



## Course Syllabus: Introduction to Combustion Engines - ME 376

<b>Division</b>	Physical Science and Engineering Division
<b>Course Number</b>	ME 376
<b>Course Title</b>	Introduction to Combustion Engines
<b>Academic Semester</b>	Fall
<b>Academic Year</b>	2019/2020
<b>Semester Start Date</b>	08/25/2019
<b>Semester End Date</b>	12/10/2019
<b>Class Schedule</b> (Days & Time)	09:00 AM - 10:30 AM   Tue , 10:30 AM - 12:00 PM   Thu

Instructor(s)				
Name	Email	Phone	Office Location	Office Hours
Bengt Johansson	bengt.johansson@kaust.edu.sa	+966128087293	4219, 5, Al-Kindi (bldg. 5)	9-17 Sunday-Thursday

Teaching Assistant(s)	
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Course Information	
<b>Comprehensive Course Description</b>	The course mainly deals with combustion engines having internal combustion. First a general description of the most common engine types is given. The spark ignition and compression ignition principles are explained and the difference between two and four stroke engines is discussed. A brief coverage of two alternatives, the Wankel and Stirling engines is presented. Thereafter, a number of definitions of mean effective pressure and efficiency are explained. The coupling between the power requirement of a normal vehicle and the power produced by an engine is explained. The fact that all passenger cars have excessive displacement volume should be obvious here and possible ways to improve the situation are discussed. The general conversion of fuel to CO <sub>2</sub> , H <sub>2</sub> O and heat is discussed and stoichiometry is explained. Also, exhaust gas analysis is discussed in some detail. Ideal thermodynamic cycles are presented and used to explain the effects of compression ratio on fuel efficiency. The combustion process in the spark ignition engine is presented. Cycle to cycle variations in the combustion process are explained and abnormal combustion, "knock", is discussed. The exhaust emissions generally and from the spark ignition engine are explained, including the principle of cleaning with the three way catalyst. The diesel engine combustion process is presented both with the classical model and the newer Dec model. The emissions from the diesel engine are also discussed. The engine mechanical systems and gas exchange processes, for instance supercharging are presented. ?
<b>Course Description from Program Guide</b>	The objective of the course is to provide a thorough understanding of the processes that occur in an internal combustion engine and the reason why it is designed as it is. The course will after an introduction deal with the performance measures of ICE, the link between engine performance and vehicle requirements, fundamental combustion, thermodynamic cycles, multicylinder balance, in-cylinder flow and turbulence, Spark Ignition Combustion, Spark Ignition engine emissions, The combustion in Compression Ignition engines and its aftertreatment needs. The course ends with a rather comprehensive description of the gas exchange system with valve system, gas dynamics in inlet and exhaust systems, two-strokes and finally supercharging/turbocharging.
<b>Goals and Objectives</b>	The objective of the course is to provide a thorough understanding of the processes that occur in an internal combustion engine and the reason why it is designed as it is.
<b>Required Knowledge</b>	Basic knowledge of thermodynamics and combustion.

<b>Reference Texts</b>	<b>Book by Bengt Johansson; "Internal Combustion Engine, Volume 1"</b>
<b>Method of evaluation</b>	100.00% - Final exam
<b>Nature of the assignments</b>	The course contains lectures, seminars, exercises. There are two exercises each for the chapters of Performance measures, Combustion and Thermodynamic Cycles.
<b>Course Policies</b>	Lectures should be attended as well as exercises.
<b>Additional Information</b>	

### Tentative Course Schedule

*(Time, topic/emphasis & resources)*

<b>Week</b>	<b>Lectures</b>	<b>Topic</b>
1	Tue 09/03/2019	1. Introduction part 1
1	Thu 09/05/2019	1b. Introduction part 2
2	Tue 09/10/2019	2. Performance measures
2	Thu 09/12/2019	3. Engines in vehicles
3	Tue 09/17/2019	No lecture: SAE ICE2019 Capri
3	Thu 09/19/2019	No lecture: SAE ICE2019 Capri
4	Tue 09/24/2019	No lecture: National day
4	Thu 09/26/2019	No lecture: CRG knock project meeting
5	Tue 10/01/2019	4. Combustion fundamentals
5	Thu 10/03/2019	3b. Engines in vehicles - example
6	Tue 10/08/2019	5. Thermodynamic cycles
6	Thu 10/10/2019	E1: Performance measures exercise 1
7	Tue 10/15/2019	6. Mechanical systems (balance)
7	Thu 10/17/2019	E2: Performance measures exercise 2
8	Tue 10/22/2019	7. In-cylinder flow and turbulence
8	Thu 10/24/2019	E3: Combustion fundamentals exercise 1
9	Tue 10/29/2019	8. Spark Ignition Combustion
9	Thu 10/31/2019	E4: Combustion fundamentals exercise 2
10	Tue 11/05/2019	9. Si engine emissions
10	Thu 11/07/2019	E5: Thermodynamic cycles exercise 1
11	Tue 11/12/2019	9b: SI engine emission control
11	Thu 11/14/2019	E6: Thermodynamic cycles exercise 2
12	Tue 11/19/2019	10. Compression Ignition Combustion
12	Thu 11/21/2019	11a. Gas exchange 1: Valve systems
13	Tue 11/26/2019	11b. Gas exchange 2: Variable inlet and valve systems
13	Thu 11/28/2019	11c. Gas exchange 3: Two-stroke and supercharging
14	Tue 12/03/2019	Summary

#### Note

The instructor reserves the right to make changes to this syllabus as necessary.