



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Engineering

Level: PG

Branch: Mechanical (I.C.Engine & Automobile Engineering)

Course / Subject Code : ME01000471

Course / Subject Name : Alternate Fuels and Energy

w. e. f. Academic Year:	2024-25
Semester:	1 st Semester
Category of the Course:	PEC

Prerequisite:	None
Rationale:	The course aims to educate students on the utilization of alternate fuels in internal combustion (I.C.) engines. Students will explore the role of these fuels in combustion, engine performance, and emissions. Additionally, the course covers energy storage methods and their application in modern vehicles.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT level
1	Understand the properties and applications of conventional fuels.	2
2	Gain knowledge about alternative fuels and their applications.	4
3	Learn about the production methods of various alternative fuels.	5
4	Be familiar with electric and hybrid vehicles, including their components and recent advancements.	3

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
L	T	PR	C	Theory		Tutorial / Practical		
				ESE (E)	PA / CA (M)	PA/CA (I)	ESE (V)	
3	0	2	4	70	30	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	Conventional and Alternate Fuels: Conventional Fuels: Estimation, advantages, and disadvantages.	11	25



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	<p>Alternate Fuels: Need, availability, and comparative properties. Types of Alternate Fuels: Alcohols, LPG, Hydrogen, CNG, LNG, Vegetable oils, Biogas. Merits and Demerits: Comparative analysis of various alternate fuels.</p>		
2.	<p>Alcohol as a Fuel: Manufacture of Alcohols: Production processes. Properties as Engine Fuels: Alcohol and gasoline blends in S.I. engines. Performance Analysis: Methanol and gasoline blends, impact of compression ratio, stratified charge engines. Combustion Characteristics: Alcohol use in CI engines, ignition accelerators, diesel emulsions, dual fuel systems.</p>	10	25
3.	<p>Vegetable Oils, Biogas, and Other Fuels: Vegetable Oils: Esterification, engine performance. Biogas: Performance and emission characteristics. Other Fuels: Shale oil, coal liquid, tars—performance and emission analysis.</p>	7	15
4.	<p>Gaseous Fuels: CNG & LPG: Availability of CNG; Properties; Modification required to use in Engines; Performance and Emission characteristics of CNG, LPG in SI and CI Engines; Performance and Emission data for LPG; Hydrogen: Production methods; Storage and handling; Performance; Safety aspects.</p>	10	20
5.	<p>Electric and Hybrid Vehicles Electric Vehicles: Layout, advantages, limitations, specifications, and components. Hybrid Vehicles: Electronic control systems, high-energy batteries. Solar and Hydrogen Energy Vehicles: Latest developments and applications.</p>	7	15
Total		45	100

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
15	15	15	15	10	



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Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

1. Alternate Fuels Guide Book by Bechtold R.L., SAE
2. Solar Engineering of Thermal Processes by Duffie & Beckman, John Wiley
3. Energy: The Biomass Option by Bungay, John Wiley
4. Introduction to Wind Energy Technology by Lysen, Georgia Institute
5. Energy by Doolittle, Matrix Publications
6. Energy & Environment by Fowler, McGraw Hill
7. Solar Energy by S.P. Sukhatme, Tata McGraw Hill

(b) Open-source software and website:

Open-Source Software

1. **OpenFOAM (Computational Fluid Dynamics - CFD), Website: openfoam.org**
2. **Cantera (Chemical Kinetics and Thermodynamics) Website: cantera.org**
3. **Blender (3D Modeling for Engine and Vehicle Design) Website: blender.org**
4. **SciPy (Scientific Computing in Python) Website: scipy.org**
5. **Octave (Numerical Computation) Website: gnu.org/software/octave**

Open-Source Websites

1. **ResearchGate, Website: researchgate.net**
2. **Energy.gov (Department of Energy), Website: energy.gov**
3. **OpenEI (Open Energy Information) Website: openei.org**
4. **NREL (National Renewable Energy Laboratory), Website: nrel.gov**
5. **Sustainable Energy for All (SEforALL), Website: seforall.org**

Suggested Course Practical List: If any

1. To analyze the physical and chemical properties of conventional fuels (e.g., gasoline, diesel) and alternate fuels (e.g., ethanol, biodiesel, CNG).
2. To evaluate the performance of an engine using various alcohol-gasolines blends.
3. To investigate the use of vegetable oil as a fuel in a diesel engine.
4. To study Biogas Production and Utilization and evaluate its use in an engine.
5. To test the performance and emission characteristics of an engine using CNG and LPG as fuels.



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6. To study the storage, handling, and safety measures associated with hydrogen fuel.
7. To study the layout, specifications, and working of major components of an electric vehicle (e.g., battery, motor, control system).
8. To simulate the operation of a hybrid vehicle using software tools and analyze its energy efficiency and fuel consumption.
9. To study and design a small-scale solar-powered vehicle.
10. Study and demonstrate the use of solar panels or wind turbines to supplement energy in a hybrid or electric vehicle.

List of Laboratory/Learning Resources Required:

- Internal Combustion Engine Test Rig
- Fuel Property Testing Equipment (e.g. Viscometer, Bomb Calorimeter, Hydrometer, Flash Point Tester)
- Gas Chromatograph
- Emission Analyzer
- Electrolysis Kit
- Electric Vehicle (EV) Training Kit
- Simulation Software (Examples: MATLAB/Simulink, OpenModelica, or any relevant automotive simulation software)
- Solar Panel and Small-Scale Vehicle Model

Learning Resources

- Textbooks and Reference Books
- Online Databases and Journals
- Software for Data Analysis
- Multimedia Learning Resources
- Safety Equipment (Examples: Fire extinguishers, Safety goggles, Lab coats, Gloves, Hydrogen gas detectors)

Suggested Project List:

1. To design and develop a small-scale hybrid vehicle model that utilizes both internal combustion engine (ICE) and electric motor for propulsion.
2. To evaluate the performance and emission characteristics of a diesel engine using different biodiesel blends (e.g., B10, B20, B100).
3. To optimize the production of biogas from organic waste and assess its feasibility as a fuel for automotive engines.



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4. To design and build a small-scale electric vehicle powered by solar energy.
5. To produce hydrogen through electrolysis and use it in a fuel cell to power an electric motor.
6. To explore and evaluate different energy storage solutions (e.g., lithium-ion batteries, super capacitors) for electric vehicles.
7. To design and develop a vehicle prototype that runs on low-emission alternative fuels such as LPG, hydrogen, or biogas.

Suggested Activities for Students: If any

1. Case Study Analysis
2. Industry Visit
3. Group Discussions and Debates
4. Seminar Presentations
5. Hands-on Workshops
6. Research Paper Writing ,Poster and Model Exhibition
7. Collaborative Project with Industry
8. Participation in Competitions
9. Online Learning and Certification

These activities are designed to enrich the students' learning experience, helping them apply theoretical knowledge to practical scenarios, and develop skills that are essential for their future careers in the field of alternate fuels and energy.

Any Other:

- Guest Lectures and Expert Talks
- Interdisciplinary Collaboration
- Virtual Reality (VR) Simulations
- Participation in Hackathons

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