

1. Preamble

This course introduces the world and Indian energy scenario, need for hydrogen, comparative properties of hydrogen with other fuels, production and storage methods of hydrogen. Further it makes the students to understand the ways and means of usage of hydrogen in SI and CI Engines and its application in fuel cell technology

2. Pre-Requisite

1151AU107 I.C Engines

3. Links to other courses

- Advanced theory of IC engines
- Fuel conservation & Alternate fuels

4. Course Educational Objective

Students undergoing this course are expected to

- To introduce about the world and Indian energy scenario, need for hydrogen and its properties.
- To create the basic knowledge about different production and storage methods of hydrogen.
- To impart technological aspects usage of hydrogen in SI and CI Engines.
- To analyze new technical challenges and create technical advancements in the generation and use of hydrogen.

5. Course Outcomes

Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's)
CO1	Understand the need for hydrogen and its suitability to use in I.C.Engines	K2
CO2	Describe the different production, storage and distribution methods of hydrogen.	K2
CO3	Explain the concept, methods and various features related to usage of hydrogen in SI Engines.	K2
CO4	Explain the concept, methods and various features related to usage of hydrogen in CI Engines.	K2
CO5	Discuss new technical challenges and create technical advancements in the generation and use of hydrogen.	K2

6. Correlation of COs with Programme Outcomes

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO 1	H	M	L	M	H	M	M			L	L		M	M
CO 2	H	M	L	M	H	M	M			L	L		M	M

CO 3	H	M	M	M	H	M	M			L	L		M	M
CO 4	H	M	M	M	H	M	M			L	L		M	M
CO 5	H	M	M	M	H	M	M			L	L		M	M

H- High; M-Medium; L-Low

7. Course Structure

UNIT – I INTRODUCTION

L- 9

World and Indian Energy Scenario – Need for Hydrogen, Properties of Hydrogen, Comparison With Fossil and Other Alternate Fuels - Pollution Caused by Conventional Fuels- Emission Standards.

UNIT – II PRODUCTION AND STORAGE, SAFETY AND DISTRIBUTION

L- 9

Production Methods – Electrolysis- Steam Reformation and Renewable Energy - Storage Methods - Gaseous, Liquid And Metal Hydrides- Safety Aspects and Devices - Distribution Types, Hydrogen Refueling Methods.

UNIT – III HYDROGEN IN S.I. ENGINE SYSTEM

L- 9

Engine Modifications Required for Hydrogen Use in S.I. Engine, Combustion Characteristics – Dual Fueling, Direct Injection of Gaseous And Liquefied Hydrogen In S.I. Engine.

UNIT – IV HYDROGEN IN C.I. ENGINE SYSTEM

L- 9

Engine modification required for hydrogen use in C.I. Engine, Combustion characteristics - Direct Injection – Gaseous and liquified Hydrogen, Dual fuel mode, Hydrogen enrichment.

UNIT – V RECENT ADVANCES

L- 9

Hybrid Electric Vehicle - On Board Generation and Storage of Hydrogen - Proton Exchange Membrane Fuel Cells.

Total: 45 Periods

8. TEXT BOOKS

1. S. S. Thipse., Alternative Fuels: Concepts, Technologies and Developments, Jaico Book Distributors, 2010.
2. Richard Folkson., Alternative Fuels and Advanced Vehicle Technologies for Improved Environmental Performance, Woodhead Publishing, 2014.
3. Richard L Bechtold P.E., Alternative Fuels Guide book, Society of Automotive Engineers, 1997. ISBN 0-76-80-0052-1.

9. REFERENCES:

1. International Journal of Hydrogen Energy.
2. Alternative Fuels (A decade of success and Promise) edited by RedaMoh.Bata, SAE PT-48, ISBN 1-56091 – 593 – 5.
3. Osamu Hirao and Richard K. Pefley, Present and future Automotive Fuels, John Wiley and Sons, 1988.
4. Keith Owen and Trevor Eoley, Automotive Fuels Handbook, SAE Publications, 1990.
5. Richard L. Bechtold, Automotive Fuels Guide Book, SAE Publications, 1997.