ABEN 452-652 - Bioenvironmental Systems Design

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206 Agricultural and Biosystems Engineering   701-231-6107
3 credits   www.ndsu.edu/aben

Prerequisite(s): CE309 (or equivalent) and ME 350, Thermodynamics (or equivalent)

Required Text: MWPS Ventilation Package (MWPS 32, 33, 34) and MWPS Manure Packaging (MWPS 18-S1, 18-S2, and 18-S3).

References: Managing Livestock Wastes by James A Merkel and others as found.

Web pages: https://bb.ndsu.nodak.edu/webapps/portal/frameset.jsp (Blackboard homepage)

Course Description: Study of psychrometrics, heat and mass transfer, and physiological requirements for livestock and bioproducts. Design of environmental modifications, livestock wastes and control systems.

Course Objectives: This course meets the following objectives that also apply towards the requirements of the ABET (Accreditation Board for Engineering and Technology) for program accreditation. The course objectives are as follows:

- the student will have a basic understanding of the heat transfer and psychrometrics important in agricultural facilities (abet a and e);
- be familiar with animal/environment interactions (abet c and h));
- be able to use techniques for analyzing thermal conditions and balances in buildings (abet a);
- be familiar with systems for heating and cooling agricultural structures (abet a);
- understand properties and characteristics of various insulating materials and how to calculate overall thermal resistance (abet a);
- be able to determine required ventilation rates and supplemental heat needs (abet a);
- be able to estimate total heat load on buildings (abet a);
- be able to predict if condensation will occur on a surface (abet a);
- understand the principles of air movement, distribution and control, natural ventilation, effects of building design, and know how to design ventilation systems (abet e);
- understand the basics of livestock waste collection and treatment (abet c, e, and h);
- communicate results appropriately in homework, reports, and exams (abet g).
- be aware of current concerns and issues in livestock waste management (abet i and j)

Academic Honesty: CEA Honor System: All work in this course must be completed in a manner consistent with NDSU University Senate Policy, Section 335: Code of Academic Responsibility and Conduct (http://www.ndsu.edu/fileadmin/policy/355.pdf) and the CEA Honor System available at http://www.ndsu.nodak.edu/ndsu/cea/
In addition, all students are expected to adhere to the Honor Code of the College of Engineering and Architecture.

Penalties for violations can range from assigned seating, failure of quiz/exam, failure of the course, to expulsion from the university depending on the severity of the offence and the instructor’s discretion and the honor code jurisdiction.

**Grading:**

I use a grading system of 90%+ A, 80%+ B, 70%+ C, 60%+ D and below 60% F. The tentative grading procedure planned for the course is as follows:

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<thead>
<tr>
<th></th>
<th>Undergraduate</th>
<th>Graduate</th>
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<tbody>
<tr>
<td>Homework</td>
<td>10%</td>
<td>10%</td>
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<tr>
<td>1 hour exams (3)</td>
<td>45%</td>
<td>35%</td>
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<tr>
<td>Projects</td>
<td>15%</td>
<td>10%</td>
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<tr>
<td>drop quizzes</td>
<td>10%</td>
<td>10%</td>
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<tr>
<td>Research project</td>
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<td>15%</td>
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<tr>
<td>Final exam</td>
<td>20%</td>
<td>20%</td>
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<tr>
<td><strong>Total</strong></td>
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**Homework, Essays, and Exams:** Homework will be accepted until 5:00 p.m. on the date it is due without penalty. A penalty of 10% is assessed if it is not turned in within two days after it is due and after that a 50% penalty is assessed.

Team presentations of their solution to the project(s) will be made in class. Project information will be given out one month before the project is due.

**Students with Disabilities:** Any students with disabilities or other special needs that need special accommodations in this course are invited to share these concerns or requests with the instructor as soon as possible.

**Veteran's Preference:** Veterans and student soldiers with special circumstances or who are activated are encouraged to notify the instructor in advance.

**Educational Objectives:**

Educational Objective 1:
Within a few years of graduation, graduates are expected to have established themselves as practicing engineers with the ability to address new and existing engineering challenges in agricultural and closely related biological industries.

Educational Objective 2:
Within a few years of graduation, graduates are expected to have established themselves as practicing engineers who have interpersonal and collaborative skills and the capacity for productive and advancing careers in leadership roles.
Course Schedule/Topics:
- Applications of Environmental Control
- Psychrometrics
- Heat Transfer Basics
- Steady State Thermal Analysis
- Steady State Energy and Mass Balances
- Ventilation rates
- Thermal Insulation and Moisture Barriers
- Air Inlets and Outlets
- Air Distribution
- Ventilation Control
- Livestock Waste Management Principles
- Livestock Waste Collection
- Livestock Waste Storage and Treatment
- Livestock Waste Disposal
- Composting
- Nutrient management
- Air quality