
Class info: Lecture- 12:00 to 12:50 p.m. M & W. ABEN room 208
Lab 2:00 – 4:50 p.m. Monday ABEN room 123.
3 cr.

Instructor: Tom Bon, Office: ABEN 202. Phone: (23)1-7275.
e-mail: Thomas.Bon@ndsu.nodak.edu

Office hrs: 10:00 – 10:50 a.m. M, Tu, W, Th, and F.
Also you can call for an appointment or drop by and see if I am in my office, I am usually available if I am in my office unless it is just before a class or meeting.

Student Outcomes:

1. Understand vehicle principles, equipment interface to the machine, traction, power train, and engine principles. (abet a, c, e, h, and k)
2. Conduct experiments, analyze collected information, and appropriately present the results. (abet b and g)
3. Understand potential trends in off-road vehicle development. (abet i and j)

Overview:

The topic of off-road vehicles covers a numerous applications. One of the first applications for the Agricultural and Biosystems Engineer is a tractor. However, even here there are numerous variations and specialized applications from the large four-wheel drive tractors used in tillage applications to small lawn and garden tractors. Construction equipment is another off-road application the quickly comes to mind. Often this may be road construction equipment. Mining and forestry equipment are yet other areas of specialized off-road equipment.

Off-road equipment is composed of numerous subsystems. These include the engine, drive, electrical and electronic systems, operator's cab and environment, hydraulic systems, and possibly many others. Each of the mentioned subsystems is in itself composed of subsystems. For example the engine has the valve system; the engine block, pistons, connecting rods, and crankshaft; the starting system; the alternator system; the fuel system; air cleaning system; the electronic monitoring and control system; and possibly many others.

The modern off-road vehicle is an engineering wonder. What will the future hold? No one has a crystal ball. However, there are factors than can be expected to impact the design and development of off-road vehicles. These will be very briefly discussed in the following paragraphs.
Social trends and politics will have an impact. Social policy is trending towards pollution controls. This is exemplified by the Tier IV requirements. There is concern about environmental quality and air pollution produced by off road vehicles. Considerable engineering design in the engine and the integration of electronic monitoring and control of the engine has been used to meet the Tier III requirements. This trend is likely to continue.

Increased globalization with marketing of product around the world will continue. Companies will look at expanding their markets to new areas such as China, the former Soviet Union, South America, etc. The market in the United States is relatively small, especially with respect to combines and tractors. The speaker from AGCO at the ASAE AEM award luncheon spoke on this topic. Platforms will need to be developed that can be sold around with world with minimal modifications.

Energy will be a factor. Fuel prices are increasing again in a fashion reminiscent of the 1970s oil crisis. Numerous factors may be affecting this, there is increased world demand for oil while some analysts believe that world production capability is reaching is peak capabilities. Fuel economy will increase in importance. Alternative fuel and/or renewable fuel sources such as biofuels are likely to obtain increasing attention as research and development topics.

The internal combustion engine has been developed for over 100 years. Will the internal combustion engine remain the power source of the future? It is unlikely that internal combustion engines will disappear quickly but there way well be alternatives in the future. For example, some of the large drag-lines used in stripe mining of coal are actually electrically powered. Will steam engines, sterling engines, fuel cells, and other technologies replace the internal engine? Time will tell.

Examination of operations will continue to see if new approaches outside of conventional thinking and methods can accomplish current tasks more quickly, more efficiently, and/or at a lower cost.

Finally, there is the possibility of true "breakout" innovations. A truly revolutionary new idea that completely changes the way current tasks are done. What might this be? If I knew, I would be rich enough to retire and teach as a hobby.

**Grading:**

The course will be graded with the following weights:

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight</th>
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<tbody>
<tr>
<td>1 hr exams (ideally 3)</td>
<td>35%</td>
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<tr>
<td>laboratory reports</td>
<td>15%</td>
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<tr>
<td>homework</td>
<td>10%</td>
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<tr>
<td>quizzes</td>
<td>10%</td>
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<tr>
<td>lab presentations</td>
<td>10%</td>
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<tr>
<td>final exam</td>
<td>20%</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>100%</strong></td>
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**Final Exam is scheduled for Monday, December 14, 2014, from 1:00 to 3:00 p.m.**
I use a straight grading system. The breaks are, 90% (A), 80% (B), 70% (C), 60% (D), and below failing.

Homework is due by 5:00 p.m. on the due date. Homework must be given to me in class or placed in my mailbox. My mailbox is located in ABEN 100. Late homework will be discounted 10% if I receive it before I have graded the assignments and 30% if I receive it after I have graded the assignments.

Quizzes may be given anytime. They may be announced or unannounced. They are worth about 10 pts each. Quizzes will be used to test the understanding of concepts and to encourage students to keep up with the material. **If a quiz is missed, it cannot be made up.** Generally, I drop the lowest quiz from the grades. If a quiz is missed, that is the one dropped. Extenuating circumstances may be considered at the instructor's discretion. If you expect to miss a class due to items such as interviews, professional trips, etc., please inform me by e-mail before the event. If you are caught in sudden events such as illnesses, family emergencies, etc. please inform me as soon as possible.

Anyone in the class who has a diagnosed disability or other special need should inform the instructor as soon as possible. The counseling center should also be notified so the counseling center can work with the instructor and student to best accommodate the situation.

**ACADEMIC HONESTY:**

Students with disabilities needing special consideration are requested to alert me at the first class.

All work in this course must be completed in a manner consistent with NDSU University Senate Policy, Section 355: Code of Academic Responsibility and Conduct available at [http://www.ndsu.nodak.edu/policy/355.htm](http://www.ndsu.nodak.edu/policy/355.htm) and the Honor System of the College of Engineering and Architecture (CEA) available at [http://www.ndsu.nodak.edu/ndsu/cea/](http://www.ndsu.nodak.edu/ndsu/cea/). You are expected to read and abide by both policies, which are incorporated herein by reference. A signature sheet indicating your agreement to abide by the CEA Honor Pledge will be distributed in class. The CEA Honor Code states the following about violations: “If, from the evidence presented, the [Honor] Commission determines that a violation has taken place, it will recommend disciplinary action. Disciplinary action may include, but is not limited to, failure or a grade reduction in the course; failure or grade reduction on the examination, quiz, paper or project in question; or a recommendation for suspension or expulsion.”

**Lectures:**

My plans are to start a major revision of this course. Student feedback and suggestions will be sought in the class evaluations. I will go through this list pretty much sequentially.
Topics (subject to possible change):

Introduction, pretest, history           Chapter 1
Combustion and Tier levels
Overview of an off-road machine
Tractor testing principles
Machinery/Implement interface
Ground/Propulsion system interaction
Power Train principles
Clutches and Brakes
Engine Principles
Electrical/Electronic Systems
Operator Platform/Ergonomics

Some topics will definitely be covered more thoroughly than others.

Laboratory exercises:

I will be working with Mr. Solseng and Mr. Moos to set up the laboratory exercises. These are topics to be considered. Working with them and the weather will affect which laboratory exercises are used and the dates they are used. Materials will be posted on the web a few days before the lab for students to familiarize themselves with the upcoming lab. There will be a major report required for the tractor-testing laboratory. Many other laboratory exercises will have in lab reports.

Lab topics:

Either a tour of CNH assembly or Excel spreadsheets for eqn. solving
Big Iron (Sept. 9-11)
Engine testing
Possible CNH testing facility tour
Possible CNH assembly line tour
Power trains
CAN bus
Presentations (each person, expected to cover 1 weeks)

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Some information concerning ABET:

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 by a site visit 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.

Educational Objective 1: Provide students with technical knowledge, design, and problem solving skills that are foundational to their engineering careers by ensuring that graduates have ability to:

a. Apply knowledge of mathematics, science, and engineering.
b. Design and conduct experiments, as well as to analyze and interpret data.
c. Design a system, component, or process to meet desired needs.
e. Identify, formulate, and solve engineering problems.
k. Use techniques, skills, and modern engineering tools necessary for engineering practice.

Educational Objective 2: Provide learning and practice experiences that build student interpersonal and collaborative skills and the capacity for productive careers by ensuring that graduates have:
d. An ability to function on multi-disciplinary teams.
f. An understanding of professional and ethical responsibility.
g. An ability to communicate effectively.
h. The broad education necessary to understand the impact of engineering solutions in the global and societal context.
i. A recognition of the need for and an ability to engage in lifelong learning.
j. A knowledge of contemporary issues.

Educational Objective 3: Provide students with specialized (discipline-specific) knowledge, educational depth, and breadth to meet the challenges of changing careers and opportunities in agricultural and closely related biological industries by ensuring that graduates have competencies in one or more of the following areas:

l(i) Apply engineering skills to agricultural systems.
l(ii) Apply engineering skills to biomaterials systems.
l(iii) Apply engineering skills to environmental systems.

Criterion 4. Professional component from the 2003-2004 Criteria for Accrediting Engineering Programs also states the following:

Students must be prepared for engineering practice through the curriculum culminating in a major design experience based on the knowledge and skills acquired in earlier course work and incorporating engineering standards and realistic constraints that include most of the following considerations: economic; environmental; sustainability; manufacturability; ethical; health and safety; social; and political.