NON-CONVENTIONAL ENERGY SOURCES

Sub Code:	**18SPHDME04**	**IA Marks :**	**50**
Hrs/ Week :		**Exam Hours :**	**2**
Credits:	**4**	**Exam Marks:**	**50**
		Total Hours:	**40**

Course Objectives:

- To introduce the concepts of solar energy, its radiation, collection, storage and application.
- To introduce the concepts and applications of Wind energy, Biomass energy, Geothermal energy and Ocean energy as alternative energy sources.
- To explore societies present needs and future energy demands.
- To examine energy sources and systems, including fossil fuels and nuclear energy, and then focus on alternate, renewable energy sources such as solar, biomass (conversions), wind power, geothermal, etc.

Course Outcomes:

At the end of the course, the student will be able to:

CO1: Describe the environmental aspects of non-conventional energy resources. In Comparison with various conventional energy systems, their prospects and limitations.

CO2: Know the need of renewable energy resources, historical and latest developments.

CO3: Describe the use of solar energy and the various components used in the energy production with respect to applications like-heating, cooling, desalination, power generation, drying, cooking etc.

CO4: Appreciate the need of Wind Energy and the various components used in energy generation and know the classifications.

CO5: Understand the concept of Biomass energy resources and their classification, types of biogas Plants applications

CO6: Compare Solar, Wind and bio energy systems, their prospects, Advantages and limitations.

CO7: Acquire the knowledge of fuel cells, wave power, tidal power and geothermal principles and applications.

Module I

Introduction: Energy source, India's production and reserves of commercial energy sources, need for non-conventional energy sources, energy alternatives, solar, thermal, photovoltaic. Water power, wind bio-mass, ocean temperature difference, tidal and waves, geothermal, tarsands and oil shale, nuclear (Brief descriptions); advantages and disadvantages, comparison (Qualitative and Quantitative).

Energy from Bio Mass : Photosynthesis, photosynthetic oxygen production, energy plantation, bio gas production from organic wastes by anaerobic fermentation, description of bio-gas plants, transportation of bio-gas, problems involved with bio-gas production, application of bio-gas, application of bio-gas in engines, advantages.

08 Hours

Module II

Solar Radiation : Extra-Terrestrial radiation, spectral distribution of extra terrestrial radiation, solar constant, solar radiation at the earth's surface, beam, diffuse and global radiation, solar radiation data.
Measurement of Solar Radiation : Pyrometer, shading ring pyrheliometer, sunshine recorder, schematic diagrams and principle of working.
Solar Radiation Geometry : Flux on a plane surface, latitude, declination angle, surface azimuth angle, hour angle, zenith angle, solar altitude angle expression for the angle between the incident beam and the normal to a plane surface (No derivation) local apparent time. Apparent motion of sum, day length, numerical examples.

08 Hours

Module III

Radiation Flux on a Tilted Surface: Beam, diffuse and reflected radiation, expression for flux on a tilted surface (no derivations) numerical examples.
Solar Thermal Conversion: Collection and storage, thermal collection devices, liquid flat plate collectors, solar air heaters concentrating collectors (cylindrical, parabolic, paraboloid) (Quantitative analysis); sensible heat storage, latent heat storage, application of solar energy water heating. Space heating and cooling, active and passive systems, power generation, refrigeration. Distillation (Qualitative analysis) solar pond, principle of working, operational problems.

08 Hours

Module IV

Photovoltaic Conversion: Description, principle of working and characteristics, applications.
Wind Energy : Properties of wind, availability of wind energy in India, wind velocity and power from wind; major problems associated with wind power, wind machines; Types of wind machines and their characteristics, horizontal and vertical axis wind mills, elementary design principles; coefficient of performance of a wind mill rotor, aerodynamic considerations of wind mill design, numerical examples.

08 Hours

Module V

Tidal Power: Tides and waves as energy suppliers and their mechanics; fundamental characteristics of tidal power, harnessing tidal energy, limitations.
Ocean Thermal Energy Conversion: Principle of working, Rankine cycle, OTEC power stations in the world, problems associated with OTEC.

08 Hours

TEXT BOOKS:

1. Non-Conventional Energy Sources by *G.D Rai K*, Khanna Publishers, 2003.
2. Solar energy, by *Subhas P Sukhatme* – Tata McGraw Hill, 2nd Edition, 1996.

REFERENCE BOOKS:

1. Renewable Energy Sources and Conversion Technology by *N.K.Bansal, Manfred Kleeman & Mechael Meliss*, Tata McGraw Hill, 2001.
2. Renewable Energy Resources, *John W.Twidell Anthony D. Weir El*, BG 2001.
3. Solar Power Engineering, *P.K.Nag*, Tata McGraw Hill, 2003.

INTERNAL COMBUSTION ENGINES

Sub Code:	**18SPHDME05**	**IA Marks :**	**50**
Hrs/ Week :		**Exam Hours :**	**2**
Credits:	**4**	**Exam Marks:**	**50**
		Total Hours:	**40**

Course Objectives:

- To understand the working cycle, Engine design and operating conditions, combustion phenomena, Engine emission and control
- Use of alternate fuels in IC engines.

Course Outcomes:

CO1: The main objective of this course is to impart knowledge in automotive engine. The detailed concept, construction and principle of operation of engine and various engine components, combustion, cooling and lubrication systems will be taught to the students.

CO2: At the end of the course the students will have command over automotive engines and the recent development in the area of engines.

Module I

Construction and Operation: Constructional details of spark ignition (SI) and compression ignition (CI) engines. Working principles. Two stroke SI and CI engines - construction and working. Comparison of SI and CI engines and four stroke and two stroke engines. Engine classification, firing order. Otto, diesel and dual cycles. Simple Numericals.

08 Hours

Module II

Fuel Systems: Air fuel ratio requirements of SI engines, Air fuel ratio and emissions, Working of a simple fixed venturi carburetor, Constant vacuum carburetor. Diesel fuel injection systems-Jerk pumps, distributor pumps, pintle and multihole nozzles, Unit injector and common rail injection systems. Injection pump calibration. Need for a governor for diesel engines. Description of a simple diesel engine governor.

08 Hours

Module III

Combustion and Combustion Chambers:

Introduction to combustion in SI and diesel engines and stages of combustion. Dependence of ignition timing on load and speed. Knock in SI and CI engines. Combustion chambers for SI and CIengines. Direct and indirect injection combustion chambers for CI engines. Importance of Swirl, squish and turbulence. Factors controlling combustion chamber design.

08 Hours

Module IV

Engine emissions and their control: Air pollution due to IC engines, emission characteristics ,Euro norms, engine emissions, Hydro carbon emissions, CO emission, NOx- Photo chemical smog, Particulates, other emissions, Smoke, emission control methods – thermal converters, catalytic converters, particulate traps, Ammonia injection systems, exhaust gas recirculation, ELCD, Crank case blow by control. IC engine Noise characteristics, types, standards and control methods, Air quality emission standards

08 Hours

Module V

Alternate fuels for I.C Engines: Vegetable oils, alcohol's, L.P.G, C.N.G, Hydrogen fuels, Bio gas ,Dual fuels, other possible fuels

08 Hours

Text Books:

1. A course in I. C. Engines – Mathur& Sharma, DhanpatRai& sons, New Delhi,1994.
2. Internal Combustion Engines Fundamentals – John B. Heywood, McGraw Hill International Edition,
3. Ganesan.V., Internal Combustion Engines, Tata McGraw Hill Publishing Co., New York,1994

Reference Books:

1. John,B., Heywood, "Internal Combustion Engine Fundamentals", McGraw Hill Publishing Co., New York, 1990.
2. Benson,R.S., Whitehouse,N.D., "Internal Combustion Engines", Pergamon Press, Oxford, 1979.
3. C.R. Fergusan, "Internal Combustion Engines: Applie d Thermo sciences", John Wiley & Sons
4. Richard stone ''Introduction to IC Engines'' Palgrave Publication 3rd edition
5. Charles Fayette Taylor '' The Internal-Combustion Engine in Theory and Practice'' MIT Press, 2nd edition

ALTERNATE FUELS FOR I C ENGINE APPLICATION

Sub Code:	**18SPHDME06**	**IA Marks :**	**50**
Hrs/ Week :		**Exam Hours :**	**2**
Credits:	**4**	**Exam Marks:**	**50**
		Total Hours:	**40**

Course Objectives:

- To understand different alternative fuels used for IC engine application.
- To study different standards used for pollution control
- To predict the performance of an engine for different alternative fuels
- To appreciate use of fuel cells for engine application

Course Outcomes:

CO1: To select suitable fuel for different types engines.
CO2: To analyse the performance of an engine for particular fuel.
CO3: Appreciate use of alternative fuels for emission reduction

Module I

Need for Alternative Fuels: Effects of constituents of Exhaust gas emission on environmental condition of earth (N_2, CO_2, CO, NO_x, SO_2, O_2) Pollution created by Exhaust gas emission in atmosphere. Greenhouse effect, Factors affecting greenhouse effect. Study of Global Carbon Budget, Carbon foot print and Carbon credit calculations. Emission norms as per Bharat Standard up to BS – IV and procedures for confirmation on production.

08 Hours

Module II

Alcohols: 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.

08 Hours

Module III

Biodiesel: Raw materials used for production of Bio Diesel (Karanji oil, Neemoil, Sunflower oil, Soyabeen oil, Musturd oil, Palm oil, Jatropha seeds). Process of separation of Bio Diesel. Properties Diesel blended with vegetable oil, Performance and emission characteristics of using biodiesel blend.

08 Hours

Module IV

Gaseous alternative fuels:

Hydrogen: Hydrogen as a substitute fuel. Study Properties, Sources and methods of Production of Hydrogen, Storage and Transportation of hydrogen. Also, the economics of Application and Advantages of hydrogen (Liquid hydrogen) as fuel for IC engine/ hydrogen car. Layout of a hydrogen car.

Biogas: Introduction to Biogas system, Process during gas formation, Factors affecting biogas formation. Usage of Biogas in SI engine & CI engine.

LPG & CNG: Properties of LPG & CNG as engine fuels, fuel metering systems, combustion characteristics, effect on performance, emission, cost and safety.

08 Hours

Module V

Fuel cell and solar powered vehicles:

Fuel cell:

Concept of fuel cells based on usage of Hydrogen and Methanol. Power rating, and performance. Heat dissipation, Layout of fuel cell vehicle. Working principle, Different types of fuel cells used for IC engine application, Advantages and limitations.

Solar cells for energy collection. Storage batteries, layout of solar powered automobiles. Advantages and limitations.

08 Hours

Text Books:

1. Gerhard Knothe, Jon Van Gerpen, Jargon Krahl, The Biodiesel Handbook, AOCS Press Champaign, Illinois 2005.
2. Richard L Bechtold P.E., Alternative Fuels Guide book, Society of Automotive Engineers, 1997 ISBN 0-76-80-0052-1.

Reference Books:

1. Transactions of SAE on Biofuels (Alcohols, vegetable oils, CNG, LPG, Hydrogen, Biogas etc.
2. Automotive Emission Control" by Crouse, AND Anglin – McGraw Hill
3. Kordesch, K and G.Simader, Fuel Cell and Their Applications, Wiley-Vch, Germany