to the NDSU community.

Use of cell phones or other portable electronic devices for communication, transmission, retrieval, or storage of information during the administration of a test or quiz may be considered an incident of **academic dishonesty**. One exception to this policy is the use of handheld calculators for computational purposes. Use of cell phones or similar devices as a calculator during tests and quizzes will not be allowed because it is difficult to distinguish such activity from sending and receiving text messages, which could obviously be interpreted as a form of academic dishonesty.

### **Dead Week Policy:**

The NDSU Dead Week policy is available at <http://www.ndsu.edu/registrar/dates/deadweek/>.

**Important Dates:** (<https://www.ndsu.edu/registrar/dates/2020/>)

|                       |                                                              |
|-----------------------|--------------------------------------------------------------|
| August 26             | Classes begin at 4:00 p.m.                                   |
| <b>September 2</b>    | <b>Labor Day holiday (no classes/offices closed)</b>         |
| September 4           | Last day to add classes via Campus Connection                |
| September 4           | Last day for no-record drop of classes @ 100% refund         |
| September 4           | Last day to withdraw to 0 credits @ 100% refund              |
| September 10          | Financial Aid applied to Student Accounts                    |
| September 16          | Last day to submit request to audit, pass/fail               |
| September 20          | Undergraduate fall graduation application due                |
| September 20          | Graduate student fall Graduate Degree applications due       |
| October 4             | Last day to Withdraw to Zero Credits @ 75% refund            |
| October 18            | Grades of Incomplete convert to F                            |
| November 4            | Spring registration begins                                   |
| <b>November 11</b>    | <b>Veteran's Day (no classes/offices closed)</b>             |
| November 15           | Last day to drop classes with record (W)                     |
| November 15           | Last day to withdraw to 0 credits                            |
| November 15           | Late fees applied to unpaid account balances                 |
| <b>November 27-29</b> | <b>Thanksgiving (offices open on Wednesday &amp; Friday)</b> |
| December 2            | Fall commencement participation deadline                     |
| <b>December 9-13</b>  | <b>Dead Week</b>                                             |
| <b>December 16-20</b> | <b>Final Examinations</b>                                    |
| December 20           | Commencement                                                 |
| <b>December 24</b>    | <b>Fall grade access begins online</b>                       |