Western University
Department of Mechanical & Materials Engineering

MME 4423A – Internal Combustion Engines

COURSE OUTLINE – 2026-2027

CALENDAR DESCRIPTION: This course elaborates on the fundamentals of internal combustion engines and what affects their performance, operation, fuel requirements, and environmental impact. The course considers thermodynamic, combustion, heat transfer and friction phenomena, and fuel properties, relevant to engine power, efficiency and emissions, and examines design features and operating characteristics of different types of internal combustion engines; including spark-ignition, diesel, stratified-charge, mixed-cycle engines.

COURSE INFORMATION:

Instructor: Dr. Rex Sherratt

Email: asherra@uwo.ca

Lectures/tutorials/labs: See Draft My Schedule

CONSULTATION HOURS: By appointment

PREREQUISITES: MME 3334A/B

ANTIREQUISITES: None

ACCREDITATION UNITS: Engineering Science = 75%, Complementary Studies = 25%

TOPICS:

1. Introduction to internal combustion engines
2. Overall engine performance; engine testing
3. Advanced gas cycles; the Miller cycle
4. Fuel air and combustion thermodynamics
5. Fuel air cycles; finite heat release
6. Heat and mass transfer
7. Combustion thermodynamics and heat release
8. Fuels and lubricants
9. Emissions
10. Future engine technology

LEARNING OUTCOMES:

Upon successful completion of this course, students will be able to:

1. describe the basic operation of different IC engines including the method of combustion, engine speed control and all the major components; (KB4)
2. conduct performance analysis of IC engines based on engineering parameters such as mean-effective pressure and volumetric efficiency; (I1)
3. conduct complete thermodynamic analyses of IC engines including the effects of residual mass fraction, finite heat release, valve timing, and heat losses; (**ET2**)
4. carry out calculations of combustion reactions for hydrocarbon fuels using simple stoichiometric analysis, and general chemical equilibrium modeling; (ET2)
5. characterize properties of fuels in terms of octane number, cetane number and volatility; (KB4)
6. quantify the impact of air/fuel equivalency ratio, mixing and combustion temperature on emissions; emission control; (IESE2, **IESE3**)
7. characterize engine enhancements in terms of their impact on combustion efficiency, overall engine performance and emissions; (**I3**)
8. conduct laboratory tests on IC engines (I2)

The terms in parentheses following each learning outcome refer to Graduate Attributes (GAs) established by the Canadian Engineering Accreditation Board (CEAB) of Engineers Canada. These attributes are used in the accreditation process to ensure that accredited engineering programs are providing the academic requirements for licensure as a professional engineer in Canada. Information on Graduate Attributes and Indicators can be found at GA Indicators. The table below indicates which specific attributes are measured in this course and the level at which it is measured, wherein I=*Introduced*, D=*Developed* and A=*Advanced*/*Applied*

CEAB Graduate Attribute Learning Levels for this course:

Knowledge Base	A	Engineering Tools	A	Impact on Society	A
Problem Analysis		Individual & Teamwork		Ethics and Equity	
Investigation	A	Communication		Economics & Project Mgmt.	
Design		Professionalism		Life-Long Learning	

COMPUTING

Computing is required in this course. Students will be required to use Microsoft EXCEL and MATLAB to carry out assignments and analyses.

CONTACT HOURS:

3 lecture hours, 0.25 laboratory hours per week (3 one-hour laboratory exercises per term); half course

TEXTBOOK:

None required.

Reference:

Ferguson C.R, Kirkpatrick, A.T., Internal Combustion Engines, Applied Thermosciences, 3rd-Edition, Wiley, 2016. (not required to purchase; ~$210 CAD)

UNITS: SI will be used; however, English units may be introduced through examples as required.

ASSIGNMENTS Five formal problem sets in total will be assigned and each shall be graded and weighted towards 20% of the final course grade. The student should learn to solve these problems in a good professional style. These problems will be assessed and handed back to the students in a timely manner. Tentative due dates for each assignment are:

Assignment	**Due Date *(Tentative)***
Assignment 1	October 1st, 2026
Assignment 2	October 22nd, 2026
Assignment 3	November 5th, 2026
Assignment 4	November 19th, 2026
Assignment 5	December 3rd, 2026

All assignment deadlines will include a 48-hr grace period, without any grade penalty. Any submissions made past the 48-hr grace period will result in a grade of zero for the respective assignment. Please note, given the submission deadline for each assignment includes flexibility in the form of a 48-hr grace period, the instructor reserves the right to deny academic consideration for assignments which are submitted outside of this grade period.

PROJECT: Students will complete a group project (in groups of three) on a topic related to IC engine performance enhancement or efficiency modification. Topic selection will be due **October 26th, 2026**. Each group will deliver a 10-minute presentation followed by a 2-minute question period during class on the weeks of **November 23rd and November 30th**. The project is worth 15% of the final grade (5% presentation, 10% substance), with no written report required; attendance at all presentations is mandatory.

EVALUATION:

Evaluation Format	**Weight**	**Assigned**	**CEAB GAs Assessed**
Assignments	20%	Oct. 1, Oct. 22, Nov. 5, Nov. 19, Dec. 3	ET2
Laboratories	20%	**Disassembly/Reassembly:** Week of September 28th and October 5th **Gasoline Engine:** Week of November 2nd and November 9th **Diesel Engine:** Week of November 16th and November 23rd	I3

Project	15%	Week of November 23rd and November 30th	
Final Exam	45%		IES3

Important Note:

Any assignment missed with academic consideration will have its weight added to the final examination. Students must complete all laboratory exercises (including the report) to pass the course.

General Faculty / University Policies

The Faculty of Engineering and Western University have overarching policies that prescribe how undergraduate courses should run. The course-specific policies described above should be considered in addition to those overarching policies, or as course-specific interpretations of them. In the event of contradictions or confusion between course-specific policies above and general Faculty / University policies, please contact your course instructor for clarification.

Western Engineering's undergraduate policies can be found by navigating to:
https://www.eng.uwo.ca/undergraduate/academic-support-and-accommodations/policies.html
and then clicking the "Engineering Undergraduate Policies framework" link.

The policy covers:

- Absence/Late Accommodation Policy
- Religious Accommodation
- Academic Integrity
- Academic Offences
- Faculty of Engineering AI Policy
- Accessibility
- Inclusivity, Diversity, and Respect
- Health and Well-being
- Gender-Based and Sexual Violence