

GUJARAT TECHNOLOGICAL UNIVERSITY

AUTOMOBILE ENGINEERING (02) ALTERNATIVE FUEL AND POWER SYSTEMS SUBJECT CODE: 2160207 B.E. 6th SEMESTER

Type of course: Advanced

Prerequisite: Elements of Mechanical Engineering

Rationale: The course is designed for understanding of alternate fuel and power systems for automobile applications.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P		Theory Marks			Practical Marks			
			ESE (E)	PA	ALA	ESE	OEP	PA (I)		
3	0	2	5	70	20	10	20	10	20	150

L- Lectures; T- Tutorial/Teacher Guided Student Activity; P- Practical; C- Credit; ESE- End Semester Examination; PA- Progressive Assessment; OEP-Open Ended problem; AL-Active learning;

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	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.	4	9
2	Biofuels: Bio-diesels: Base materials used for production of Bio Diesel (Karanji oil, Neemoil, Sunflower oil, Soyabean oil, Musturd 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.	5	11
3	Biofuels: Biogas: Introduction to Biogas system, Process during gas formation, Factors affecting biogas formation. Usage of Biogas in SI engine & CI engine, Produces gas for biomass gasification.	5	11
4	LPG & CNG: Properties of LPG & CNG as engine fuels, fuel metering systems, combustion characteristics, effect on performance, storage, emission, cost and safety.	3	7

5	Hydrogen: History, physical and chemical properties, Hydrogen storage for automobile applications (I.C. Engine, Fuel Cell), Compressed, liquid, metal hydrides, Chemical storage.	5	11
6	Fuel Cells: Fuel cells principle, working, Thermodynamic analysis, Types, Fuel cell application in automobiles, Electric-Fuel cell hybrid configurations.	5	11
7	Electric & Hybrid Vehicles: Analysis of electrical drive trains, Topology of electric/hybrid systems, Sizing of components, Electric motors for automobile applications, Electric Propulsion system, Battery Storage	7	15
8	Solar Powered Vehicles: Solar cells for energy collection. Storage batteries, layout of solar powered automobiles. Advantages and limitations.	3	7
9	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.	5	11
10	Other Alternative Fuels: Di-Methyl Ether (DME), Pyrolysis gas/oil, Synthetic gas/oil from plastic, rubber, coal, wood etc., Eco Friendly Plastic fuels (EPF).	3	7

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
9	11	17	13	12	8

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 Outcomes:

1. Introduction to alternative fuels like biofuels – Alcohol , Biodiesel, Biogas
2. Understanding hydrogen gas as fuel of the future
3. Introduction to fuel cell technology for automobiles
4. Introduction of Electric and Hybrid vehicles

List of Experiments: (Any Ten)

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 based vehicle
4. Inspect and study different components of CNG based vehicle
5. Study of hydrogen based automobiles
6. Inspect/study Electric Hybrid Vehicles
7. Study of different topological configurations of Electric Hybrid Vehicles
8. Study of Fuel cell based vehicles.
9. Study of different Electric-Fuel cell hybrid configurations.
10. Study of solar powered vehicles.
11. Emission analysis of LPG based vehicle.
12. Emission analysis of CNG based vehicle.
13. Emission analysis of Biofuels based vehicle.

Design based Problems (DP) / Open Ended Problem (OEP):

1. Develop a working model of electric vehicle
2. Analysis of IC engine based on Alcohol as fuel
3. Analysis of IC engine based on Biodiesel as fuel

Major Equipments:

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

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.