



GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering

Subject Code: 3160207

Alternative Fuels and Power Systems

B.E. 6th SEMESTER

Type of course: Advanced

Prerequisite: Basics of Automobile systems

Rationale: The course is designed for understanding the concepts and methods behind alternate fuel and power systems for automobile applications.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	Introduction: Concept of Petroleum fuels, Estimation of petroleum reserves, Need for alternate fuels, availability and properties of alternate fuels, A.S.T.M. standards	02
2	Biofuels: Alcohol: Sources of Methanol and Ethanol, methods of its production. Properties of methanol & ethanol as engine fuels, Use of alcohols in S.I. and C.I. engines, performance of blending methanol with gasoline. Emulsification of alcohol and diesel. Dual fuel systems. Improvement/Change in emission characteristics with respect to % blending of alcohol.	05
3	Biofuels: Bio-diesels: Base materials used for production of Bio Diesel (Karanj oil, Neem oil, Sunflower oil, Soya been oil, Mustard oil, Palm oil, Jatropha seeds, algae). Process of separation of Bio Diesel. Properties Diesel blended with vegetable oil, and difference in performance of Engine. Vegetable Oils: Various Vegetable oils for Engines – Esterification – Performance and emission characteristics. Synthetic Alternative Fuels: Di-Methyl Ether (DME), Pyrolysis gas/oil, Synthetic gas/oil from plastic, rubber, coal, wood etc., Eco Friendly Plastic fuels (EPF).	08
4	Biogas, LPG & CNG: Introduction to Biogas system, Process during gas formation, Factors affecting biogas formation. Usage of Biogas in S.I. engine & C.I. engine, Produces gas for biomass gasification, Properties of L.P.G. & C.N.G. as engine fuels, fuel metering systems, combustion characteristics, effect on performance, storage, emission, cost and safety.	09
5	Hydrogen: History, physical and chemical properties, Hydrogen storage for automobile applications (I.C. Engine, Fuel Cell), Compressed, liquid, metal hydrides, Chemical storage.	04
6	Electric, Hybrid Vehicles and Fuel Cells : Analysis of electrical drive trains, topology of electric/hybrid systems, sizing of components, electric motors for automobile applications, Electric Propulsion system, Battery Storage ,Fuel cells principle, working, Thermodynamic analysis, Types, Fuel cell application in automobiles, Electric-Fuel cell hybrid configurations.	08
7	Solar Powered Vehicles: Solar cells for energy collection. Storage batteries, layout of	04



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	solar powered automobiles, advantages and limitations.	
8	Non-conventional I.C. Engine: Introduction, Dual fuel / Multi fuel engine, stratified charge, adiabatic engine, Variable Compression Ratio engine, Free piston engine, Sterling engine, Wankel engine.	05

Suggested Specification table with Marks (Theory):

R Level	U Level	A Level	N Level	E Level	C Level
9	11	17	13	15	5

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Alternate Fuels by Dr. S. Thipse, Jaico Publications.
2. Bent Sorensen (Sorensen), Hydrogen and Fuel Cells: Emerging Technologies and Applications, Elsevier Academic Press, UK
3. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003
4. "Automotive Emission Control" by Crouse, AND Anglin – McGraw Hill
5. "Alternative Fuels Guidebook" by Bechtold R.
6. SAE Paper nos. 840367, 841333, 841334
7. "The properties and performance of modern alternative fuels" – SAE Paper No. 841210.
8. Viswanathan, B and M Aulice Scibioh, Fuel Cells – Principles and Applications, Universities Press
9. Rebecca L. and Busby, Hydrogen and Fuel Cells: A Comprehensive Guide, Penn Well Corporation, Oklahoma
10. Kordesch, K and G.Simader, Fuel Cell and Their Applications, Wiley-Vch, Germany
11. Hart, A.B and G.J.Womack, Fuel Cells: Theory and Application, Prentice Hall, NewYork Ltd., London
12. Jeremy Rifkin, The Hydrogen Economy, Penguin Group, USA
13. Mehrdad Ehsani, Yami Gao, Sebastin E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004
14. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003

Course Outcome: After learning the course the students will able to:

Sr. No.	CO statement	Marks % weightage
CO-1	Identify the need for alternate fuels and characterize prospective alternate fuels	17
CO-2	Interpret the properties and performance characteristics of liquid fuels like gasoline, alcohol, vegetable oils in both SI and CI engines.	21
CO-3	Compare the properties and performance characteristics of gaseous fuels like LPG, CNG, and Hydrogen	24
CO-4	Familiarize the electric , hybrid and solar powered vehicle	21
CO-5	Judge the scope and limitation of different alternate fuels	17



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List of Experiments

1. Flash and fire point density measurement test of Biofuel – Alcohol
2. Flash and fire point density measurement test of Biofuel – Biodiesel
3. Inspect and study different components of LPG and CNG based vehicle
4. Study of hydrogen based automobiles
5. Inspect/study Electric Hybrid Vehicles
6. Study of different topological configurations of Electric Hybrid Vehicles
7. Study of Fuel cell based vehicles.
8. Study of different Electric-Fuel cell hybrid configurations.
9. Study of solar powered vehicles.
10. Emission analysis of LPG, CNG and Biofuels based vehicle.

Major Equipment:

1. Multi / single cylinder four stroke petrol engine
2. Multi / single cylinder four stroke diesel engine
3. Exhaust gas analyzer

List of Open Source Software/learning website:

1. <http://nptel.ac.in>