

# GUJARAT TECHNOLOGICAL UNIVERSITY

## ENERGY ENGINEERING (39)

ALTERNATIVE FUELS FOR TRANSPORTATION

SUBJECT CODE: 2723913

SEMESTER: II

**Type of course:** Elective-II

**Prerequisite:** Thermodynamics

**Rationale:** The course is designed to give fundamental knowledge and relevant technologies of Alternative Fuels for Transportation

**Teaching and Examination Scheme:**

Teaching Scheme			Credits C	Examination Marks						Total Marks
L	T	P		Theory Marks		Practical Marks				
			ESE (E)	PA (M)	PA (V)		PA (I)			
					ESE	OEP	PA	RP		
3	2 <sup>#</sup>	2	5	70	30	20	10	10	10	150

**Content:**

Sr. No.	Content	Total Hrs	% Weightage
<b>Module I</b>			
1.	<b>Overview</b> Introduction, Modes of different Transportation (Land, Sea and Air), Energy Consumption Scenario and GHG emission from Transport Sector, Introduction to conventional fuels used in SI and CI engines –their availability, self ignition characteristics, Octane and Cetane Numbers	<b>07</b>	15%
2.	<b>Alternative fuels</b> Need for alternate fuels, Liquid and Gaseous Fuels, Alternative Liquid Fuels, Alcohol fuels – Ethanol, Methanol, M85, E85 and gashol, Physico-chemical characteristics, Fuel composition and properties, Fuel Induction Techniques, fumigation, combustion and emission performance in S I engine, Storage, dispensing and safety, material compatibility	<b>09</b>	20%
3.	<b>Vegetable oils and other similar fuels derived</b> Vegetable oils, properties, advantage and disadvantages, Biodiesel formulation techniques, trans-esterification, Factors affecting the process – Properties- Biodiesel blends – engine combustion, performance and emission characteristics- material compatibility , other alternative liquid fuels – benzol – acetone – diethyl ether.	<b>09</b>	20%
4.	<b>Natural Gas and LPG</b> Alternative gaseous fuels – natural gas and LPG – production – properties of natural gas and LPG – CNG conversion kits – Advantages and disadvantages of NG and LPG – comparison of gasoline and LPG – CNG and LPG fuel feed	<b>07</b>	15%

	system – LPG & CNG for CI engine – methods of fuel induction engine combustion, performance and emission characteristics.		
5.	<b>Hydrogen as Alternative Fuel</b> Hydrogen energy – properties, production, thermo- chemical methods – Hydrogen storage – Delivery – conversion – safety – Hydrogen engines, methods of usage in SI and CI engine – Hydrogen injection system – Hydrogen induction in SI engine.	<b>07</b>	
6.	<b>Biogas for I C Engines</b> Biogas – properties – Biogas for running IC engine – Biogas as vehicle fuel – biogas consumption – engine performance and emission- Biomass gasification – producer gas – consumption – dual fuel operation – engine performance and emission.	<b>07</b>	15%

### Reference Books:

1. Richard L.Bechtold, Alternate Fuels – Transportation Fuels for Today and Tomorrow, Society of Automotive Engineers (SAE) - 2002
2. John B.Haywood, Internal Combustion Engine Fundamentals, McGraw-Hill Book Company, 1988
3. Thipse.S.S., Alternative Fuels; Concepts, Technologies and Developments, Jaico Book Distributors, 2010
4. Gajendra Babu, M. K. and Subhramanian, K. A., Alternative Transportation Fuels, CRC Press, 2013
5. Arumugam S. Ramadhas, Alternative Transportation Fuels, CRC Press,2010
6. Alternate Fuels & Advanced Vehicle Technology for improved Environmental Performance By Richard Folkson.
7. Alternate Fuels for Transport – By Kerr C. Walker.
8. Alternate Fuels Guide Book- By Richard & Bechtold.
9. Alternative Fuels and Advanced Vehicle Technologies for Improved Environmental Performance edited by Richard Folkson, Woodhead Publishing

**Course Outcome:** After learning the course the students should be able:

- To get an insight into the availability of petroleum based fuels for transportation
- To understand the generation of undesirable exhaust emissions its influence on environment.
- To get exposure to the need production and technology of utilizing different alternative liquid and gaseous fuels for transportation which include alcohol, biodiesel, CNG, LPG, DME, DEE and hydrogen
- To evaluate Perform of IC engine using alternative fuels and their exhaust gas emission

### List of Experiments:

1. Testing of internal combustion engine according to Indian and International standards.
2. Study of measurement technique as per ASTM and measurement of different fuel properties.
3. Study on production of Bio-diesel using various edible and non edible oils
4. Study on emission norms for India and Europe

5. Performance and exhaust emission test on a multi / single cylinder diesel engines with different blends of a bio-diesel.
6. Performance and exhaust emission test on a multi / single cylinder petrol engines with LPG/CNG
7. Case study on HHO as substitute fuel for automobile vehicles.
8. Case study on Biogas as an alternate fuel in I C Engine

**Open Ended Problem:**

1. Evaluate prospect of alternative and renewable liquid and Gaseous fuels in environmentally sustainable transport
2. Numerical investigation on the influence of Exhaust Gas Recirculation on the emissions and performance of a SI engine fueled with gasoline and alternative fuels
3. To study about improvement in efficiency and reeducation in exhaust emission of internal combustion engines

**Major Equipments:**

1. Multi / single cylinder four stroke petrol engine
2. Multi / single cylinder four stroke diesel engine
3. Exhaust gas analyzer
4. Data Acquisition System
5. Smoke meter
6. Oil/Fuel Property Testing Equipments

**List of Open Source Software/learning website:**

[www.nptel.iitm.ac.in/courses/;](http://www.nptel.iitm.ac.in/courses/)

<http://www.catool.org/>

<http://ocw.mit.edu/>

**Review Presentation (RP):** The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester. The same list will be uploaded on GTU website during the first two weeks of the start of the semester. Every student or a group of students shall critically study 2 papers, integrate the details and make presentation in the last two weeks of the semester. The GTU marks entry portal will allow entry of marks only after uploading of the best 3 presentations. A unique id number will be generated only after uploading the presentations. Thereafter the entry of marks will be allowed. The best 3 presentations of each college will be uploaded on GTU website.