BSEN 3210 Mechanical Power for Biosystems
Credit Hours: (3) Lec. 2, Lab. 3

Text

Supplemental
*Design and Simulation of Four Stroke Engines*

Texts
Gordon P. Blair
ISBN 0-7680-0440-3
SAE Publications

*The Internal Combustion Engine in Theory and Practice*
Charles Fayette Taylor
ISBN 0-262-70026-3
MIT Press

Course Description
This course will provide students a fundamental understanding of engine performance, vehicle stability, and traction mechanics necessary to effectively design, select and apply off-highway mobile equipment.

Course Objectives
a. Review the fundamentals of engine thermodynamics, ideal engine cycles and factors that influence deviation from ideal performance. Use theoretical analysis and engine simulation to understand how engine design factors affect performance.

b. Review engine fuels and how they impact performance.

c. Learn the basics of engine components, including transmissions, fuel injection, and suspension.

d. Present fundamentals of traction and machine stability.

Course Content:

Lecture Schedule:

A. Traction Mechanics (2.5 weeks)
   a. Soil strength characteristics, soil-tire interactions
   b. Dimensionless ratios – predicting net drawbar pull, rolling resistance
   c. Variations due to tire size, type, construction

B. 2-D Analysis of Tractor Stability (2.5 weeks)
   a. Dynamic motion equations
   b. Solutions for drawbar pull, net traction, rotational stability
c. Suspension dynamics  
d. Lateral stability  
e. Determining center of gravity  

C. Test 1  

D. Engine Thermodynamics (3 weeks)  
a. Ideal Otto and Diesel cycle definitions  
b. Efficiency calculations  
c. Pressure, temperature, internal energy relationships  

E. Non-ideal Engine Thermodynamics (3 weeks)  
a. Causes  
b. Efficiency and net work calculations  

F. Test 2  

G. Engine Components, Design (1.5 weeks)  
a. Crank, valve kinematics  
b. Unsteady air flow through valves and pipes  
c. Engine tuning  

H. Fuels, Other Components (1.5 weeks)  
a. Fuel characteristics and manufacture  
b. Turbochargers, cooling systems  
c. Ambient effects on performance  

I. Transmissions (1 week)  
a. Types, simple design, gear ratios  
b. Comparison of efficiency, cost  

J. Final Exam  

Lab Schedule  

1. Traction  
a. Determining rolling radius  
b. Measurement of rolling resistance  
c. Dynamic traction tests (pull/slip relationships)  
d. Comparison of drawbar pull performance of 2WD, 4WD tractors  

2. Intro to Internal Combustion Engines  
a. Hit and miss engine timing, operation  
b. Single cylinder engine disassembly  
c. Reassemble and test  

3. Intro to Diesel Engines  
a. HP and torque curves, Dynamometers (2 weeks)  
b. Biodiesel production, testing  
c. Simulation of engine performance  
d. Site visit to Caterpillar Assembly plant  
e. Cam profile measurement  
f. Transmissions
Course Requirements/Evaluation:

Grade Assignment:

- A = 90 - 100 %
- B = 80 - 89.9 %
- C = 70 - 79.9 %
- D = 60 - 69.9 %
- F = below 60 %

Grade Breakdown:

1. Homework Assignments 15%
2. Lab Participation 5%
3. Lab Assignments 20%
4. Mid-Term Exams (2) 40%
5. Final Exam 20%

Course Policies:

Academic Honesty

Students are expected to adhere to the Auburn University Oath of Honor listed below. Additional info about the academic honesty policy can be found in the current Tiger Cub Student Handbook, Code of Laws (www.auburn.edu/tigercub). Plagiarism or any other form of academic misconduct will not be tolerated and will be punished to the fullest extent. Specifically, the contents of assignments, laboratory reports, term papers, quizzes, and examinations will be solely that of the student unless otherwise appropriately cited. Students should not use any notes, materials, or aids (including previous reports) except those permitted by the instructor.

Oath of Honor: “In Accordance with those virtues of Honesty and Truthfulness set forth in the Auburn Creed, I, as a student and fellow member of the Auburn Family, do hereby pledge that all work is my own, achieved through personal merit and without any unauthorized aid. In the promotion of integrity, and for the betterment of Auburn, I give honor to this, my oath and obligation.” (www.auburn.edu/sga/oath/code).

1. Atmosphere

Classroom atmosphere will be informal; questions are encouraged at any time. Please be aware that it is the intention of the Biosystems Engineering Department to foster a professional demeanor in all its students. Interactions among all students should therefore be respectful and inclusive.

2. Attendance

Class attendance is not required, but strongly encouraged. Attendance during lab is not optional. Excused absences will not count against students in evaluating lab participation as long as arrangements have been made prior to the absence. Notification after the fact will result in no make-up of class material. When a class is missed, it is the responsibility
of the student to contact the instructor about lecture material covered, or any other topics discussed.

3. Assignment Submissions
Most assignments (homework, lab reports, etc.) must be generated through electronic media (MS Word, MS Excel, etc.) with a hardcopy submitted for grading. Handwritten assignments will be accepted only for homework assigned from the text.

4. Deadlines
   a. Assignments are due when specified. A 10% assignment grade reduction per day will be assessed for late assignments.
   b. Homework will not be accepted after graded assignments are returned.
   c. Lab reports are due the following lab period.

5. Accessibility
It is the policy of Auburn University to provide accessibility to its programs and activities, and reasonable accommodation for persons defined as having a disability under Section 504 of the Rehabilitation Act of 1973, as amended, and the Americans With Disabilities Act of 1990. Students who need special accommodations should make an appointment to see the instructor as soon as possible or contact the Students with Disabilities Office at 334.844.5943 (Voice/TT)