ME 436: Combustion Engines

Course description: Internal combustion engines; spark ignition engines, diesels, and gas turbines.

Number of credits: 3

Course Coordinator: C.D. Richards

Prerequisites by course: ME 301; ME 303

Prerequisites by topic:

1. Concept and application of the ideal gas law
2. First law of thermodynamics
3. Gas power cycles
4. Conservation of mass
5. Conservation of momentum

Postrequisites: None

Textbooks/other required materials: Pulkrabek, W.W. *Engineering Fundamentals of the Internal Combustion Engine.* Pearson Prentice Hall, 2003, 2/e.

Course objectives:

1. Types and configurations of spark ignition and diesel engines.
2. Engines performance parameters such as BMEP, Torque, BSFC and their relationship to operating conditions.
3. Basic Combustion: calculations, equilibrium concepts, introduction to kinetics.
4. Ideal air standard cycles and fuel/air cycles.
5. Parameters affecting volumetric efficiency, valve timing, port design.
6. Turbocharging: compressor and turbine performance, matching components, introduction to impeller design.
7. Combustion Processes in both spark and compression ignition engines: flame structure, cycle-to-cycle variation, knock, ignition, fuel injection, octane number, ignition delay, cetane number.
8. Emissions: NO_x, CO, UHC, Smoke, and Catalytic converters.
9. Analysis of the performance of ramjets, turbojets, turbofans, and turboprops.

Topics covered:

1. Engine types.
2. Engine performance.
3. Combustion.
4. Engine cycles.
5. Intake and exhaust processes.
6. Spark ignition engines.
7. Compression ignition engines.
8. Emissions.
9. Gas turbine engines.

Expected learning outcomes:	1. The student will understand how an internal combustion engine works. 2. The students will be able to apply engineering science (thermo, fluids, heat transfer) to analyze the operation and performance of an internal combustion engine. 3. The student will gain experience in component design and system matching, such as a turbocharger. 4. The student will gain an appreciation of the environmental concerns in design combustion systems and be exposed to standards and public policy concerning the regulation of combustion emissions.
Class schedule:	Three 50-minute lecture sessions per week, for one semester.
Laboratory schedule:	None
Contribution to meeting the professional component:	Engineering Topics
Relationship of course to student outcomes:	Meets: 1. School of MME ME educational objectives: 1, 2, 3 2. School of MME ME program outcomes: 1, 2, 4, 7 3. ABET EC2019, Criterion 3 program outcomes: 1, 2, 4, 7

Prepared by: Amy Johnson and C.D. Richards *Date:* December 16, 2020

POLICIES

A. **Reasonable Accommodation** (the nature of the particular course determines which one applies):

- Pullman Campus. Reasonable accommodations are available for students with a documented disability. If you have a disability and need accommodations to fully participate in this class, please either visit or call the Access Center (Washington Building 217; 509-335-3417) to schedule an appointment with an Access Advisor. All accommodations MUST be approved through the Access Center.
- WSU Online Course. Reasonable accommodations are available in online classes for students with a documented disability. All accommodations must be approved through your WSU Disability Services office. If you have a disability and need accommodations, we recommend you begin the process as soon as possible. For more information contact a Disability Specialist on your home campus: Pullman or WSU Online (http://accesscenter.wsu.edu), Spokane (http://spokane.wsu.edu/students/current/studentaffairs/disability/), Tri-Cities (http://www.tricity.wsu.edu/disability), Vancouver (http://studentaffairs.vancouver.wsu.edu/student-resource-center/disability-services).

B. **Academic Integrity**

WSU expects all students to behave in a manner consistent with its high standards of scholarship and conduct. Students are expected to uphold these standards both on and off campus and acknowledge the university's authority to take disciplinary action. The Standards of Conduct for Students can be found at http://conduct.wsu.edu.

C. **WSU Safety**

WSU is committed to maintaining a safe environment for its faculty, staff, and students. Safety is the responsibility of every member of the campus community and individuals should know the appropriate actions to take when an emergency arises. In support of our commitment to the safety of the campus community the University has developed a Campus Safety Plan, http://safetyplan.wsu.edu. It is highly recommended that you visit this web site as well as the University emergency management web site at http://oem.wsu.edu/ to become familiar with the information provided.