

**B.E Semester: VII**  
**Automobile Engineering**  
**Subject Name: Elective-I: Fuel cell technology (AE706B)**

**Course Objective**

- To present a problem oriented in depth knowledge of fuel cell technology.
- To address the underlying concepts, methods and application of fuel cell technology.

**Teaching / Examination Scheme**

SUBJECT		Teaching Scheme				Total Credit	Evaluation Scheme					Total Marks
		L	T	P	Total		THEORY		IE	CIA	PR. / VIVA	
CODE	NAME	Hrs	Hrs	Hrs	Hrs	Hrs	Marks	Marks	Marks	Marks	Marks	
AE706B	Elective-I: Fuel cell technology	4	0	0	4	4	3	70	30	20	-	120

**Detailed Syllabus:**

Topic no	Details
1.	<b>INTRODUCTION TO FUEL CELLS</b> Introduction – working and types of fuel cell – low, medium and high temperature fuel cell, liquid and methanol types, proton exchange membrane fuel cell solid oxide, hydrogen fuel cells – thermodynamics and electrochemical kinetics of fuel cells.
2.	<b>FUEL CELLS FOR AUTOMOTIVE APPLICATIONS</b> Fuel cells for automotive applications – technology advances in fuel cell vehicle systems – onboard hydrogen storage – liquid hydrogen and compressed hydrogen – metal hydrides, fuel cell control system – alkaline fuel cell – road map to market.
3.	<b>FUEL CELL COMPONENTS AND THEIR IMPACT ON PERFORMANCE</b> Fuel cell performance characteristics – current/voltage, voltage efficiency and power density, ohmic resistance, kinetic performance, mass transfer effects – membrane electrode assembly components, fuel cell stack, bi-polar plate, humidifiers and cooling plates.
4.	<b>FUELING</b> Hydrogen storage technology – pressure cylinders, liquid hydrogen, metal hydrides, carbon fibers – reformer technology – steam reforming, partial oxidation, auto thermal reforming – CO removal, fuel cell technology based on removal like bio-mass.
5.	<b>FUEL CYCLE ANALYSIS</b> Introduction to fuel cycle analysis – application to fuel cell and other competing technologies like battery powered vehicles, SI engine fueled by natural gas and hydrogen and hybrid electric vehicle.

## Lesson planning

<u>SR. NO</u>	<u>DATE/WEEK</u>	<u>UNIT NO</u>	<u>%WEIGHTAGE</u>	<u>TOPIC NO</u>
1	1 <sup>ST</sup> , 2 <sup>ND</sup> , 3 <sup>RD</sup>	Unit 1	20 % .	1
2	4 <sup>TH</sup> ,5 <sup>TH</sup> , 6 <sup>TH</sup>	Unit 2	20 %	2
3	7 <sup>TH</sup> ,8 <sup>TH</sup> , 9 <sup>TH</sup>	Unit 3	20 %	3
4	10 <sup>TH</sup> ,11 <sup>TH</sup> , 12 <sup>TH</sup>	Unit 4	20 %	4
5	13 <sup>TH</sup> ,14 <sup>TH</sup> , 15 <sup>TH</sup>	Unit 5	20 %	5

## Instructional Method & Pedagogy

- At the start of course, the course delivery pattern , prerequisite of the subject will be discussed
- Lecture may be conducted with the aid of multi-media projector, black board, OHP etc. & equal weightage should be given to all topics while teaching and conduction of all examinations.
- Attendance is compulsory in lectures and laboratory, which may carries five marks in overall evaluation.
- One/Two internal exams may be conducted and total/average/best of the same may be converted to equivalent of 30 marks as a part of internal theory evaluation.
- Assignment based on course content will be given to the student for each unit/topic and will be evaluated at regular interval. It may carry an importance of ten marks in the overall internal evaluation.
- Surprise tests/Quizzes/Seminar/Tutorial may be conducted and having share of five marks in the overall internal evaluation.
- The course includes a laboratory, where students have an opportunity to build an appreciation for the concept being taught in lectures.

## Students Learning Outcomes

- The student can identify different areas of fuel cell technology.
- Can find the applications of all the areas in day to day life.

## Recommended Demonstrate Materials

1. Fuel Cells for automotive applications – professional engineering publishing UK. ISBN 1-86058 4233, 2004.
2. Fuel Cell Technology Handbook SAE International Gregor Hoogers CRC Press ISBN 0-8493-0877-1-2003.