



SARVAJANIK UNIVERSITY
Sarvajani College of Engineering and Technology
Bachelor of Technology



Mechanical Engineering
Semester V

Course Name: Alternative Fuels and Power Systems **Course Code:** BTME19521

Type of course: Honors -Advances in Automobile Engineering

Prerequisite: Nil

Rationale of Course: This Course will enable students to understand various energy sources in context of economics, environmental impact and feasibility.

Teaching and Examination Scheme:

| Teaching Scheme | | | | Theory Marks | | | Practical Marks | | Total |
|-----------------|---|---|---|--------------|-----|-----|-----------------|-----|-------|
| L | T | P | C | TEE | CA1 | CA2 | TEP | CA3 | |
| 4 | 0 | 2 | 5 | 60 | 25 | 15 | 30 | 20 | 150 |

CA1: Continuous Assessment (assignments/projects/open book tests/closed book tests) **CA2:** Sincerity in attending classes/class tests/ timely submissions of assignments/self-learning attitude/solving advanced problems **TEE:** Term End Examination **TEP:** Term End Practical Exam (Performance and viva on practical skills learned in course) **CA3:** Regular submission of Lab work/Quality of work submitted/Active participation in lab sessions/viva on practical skills learned in the course.

Contents:

| Sr. No. | Content | Total Hrs | Module Weightage |
|---------|--|-----------|------------------|
| 1 | Introduction: Types of energy sources, their availability, need of alternative energy sources, non-conventional energy sources, Classification of alternative fuels and drive trains. Scenario of conventional auto fuels, oil reserves of the world. Fuel quality aspects related to emissions. Technological upgradation required business driving factors for alternative fuels. Implementation barriers for alternative fuels. Stakeholders of alternative fuels, Road map for alternative fuels. | 10 | 20% |
| 2 | Bio Fuel: Introduction, Raw materials used for production of Bio Diesel, Biodiesel production methods, Bio Diesel Production Equipment, Types of Transesterification process, Bio Diesel Properties Biogas production method, Biogas Plants, Factors affecting biogas formation, Engine Modification required for biogas uses in SI and CI engine | 06 | 10% |



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| | | | |
|----------|---|-----------|------------|
| 3 | Reformulated Conventional Fuels: Introduction. Production of coal water slurry, properties, as an engine fuel, emissions of CWS. RFG, Emulsified fuels. Hydrogen-enriched gasoline. Future Alternative Fuels: Production, properties, Engine performance, advantages and disadvantages of PMF, Ammonia, Liquid-Nitrogen, Boron, Compressed Air, Water as fuel for Internal combustion Engine. | 05 | 5% |
| 4 | Solar Energy: Solar energy geometry, solar radiation measurement devices. Solar energy collectors, types of collectors. Direct application of solar energy, solar energy storage system. P. V. effect solar cells and characteristics. Application of solar energy for automobiles. | 06 | 5% |
| 5 | CNG & LPG and Hydrogen: Potential of LPG, LPG production, Properties of LPG, LPG Economics, LPG Safety aspects, LPG Merits and Demerits, CNG Storage, CNG Distribution, CNG Safety, CNG Advantages, CNG challenges, Hydrogen Production, Hydrogen Storage, Hydrogen Properties, Hydrogen Economics, Hydrogen Safety, Hydrogen in Fuel cell, Hydrogen in SI and CI engines, Hydrogen Benefits, Hydrogen Barriers and challenges | 10 | 20% |
| 6 | Alternative Power Trains: Components of an EV, EV batteries, chargers, drives, transmission and power devices. Advantages and disadvantages of EVs. Hybrid electric vehicles, HEV drive train components, advantages of HV. History of dual fuel technology, Applications of DFT. Dual fuel engine operation. Advantages and disadvantages of dual fuel technology. | 10 | 20% |
| 7 | Solar Powered Vehicles: Solar cells for energy collection. Storage batteries, layout of solar powered automobiles. Advantages and limitations. | 5 | 5% |
| 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. | 8 | 15% |



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Percentage Distribution of Marks as per Bloom’s Taxonomy (Theory/Practical):

| Percentage Distribution of Marks | | | | | |
|---|----------------|----------------|----------------|----------------|----------------|
| R Level | U Level | A Level | N Level | E Level | C Level |
| 30 | 15 | 20 | 5 | 10 | 20 |

Legends: **R:** Remembrance, **U:** Understanding; **A:** Application, **N:** Analyse, **E:** Evaluate **C:** Create and above Levels

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 Text Books:

| Sr no | Title of book /article | Author(s) | Publisher and details like ISBN | Year of publication | Publication Edition |
|--------------|---|--------------------------------------|--|----------------------------|----------------------------|
| 1 | Alternative Fuel | S. S. Thipse | JAICO Publishing House | 2010 | 1 st |
| 2 | Non-Conventional Energy | G. D. Rai | Khanna Publishing | 2010 | 6 th |
| 3 | Modern Electric, Hybrid Electric and Fuel cell Vehicles | Mehrdad Ehsani, Yimin Gao, Ali emadi | CRC Press | 2018 | 3 rd |
| 4 | Electric Vehicle Technology | James Larminie, John Lowry | Wiley | 2012 | 2 nd |
| 5 | Fuel Cell and Their Applications | Kordesch, K and G.Simader | ISBN: 978-3-527-60653-5 | 2006 | - |



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Course Outcome:

| Sr. No. | CO Statement After learning this subject, students will be able to | Marks % weightage |
|-------------|--|----------------------|
| CO-1 | Compare broad comprehension of future alternative transportation fuels-alcohol, biodiesel, biogas and their production technologies. | 30 |
| CO-2 | Identify and recognize the conventional fuels and solar energy | 10 |
| CO-3 | Compare Electric, Hybrid fuel cell and solar vehicle technologies and their economic consideration | 20 |
| CO-4 | Anticipate assessment of alternative Power Trains and fuels like CNG & LPG and Hydrogen | 20 |
| CO-5 | Apply various methods for Non-conventional I.C. Engine and solar powered vehicles. | 20 |

Mapping with Program Outcomes (PO's) and Program Specific Outcomes (PSO's):

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|-------------------|-----------|----------|-----------|-----------|-----------|-----------|-----------|----------|----------|----------|-----------|-----------|
| CO-1 | 2 | 1 | 1 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 3 | 3 |
| CO-2 | 2 | 1 | 2 | 2 | 3 | 2 | 1 | 0 | 0 | 0 | 1 | 0 |
| CO-3 | 3 | 1 | 2 | 2 | 3 | 3 | 3 | 0 | 0 | 0 | 3 | 3 |
| CO-4 | 3 | 1 | 2 | 3 | 2 | 3 | 3 | 2 | 0 | 1 | 3 | 3 |
| CO-5 | 3 | 1 | 3 | 3 | 3 | 2 | 3 | 0 | 0 | 0 | 3 | 3 |
| Rationale* | 13 | 5 | 10 | 13 | 14 | 13 | 13 | 5 | 1 | 2 | 13 | 12 |



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***Rationale of CO-PO-PSO mapping*:**

This course highly maps with Program outcomes 1,3,4,5,6,7,11,12. It states that the course will develop engineering knowledge, design / development of solutions, conduct investigations of complex problems, modern tool usage, the engineer and society, environment and sustainability, project management and finance, life-long learning.

List of Practical:

1. To study various properties of Biodiesel.
2. To study different components of LPG based vehicle
3. To study different components of CNG based vehicle
4. Emission analysis of Petrol based vehicle.
5. Emission analysis of Diesel based vehicle.
6. Study of solar powered vehicles.
7. Study of Fuel cell based vehicles
8. To prepare model of electric and hybrid vehicle.

Major Equipment:

1. Multi / single cylinder four stroke petrol engine
2. Multi / single cylinder four stroke diesel engine
3. Exhaust Gas Analyser

List of Open Source Software/learning website:

1. <https://nptel.ac.in/courses/103103206>