جامعة الملك عبدالله
للعلوم والتقنية
King Abdullah University of
Science and Technology

Course Syllabus: Advanced Internal Combustion Engines - ME 377

Division	Physical Science and Engineering Division
Course Number	ME 377
Course Title	Advanced Internal Combustion Engines
Academic Semester	Spring
Academic Year	2018/2019
Semester Start Date	01/27/2019
Semester End Date	05/23/2019
Class Schedule (Days & Time)	10:30 AM - 12:00 PM | Tue 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

Teaching Assistant(s)

Name	Email
N/A	

Course Information

Comprehensive Course Description	The course starts with an in-cylinder pressure analysis for heat release evaluation. Modern and advanced Otto and Diesel type engines are investigated as well as the historical development of engines. Advanced gas exchange systems are discussed and special emphasis is provided on direct fuel injection since such systems have evolved dramatically the last years. New types of internal combustion engines such as HCCI and PPC are explained. Measuring techniques for the analyzing of engines as well as engine control are presented. Fuel aspects with emphasis on engine performance and emissions are presented.
Course Description from Program Guide	The course starts with an in-cylinder pressure analysis for heat release evaluation. Modern and advanced Otto and Diesel type engines are investigated as well as the historical development of engines. Advanced gas exchange systems are discussed and special emphasis is provided on direct fuel injection since such systems have evolved dramatically the last years. New types of internal combustion engines such as HCCI and PPC are explained. Measuring techniques for the analyzing of engines as well as engine control are presented. Fuel aspects with emphasis on engine performance and emissions are presented.
Goals and Objectives	The objective of the course is to provide a deeper understanding of the design of modern internal combustion engines as well as on advanced engine concepts and methods

Required Knowledge	The student should have background knowledge in internal combustion engines equililent to the content of the course "Introduction to Internal Combustion Engines" ME376. This means a student should be able to give an overview of the functions of main components of a modern combustion engine as well as how they have evolved over time be able to provide an individual written explanation of the combustion processes in spark ignition and compression ignition engines and how they are influenced by various operating and design parameters at a detailed conceptual level ? be able to perform stoichiometric analysis of combustion of any hydrocarbon fuel with air ?*Competences and skills* ?For a passing grade the student must ?be able to use mean effective pressures and other characteristic engine parameters to analyse combustion engines, select an engine type and design the engine (in terms of displacement volume, number of cylinders, cylinder bore and engine speed) for a given simple application ? be able to calculate the air/fuel ratio given a measured exhaust composition as well as the air requirement for complete combustion of any hydrocarbon fuel ? be able to apply ideal thermodynamic cycles in order to calculate efficiency and mechanical work for combustion engines and relate the results to real thermodynamic cycles ?
Reference Texts	"Combustion Engines - Volume 2" by Prof. Bengt Johansson
Method of evaluation	**100.00**% - Final exam
Nature of the assignments	The course will include laboratories for HCCI and PPC combustion modes. A mandatory report of the two labs will be required before the student can take the final exam.
Course Policies	Students are expected to attend the lectures and must take part in the two labs.
Additional Information	

Tentative Course Schedule *(Time, topic/emphasis & resources)*		
Week	**Lectures**	**Topic**
1	Tue 01/29/2019	ICE history 1/2
1	Thu 01/31/2019	ICE history 2/2
2	Tue 02/05/2019	Measurement techniques
2	Thu 02/07/2019	Heat release and analysis 1/2
3	Tue 02/12/2019	Heat release and analysis 2/2
3	Thu 02/14/2019	Si engine cycle to cycle variations
4	Tue 02/19/2019	SI engine ignition system
4	Thu 02/21/2019	SI engine fuel system including GDI
5	Tue 02/26/2019	HCCI part 1 Fundamentals
5	Thu 02/28/2019	HCCI part 2 Optical diagnostics
6	Tue 03/05/2019	CCRC combustion conference
6	Thu 03/07/2019	CCRC combustion conference 2/2
7	Tue 03/12/2019	HCCI part 3 Closed Loop Combustion Control
7	Thu 03/14/2019	HCCI part 4 Concepts and fuel effects
8	Tue 03/19/2019	Spark Assisted Compression Ignition, SACI
8	Thu 03/21/2019	Partially Premixed Combustion, PPC part 1: Concept
9	Tue 03/26/2019	Spring Break
9	Thu 03/28/2019	PPC part 2: Fuel effects
10	Tue 04/02/2019	PPC part 3: Low load strategies
10	Thu 04/04/2019	SAE break
11	Tue 04/09/2019	SAE break
11	Thu 04/11/2019	SAE break
12	Tue 04/16/2019	PPC part 4: Combustion stratification
12	Thu 04/18/2019	High Efficiency Themodynamics, the 8-stroke engine
13	Tue 04/23/2019	Gas engines including prechambers
13	Thu 04/25/2019	ICE trends 2019
14	Tue 04/30/2019	Heat release student presentation
14	Thu 05/02/2019	Heat release student presentation
15	Tue 05/07/2019	Backup/guest lecture to be added in program
15	Thu 05/09/2019	Backup/guest lecture to be added in program
16	Tue 05/14/2019	Backup/guest lecture to be added in program
16	Thu 05/16/2019	Summary
17	Tue 05/21/2019	Final Exam Week
17	Thu 05/23/2019	Final Exam Week

Note

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