



Course Syllabus: Introduction to Combustion Engines - ME 376

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| Division | Physical Science and Engineering Division |
| Course Number | ME 376 |
| Course Title | Introduction to Combustion Engines |
| Academic Semester | Fall |
| Academic Year | 2018/2019 |
| Semester Start Date | 08/26/2018 |
| Semester End Date | 12/11/2018 |
| Class Schedule (Days & Time) | 01:00 PM - 02:30 PM Mon Wed |

| 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) | |
|---------------------------------------------------|---------------------------------------------------------------------------------------|
| Name | Email |
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| Course Information | |
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| Comprehensive Course Description | 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 ₂ , H ₂ 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. ? |
| Course Description from Program Guide | 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. |
| Goals and Objectives | 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. |
| Required Knowledge | Basic knowledge of thermodynamics and combustion. |

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

Tentative Course Schedule

(Time, topic/emphasis & resources)

| Week | Lectures | Topic |
|-------------|-----------------|-------------------------------------------------|
| 1 | Mon 08/27/2018 | L1. Introduction |
| 1 | Wed 08/29/2018 | L2. Performance measures |
| 2 | Mon 09/03/2018 | E1. Performance measures exercise 1 |
| 2 | Wed 09/05/2018 | E2. Performance measures exercise 2 |
| 3 | Mon 09/10/2018 | L3: Engines in Vehicles |
| 3 | Wed 09/12/2018 | L4: Engine in Vehicles, example |
| 4 | Mon 09/17/2018 | Break: SAE Heidelberg |
| 4 | Wed 09/19/2018 | Break: SAE Heidelberg |
| 5 | Mon 09/24/2018 | L5: Combustion fundamentals |
| 5 | Wed 09/26/2018 | E3: Combustion fundamentals, Exercise 1 |
| 6 | Mon 10/01/2018 | E4: Combustion fundamentals, Exercise 2 |
| 6 | Wed 10/03/2018 | L6: Thermodynamic cycles |
| 7 | Mon 10/08/2018 | Break: SAE co-optima Detroit |
| 7 | Wed 10/10/2018 | Break: SAE co-optima Detroit |
| 8 | Mon 10/15/2018 | E5: Thermodynamic cycles, exercise 1 |
| 8 | Wed 10/17/2018 | E6: Thermodynamic cycles, exercise 2 |
| 9 | Mon 10/22/2018 | Break: Sunfuels final meeting, Sweden |
| 9 | Wed 10/24/2018 | L7: Mechanical systems (Engine balance) |
| 10 | Mon 10/29/2018 | Mid term break |
| 10 | Wed 10/31/2018 | Mid term break |
| 11 | Mon 11/05/2018 | L8: In-cylinder flow |
| 11 | Wed 11/07/2018 | L9: Spark Ignition engine combustion |
| 12 | Mon 11/12/2018 | L10: Spark Ignition engine emissions |
| 12 | Wed 11/14/2018 | L11: Spark Ignition engine emission control |
| 13 | Mon 11/19/2018 | L12: Compression Ignition Combustion |
| 13 | Wed 11/21/2018 | L13: Gas exchange 1; Valve systems |
| 14 | Mon 11/26/2018 | L14: Gas exchange 2; Variable valve systems |
| 14 | Wed 11/28/2018 | L15: Gas exchange 3; 2-stroke and supercharging |
| 15 | Mon 12/03/2018 | Summary of course |
| 15 | Wed 12/05/2018 | Backup |
| 16 | Mon 12/10/2018 | Backup |

Note

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