

1152AU134

**HOMOGENEOUS CHARGE COMPRESSION
IGNITION ENGINES**

**L T P C
3 0 0 3**

8. Preamble

This course provides the fundamental concept of HCCI, comparison of HCCI with conventional diesel and gasoline engines and its benefits in IC Engines. This course also enables learners to acquire knowledge about the modifications that are required for a HCCI engine, analyses the combustion characteristics and parameters influencing the HCCI combustion.

9. Pre-requisite

1151AU216 Automotive Fuels, Lubricants and Coolants

1151AU107 IC Engines

10. Links to other courses

1152AU104	Engine Testing and Certification
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11. Course Educational Objectives

- To achieve an understanding about the fundamentals of HCCI engine and its benefits in IC engines.
- To predict the techniques used in HCCI mode of operation in conventional gasoline engine and diesel engines
- To impart the knowledge in the HCCI fuel requirements & combustion with alternative fuels.
- To investigate the performance, emission and combustion characteristics of HCCI engine.
- To discuss the parameters influencing HCCI combustion and methods to improve combustion.

5. Course Outcomes

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's)
C01	Understand the concept of HCCI and extent of the challenges in methods of homogeneous charges preparation.	K2
C02	Describe the instrumentation and experimental procedures followed for HCCI mode of operation in a conventional engine.	K2
C03	Demonstrate the HCCI fuel requirements and compare the performance, combustion and emission characteristics of HCCI engine fuelled with non-conventional fuels.	K3
C04	Discuss in depth understanding of engine parameters' influence on HCCI engine combustion at different experimental aspects.	K2
C05	Examine the future trends and methods to improve in homogeneous charge compression ignition combustion.	K3

6. Correlation of COs with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	H	M	H	L		L				L	M	M	M
CO2	H	H	H	H	M		L				L	M	H	H
CO3	H	H	H	H	M		L				L	M	H	H
CO4	H	H	H	H	L		L				L	M	H	H
CO5	H	M	H	H	M		L				L	M	H	H

H- Strong; M-Medium; L-Low

7. Course Content

UNIT I HCCI ENGINE FUNDAMENTAL L-9

Conventional Diesel and Gasoline Combustion Process- Fundamental Fuel Properties- HCCI Fuel Specification- Fundamentals of HCCI- Combustion Chemistry- Techniques to HCCI Operation In Gasoline and Diesel Engines - Comparison of HCCI Engine With Conventional CIDI and SIDI Engines- Advantages and Disadvantages of HCCI Engine.

UNIT II INSTRUMENTATION AND EXPERIMENTAL METHODS L-9

Engine specifications- Modifications required for HCCI engine- Challenges; controlling initiation of combustion, cold-start capability, extending to high loads range- Emission regulations, emission on HCCI engine- Methods of homogeneous charges preparation. Structure of the experiments.

UNIT III COMBUSTION WITH ALTERNATIVE FUELS L-9

Fuel Additives and Fuel Modification- Studies on the Performance, Combustion and Emission Characteristics of Hydrogen/HCCI Engine, CNG/HCCI Engine, Methane/N-Butane/Air Mixtures, DME/HCCI Engine and Biofuel/HCCI Engine.

UNIT IV ENGINE PARAMETERS AND THE FACTORS INFLUENCING COMBUSTION L-9

HCCI/SI Switching- Transition Between Operating Modes (HCCI-SI-HCCI)- Parameters Influencing HCCI Combustion; Preheat Inlet Air, Intake Air Pressure, Varying Compression Ratios, Fuel Injection Pressure, Equivalence Ratio, Engine Speed And Torque Conditions- Performance And Emission Parameter Studies.

UNIT V IMPROVEMENT OF HCCI ENGINE L-9

Methods to Improve Homogenous Charge Compression Ignition Combustion – Comparison Of HCCI Engine Using Ethanol and Diethyl Ether Blends – Nano Additive Blends - Nox Reduction Techniques.

TOTAL: 45 Periods

8. Text Books

1. Hua Zhao “HCCI and CAI Engines for automotive industry” Wood Head Publishing in Mechanical Engineering, 2007.

2. B.P. Pundir, Engine Combustion and Emission, 2011, Narosa Publishing House.
3. Thipse.S.S., Alternative Fuels; Concepts, Technologies and Developments, Jaico Book Distributors, 2010

9. References:

1. John B Heywood, "Internal Combustion Engines Fundamentals", McGraw Hill International Edition, 1988.
2. Rajput R.K. Internal Combustion Engines, Laxmi Publications (P) Ltd, 2006.
3. Richard.L. Bechtold- Alternative Fuels Guide Book- SAE International Warrendale- 1997.
4. Willard W. Pulkrabek, Engineering Fundamentals of the Internal Combustion Engines, 2007, Second Edition, Pearson Prentice Hall.
5. Ganesan, V, Internal Combustion Engines, Tata McGraw Hill Book Co., 2003.
6. Domkundwar V, A course in Internal Combustion Engines, DhanpatRai& Co. (P) Ltd, 2002.