Mechanical Engineering Dept. Department

Syllabus
ME 432: Internal Combustion Engines (3-0-3)

Course Catalog Description:

Engine anatomy, designs, classifications, and configurations. Combustion chemistry and energy analysis. Idealized cycles of internal combustion engines. Spark-ignition (SI) and compression-ignition (CI) engines. Low-temperature combustion (LTC) and gasoline-compression-ignition (GCI) engines. Engine performance parameters. Engine knock. Fuel octane and cetane numbers. Super and turbocharging. Engine emissions and control.

Course Pre-requisites:

- ME 204: Thermodynamics II

Course Objectives:

1. To teach students the fundamentals, operations, and performance criteria of internal combustion engines (ICEs) and their different types.
2. To provide students with the ability to analyze, design, and select ICEs for specific applications.
3. To familiarize the students with the concept of hydrogen mobility and with hydrogen-fueled vehicles.

Course Learning Outcomes:

CLO1. Identify the different types of internal combustion engines (ICEs) in a variety of power-generation applications.

CLO2. Perform complex calculations to characterize the combustion process within the ICE and to perform energy balance on it. Acquire knowledge of the parameters used to assess ICE performance, and apply this knowledge to compare different ICEs.

CLO3. Acquire knowledge of the technologies used to boost/enhance ICE performance, such as super/turbocharging.

CLO4. Acquire knowledge of the different fuel types and their combustion characteristics in ICEs, and apply this knowledge to select the appropriate fuel for a given ICE. Acquire knowledge of the environmental impact of ICEs and how to control their pollutant emissions.

CLO5. Acquire knowledge of novel ICE concepts/technologies that are expected to emerge in future ICEs and replace existing technologies.

CLO6. Select the appropriate ICE type for a specific application. Work within a team to develop a computer code that performs complex calculations for optimizing/designing an ICE cycle for a

specific application and present the results in a professional project report and in front of the entire class.

CLO7. Judge the feasibility of fueling ICEs with hydrogen, and compare GCI engines to hydrogen fuel cells.

Learning Resources:

- W.W. Pulkrabek, Engineering Fundamentals of the Internal Combustion Engine, 2nd Ed., Pearson Education Limited, 2013.
- C.R. Ferguson and A.T. Kirkpatrick, Internal Combustion Engines, 3rd Ed., Wiley, 2016.
- J.B. Heywood, Internal Combustion Engine Fundamentals, McGraw Hill, 1988.

Lecture Assessment Plan:

Assessment Task	Week Due	Weight
Homework	None	8.0%
Minute papers	None	10.0%
In-class participation	None	5.0%
Mini-quizzes	None	15.0%
Team Project	None	15.0%
Major Exam	None	15.0%
Final Exam	None	32.0%

Lecture Weekly Schedule:

Week#	Topics
1	Review of combustion chemistry and energy analysis
2	Review of combustion chemistry and energy analysis (Continue)
3	Engine anatomy, designs, classifications, and configurations
4	Idealized cycles of internal combustion engines
5	Engine performance parameters
6	Engine performance parameters (Continue)
7	Engine performance parameters (Continue)
8	Engine performance parameters (Continue)
9	Engine knock and fuel ON & CN
10	Super and turbocharging
11	Engine emissions and control
12	LTC and GCI engines
13	LTC and GCI engines (Continue)
	Hydrogen mobility: H2 in ICEs and comparison with fuel cells

Week#	Topics
14	Hydrogen mobility: H2 in ICEs and comparison with fuel cells (Continue)
15	Demo on bench-scale engines in Heat-Engines Lab (B26-R121)