

ABE 466: Engineering Off-Road Vehicles – Fall 2026

Contact Information

Instructor:

Cody Allen, PhD
allencm@illinois.edu
Ph: 217-265-0561
Office: AESB 360R

Teaching Assistant:

Payton Voltz
pvoltz2@illinois.edu
Office: AESB 126

I try my best to be responsive to emails. If you place ABE 466 somewhere in the subject line of email correspondence, I will respond by the end of the next business day. Without that subject line, it is like casting a baitless hook in the middle of a lake and hoping for a fish.

Office Hours

Instructor:

- (i) Immediately following lecture for as long as needed; email me earlier if you would like a private meeting.
- (ii) By appointment (reach out via email with some available time options)

Teaching Assistant:

Fridays 2:30pm-3:30pm in AESB 126

Students are welcome at office hours for any questions or discussion (either related to the course or otherwise). If you don't understand a course topic, let's talk it through (I bet you aren't the only one!).

Course Credit: 3 Hours

Course Times & Locations

Lectures: Tuesdays & Thursdays 9:00am-9:50am CT, Live lecture online via Zoom Canvas link.

Laboratory: Thursdays 2:00pm-4:50pm CT, AESB 137* in-person

*See Canvas activity tables and in-lecture announcements for details on the exact location for the given week.

Course Website

<https://canvas.illinois.edu/courses/70578>

Course Text

Goering, C.E., Stone, M.L., Smith, D.W. and Turnquist, P.K., *Off-Road Vehicle Engineering Principles*, ASAE, 2003. ISBN: 1892769263.

*This book is available for free online via the [ASABE website](#). You must be either (i) connected to the university internet or (ii) connected via Tunnel-All VPN option to access. You might need to clear cache/cookies.

Other references:

Goering, C.E., Hansen, A.C., *Engine and Tractor Power*, 4th edition, ASAE, 2004. ISBN: 1892769425

Heywood, J.B., *Internal Combustion Engine Fundamentals*, 2nd edition, McGraw Hill, 2018.

Course Content

Design and application of off-road vehicles for farm and construction use; thermodynamics of engines; measurement of power and efficiencies; power transmission and traction; chassis mechanics; operator environment. 3 undergraduate hours. 3 graduate hours. Credit is not given for both ABE 466 and ETMA 464. Prerequisite: ABE 340 or ME 200 (or consent of instructor).

Learning Objectives

- Learn about engines, powertrains, and off-road vehicles with particular emphasis on design features and principles of operation.
- Become more familiar with powertrain and vehicle components.
- Practice of the logical engineering approach to solving problems.
- For some students, lay a foundation for further study and a career involving engines and/or off-road vehicles.
- Gain experience in laboratory testing and reporting under conditions of more responsibility as typically found in industry.
- Gain experience in oral and written presentation of technical reports.

Grading Policy

Homework	15%
Labs & Quizzes	25%
Technical Session	8%
Exam 1	15%
Exam 2	15%
Final Exam	22%

Letter grades will be assigned at the end of the semester based on the overall weighted score for the course. The instructor reserves the right to change the grading scale in a way that favors students. The percentage cutoff for each grade will be as follows:

A: 92-100	B-: 80-81.99	D+: 68-69.99
A-: 90-91.99	C+: 78-79.99	D: 62-67.99
B+: 88-89.99	C: 72-77.99	D-: 60-61.99
B: 82-87.99	C-: 70-71.99	F: 0-59.99

Lecture Format

Lectures will be held via live-streamed Zoom meetings at the normal course times. The link to the live-streamed lectures can be found on the course Canvas website. Regular attendance is expected of all students, and the instructor may give in-class Quizzes on the material. Lectures will be recorded and provided to students for exam review material prior to each exam.

Homework Assignments

Homework problems will be frequently assigned from the textbook or supplemental material. These assignments are to be completed individually, but collaboration with your peers is encouraged. Assignments will be submitted via Canvas.

Part of effective problem solving is being able to communicate solutions clearly, so please use the following format for your submissions.

1. First state what is GIVEN
2. What you are trying to FIND
3. Draw a PICTURE (or several), if applicable
4. Present your SOLUTION, in which you state the assumptions made and equations used. Be sure to define all variables. Make it clear what your final answer is, by underlining, drawing a box, or providing a summary table. Identify reference material when appropriate. Ensure that your units are correct.

Laboratory Format

Laboratory sessions will contain a mixture of presentation and hands-on activities. Labs are meant to provide students with experiential learning of the course subjects. The location of the lab each week will vary but will include rooms within AESB and at the ABE Farm (3603 S Race St in Urbana). Information about the attendance split and lab location will be made clear via the weekly activity tables on Canvas and in-lecture announcements.

An unexcused absence from a laboratory session will result in no credit (zero) for the associated laboratory assignment. If a student is unable to attend a laboratory session, they must email the instructor in advance to discuss alternate arrangements. Laboratory sessions will not be recorded, including presentation segments of the labs.

Students should wear appropriate laboratory attire. For this course, that means closed-toed shoes, no loose clothing, and no other dangling items (e.g. jewelry, long hair). Some labs involve hands-on activities in dirty environments, so it is recommended that students wear attire that they do not mind getting dirty.

Laboratory Assignments

There will be accompanying laboratory assignments which will include a combination of data analysis and reporting. These are to be completed individually unless indicated otherwise. Lab assignments will be submitted via Canvas.

Technical Sessions

Each student will conduct an independent review of a topic related to the course but not covered in detail during the course. Students will present their review in a presentation in the second half of the course. Students must get pre-approval of their chosen topic. Additional details will be available on the course website and in lecture.

Midterm Exams

There will be two midterm exams, Exam 1 and Exam 2. Each midterm exam will be held in-person during a normal course lab session as detailed in the course schedule. Additional details regarding the format of the exams will be provided on the course website.

Please note the Midterm Grade Replacement Policy detailed in the Final Exam section of this Syllabus. Due to this policy, requests to reschedule midterm exams will not be granted without a formal excused absence or extenuating circumstances communicated in advance of the exam; instead, the student will be asked to utilize this policy.

Final Exam

There will be a Final Exam held in-person during the assigned timeslot of Finals week. The Final Exam will be cumulative. Additional details regarding the format of the Final Exam will be provided on the course website.

Midterm Grade Replacement Policy: In addition to counting as an independent portion of the course grade, the Final Exam score will replace the lowest Midterm Exam score if it benefits the student's course grade.

Assignment Submissions & Late Policy

Assignments will be submitted and returned to you directly via Canvas. You must upload your assignments as a PDF unless instructed otherwise. It is your responsibility to ensure that the submission uploaded successfully and that any scanned documents are readable.

The submission deadline for lab and homework assignments will be 11:59PM CT on the specified due date. A 20% (absolute) late penalty will be applied to any unsubmitted assignments on the first business day following the deadline. After 3 business days, late assignments will be accepted only at the instructor's discretion. Submissions will never be accepted after solutions have been posted. Students may request deadline extensions by emailing the instructor prior to end of business on the deadline day with a proposed new deadline. The instructor reserves the right to accept or deny the extension request. Requests without a proposed new deadline will be ignored and should be considered denied.

Academic Integrity

The University of Illinois at Urbana-Champaign Student Code should also be considered as a part of this syllabus. Students should pay particular attention to Article 1, Part 4: Academic Integrity. Read the Code at the following URL: <http://studentcode.illinois.edu>. Please note that all course materials are protected by copyright and are considered intellectual property. Course materials should only be used for this course and should not be shared with anyone not in the course, including uploading to an AI assistant, study site, social media, or other online sharing mechanism without permission from the instructor.

Academic dishonesty may result in a failing grade. Every student is expected to review and abide by the Academic Integrity Policy <http://studentcode.illinois.edu>. Ignorance is not an excuse for any academic dishonesty. It is your responsibility to read this policy to avoid any misunderstanding. Do not hesitate to ask the instructor(s) if you are ever in doubt about what constitutes plagiarism, cheating, or any other breach of academic integrity.

Student with Disabilities

To obtain disability-related academic adjustments and/or auxiliary aids, students with disabilities must contact the course instructor as soon as possible and provide the instructor with a Letter of Academic Accommodations from Disability Resources and Educational Services (DRES). To ensure that disability-related concerns are properly addressed from the beginning, students with disabilities who require assistance to participate in this class should apply for services with DRES and see the instructor as soon as possible. If you need accommodations for any sort of disability, please speak to me after class, or make an appointment to see me or see me during my office hours. DRES provides students with academic accommodations, access, and support services. To contact DRES, you may visit 1207 S. Oak St., Champaign, call 217-333-1970, e-mail disability@illinois.edu or visit the DRES website at <http://www.disability.illinois.edu/>. Here is the direct link to apply for services at DRES, <https://www.disability.illinois.edu/applying-services>.

Emergency Response Recommendations

Emergency response recommendations and campus building floor plans can be found at the following website: <https://police.illinois.edu/em/run-hide-fight/>. I encourage you to review this website within the first 10 days of class.

Family Educational Rights and Privacy Act (FERPA)

Any student who has suppressed their directory information pursuant to Family Educational Rights and Privacy Act (FERPA) should self-identify to the instructor to ensure protection of the privacy of their attendance in this course. See <https://registrar.illinois.edu/academic-records/ferpa/> for more information on FERPA.

Sexual Misconduct Reporting Obligation

The University of Illinois is committed to combating sexual misconduct. Faculty and staff members are required to report any instances of sexual misconduct to the University's Title IX and Disability Office. In turn, an individual with the Title IX and Disability Office will provide information about rights and options, including accommodations, support services, the campus disciplinary process, and law enforcement options.

A list of the designated University employees who, as counselors, confidential advisors, and medical professionals, do not have this reporting responsibility and can maintain confidentiality, can be found here: wecare.illinois.edu/resources/students/#confidential.

Other information about resources and reporting is available here: wecare.illinois.edu.

Inclusivity Statement

The effectiveness of this course is dependent upon the creation of an encouraging and safe classroom environment. Exclusionary, offensive or harmful speech (such as racism, sexism, homophobia, transphobia, etc.) will not be tolerated and in some cases subject to University harassment procedures. We are all responsible for creating a positive and safe environment that allows all students equal respect and comfort. I expect each of you to help establish and maintain an environment where you and your peers can contribute without fear of ridicule or intolerant or offensive language.

Religious Observances

Illinois law requires the University to reasonably accommodate its students' religious beliefs, observances, and practices in regard to admissions, class attendance, and the scheduling of examinations and work requirements. Students should complete the Request for Accommodation for Religious Observances form should any instructors require an absence letter in order to manage the absence. In order to best facilitate planning and communication between students and faculty, students should make requests for absence letters as early as possible in the semester in which the request applies.

Mental Health

Significant stress, mood changes, excessive worry, substance/alcohol misuse or interferences in eating or sleep can have an impact on academic performance, social development, and emotional wellbeing. The University of Illinois offers a variety of confidential services including individual and group counseling, crisis intervention, psychiatric services, and specialized screenings which are covered through the Student Health Fee. If you or someone you know experiences any of the above mental health concerns, it is strongly encouraged to contact or visit any of the University's resources provided below. Getting help is a smart and courageous thing to do for yourself and for those who care about you.

Counseling Center (217) 333-3704

McKinley Health Center (217) 333-2700

National Suicide Prevention Lifeline (800) 273-8255

Rosecrance Crisis Line (217) 359-4141 (available 24/7, 365 days a year)

If you are in immediate danger, call 911.

This statement is approved by the University of Illinois Counseling Center

Community of Care

As members of the Illinois community, we each have a responsibility to express care and concern for one another. If you come across a classmate whose behavior concerns you, whether in regards to their well-being or yours, we encourage you to refer this behavior to the Student Assistance Center (217-333-0050 or <http://odos.illinois.edu/community-of-care/referral/>). Based on your report, the staff in the Student Assistance Center reaches out to students to make sure they have the support they need to be healthy and safe.

Further, as a Community of Care, we want to support you in your overall wellness. We know that students sometimes face challenges that can impact academic performance (examples include mental health concerns, food insecurity, homelessness, personal emergencies). Should you find that you are managing such a challenge and that it is interfering with your coursework, you are encouraged to contact the Student Assistance Center (SAC) in the Office of the Dean of Students for support and referrals to campus and/or community resources.

ABE 466: Engineering Off-Road Vehicles – Fall 2026

*Schedule is subject to change during the semester.

Week #	Date	Title	Topic
Week 1	8/25	Lecture 1	Course Intro
	8/27	Lecture 2	Engine Basics
	8/27	Lab 1	Engine Maps and Governors
Week 2	9/1	Lecture 3	Engine Performance (power flow and efficiency)
	9/3	Lecture 4	Engine Performance cont.
	9/3	Lab 2a	Engine Components (Intro, Disassembly 1)
Week 3	9/8	Lecture 5	Engine Timing
	9/10	Lecture 6	Engine Balance
	9/10		<i>No lab this week</i>
Week 4	9/15	Lecture 7	Fuel Injection
	9/17	Lecture 8	Fuel Injection cont.
	9/17	Lab 2b	Engine Components continued (Reassembly 1 - Disassembly 2)
Week 5	9/22	Lecture 9	Turbochargers, Intercoolers
	9/24	Lecture 10	Turbochargers, Intercoolers cont
	9/24	Lab 2c	Engine Components continued (Reassembly 2)
Week 6	9/29	Lecture 11	Thermodynamic Cycles
	10/1	Lecture 12	Combustion, Emissions
	10/1	Lab 3	Engine Testing
Week 7	10/6	Lecture 13	Emissions
	10/8	Lecture 14	Aftertreatment
	10/8		<i>Exam 1 during Lab Time. Finish any remaining reassembly after exam.</i>
Week 8	10/13	Lecture 15	Fuels/Lubricants
	10/15	Lecture 16	Fuels/Lubricants cont
	10/15	Lab 4	Guest Seminar / Gas Exchange
Week 9	10/20	Lecture 17	Electrical systems
	10/22	Lecture 18	Cooling systems
	10/22	Lab 5	Serviceability

Week 10	10/27	Lecture 19	Drivetrains Intro
	10/29	Lecture 20	Transmissions I
	10/29	Lab 6	NTTL, Transmissions
Week 11	11/3	Lecture 21	Transmissions II
	11/5	Lecture 22	Transmissions III
	11/5	Lab 7	Tractor Testing
Week 12	11/10	Lecture 23	Differentials
	11/12	Lecture 24	Final Drives, PTO
	11/12	<i>Exam 2 during Lab Time</i>	
Week 13	11/17	Lecture 25	Traction- Intro, Devices
	11/19	Lecture 26	Traction- Ballast, Weight Transfer, Stability (longitudinal)
	11/19	Lab 8	Tractive Performance
<i>FALL BREAK</i>			
Week 14	12/1	Lecture 27	Traction cont., Chassis Mechanics (longitudinal)
	12/3	Lecture 28	Chassis Mechanics (lateral), Safety
		<i>Technical Sessions Review</i>	
Week 15	12/8	Lecture 29	Course Review, Design of 2036
		<i>No Labs</i>	

Final Exam: Friday, Dec. 11 from 1:30pm-4:30pm @ LOCATION TBA