B.E Semester: 4 Mechanical Engineering
Subject Name: Non Conventional Energy Sources (MA403-N)

A. Course Objective:

- To present a problem oriented in depth knowledge of Non Conventional Energy Sources
- To address the underlying concepts and methods behind Non Conventional Energy Sources.

B. Teaching / Examination Scheme:

Teaching Scheme				Total Credit	Evaluation Scheme					
L	T	P	Total		Theory		Mid Sem Exam	CIA	Pract.	Total
Hrs	Hrs	Hrs	Hrs		Hrs	Marks	Marks	Marks	Marks	Marks
3	0	2	5	4	3	70	30	20	30	150

C. Detailed Syllabus:

Unit No.	Details
1	**Introduction**: Man and Energy, world production and reserve of conventional energy sources, Indian production and reserves, Energy alternatives.
2	**Solar radiation & its measurement** : solar constant, spectral distribution of solar radiation, beam, diffuse and global radiation, attenuation of beam radiation, basic earth-sun angles, local solar time, derived solar angles, sunrise, sunset and day length.
3	**Solar Thermal Systems**: Liquid flat plate collectors, Construction & working, performance analysis, collector efficiency, transmissivity of a cover system, transmissivity – absorptivity product, overall loss coefficient, collector efficiency factor, heat removal factor, selective surfaces; Concentrating Collectors: Types, concentration ratio, cylindrical parabolic collector, its thermal performance, orientation and tracking requirement, materials of concentrating collectors, central receiver collector; Solar air heaters-types, solar driers, storage of solar energy-thermal storage, solar pond – non convecting & salt gradient, solar water heaters, solar heating & cooling of buildings, solar distillation, solar still, solar cooker, solar refrigeration, application of solar energy in space. **Solar Photovoltaic:** Solar Cell Fundamentals, Solar Cell Classification, Solar Cell, Module and Array construction, Solar PV systems, Design of Solar PV systems for rooftop, Street light and solar pump, Applications of solar PV panels.
4	**Wind Energy** : Introduction, principles of wind energy conversion, wind energy estimation, site election, wind energy conversion system – classification – advantages and disadvantages, wind machines – analysis of aerodynamic forces acting on the blade – performance, energy storage, application , safety and environmental aspects.
5	**Energy from Biomass** : Biomass conversion technologies, Biogas generation plants – classification – advantages and disadvantages – constructional details – site selection – digester design consideration – filling a digester for starting – maintaining biogas production and utilization of biogas and plant waste – biogas plant scope and future.

6	**Geothermal Energy**: Estimation and nature of geothermal energy, geothermal sources and resources like hydrothermal, geo pressured hot dry rock, magma. Advantages, disadvantages and application of geothermal energy, prospects of geothermal energy in India.
7	**Energy from the ocean :** Ocean Thermal Electric Conversion (OTEC) systems like open cycle, closed cycle, Hybrid cycle, prospects of OTEC in India, Basic principle of tidal power, tidal power plants, tidal Energy systems, advantages, limitation and scope of tidal energy. Wave energy and power from wave, wave energy conversion devices, advantages and disadvantages of wave energy.
8	**Miscellaneous Non-Conventional Energy Technologies**: Magneto Hydro Dynamic (MHD) Power Generation, Principle, various systems, and future prospects; Thermoelectric Power Conversion: Principle and applications.
9	**Energy Management and Audit**: Energy economics, energy conservation, energy audit, general concept of total energy system, scope of alternative energy system in India.

Total hours (Theory):48
Total hours (Practical):32
Total hours:80

D. Lesson Planning:

Sr. No.	Date/Week	Unit	Weight age	Topic No
1	1^{st} ,2^{nd} ,3^{rd}	Unit 1	20%	1,2
2	4^{th} .5^{th} ,6^{th}	Unit 2	20%	3
3	7^{th} , 8^{th} ,9^{th}	Unit 3	20%	4,5
4	10^{th} . 11^{th} . 12^{th}	Unit 4	20%	6,7
5	13^{th} , 14^{th} ,15^{th} ,16^{th}	Unit 5	20%	8,9

E. Instructional Method & Pedagogy

1	At the start of course, the course delivery pattern , prerequisite of the subject will be discussed
2	Lecture may be conducted with the aid of multi-media projector, black board, OHP etc. & equal Weight age should be given to all topics while teaching and conduction of all examinations.
3	Attendance is compulsory in lectures and laboratory, which may carries five marks in overall evaluation.
4	One/Two internal exams may be conducted and total/average/best of the same may be converted to equivalent of 30 marks as a part of internal theory evaluation.
5	Assignment based on course content will be given to the student for each unit/topic and will be evaluated at regular interval. It may carry an importance of ten marks in the overall internal evaluation.
6	Surprise tests/Quizzes/Seminar/Tutorial may be conducted and having share of five marks in the overall internal evaluation.
7	The course includes a laboratory, where students have an opportunity to build an appreciation for the concept being taught in lectures. Suggested list of experiment is given below

F. List of Practical:

1	To verify the theoretical equation for solar radiation on inclined plate surface using digital solar meter.
2	To calculate efficiency of solar PV panel at different tilt angles (β) and to find the angle at which maximum efficiency is achieved for a given location and given day of the year.
3	To explore the effect of temperature on performance of PV panel. Plot the graph showing variation in efficiency with temperature.
4	To calibrate the digital solar meter with the help of pyranometer and find the multiplying factor to compensate for the error.
5	To find the efficiency of Solar Still under different testing conditions.
6	To demonstrate working of Solar dryer for different drying application.
7	To demonstrate working of simple flat plate collector and to find its efficiency.

G. Students Learning Outcomes:

1	The student can identify different areas of Non Conventional Energy Sources
2	Students would be able to calculate the efficiency of liquid flat plate collector
3	Students would be able to design various solar PV systems like rooftop, solar street light and solar pump
4	Students would have hands on experience of solar radiation measuring devices like pyranometer, digital solar meter, etc.
5	They would see the live demonstration of various solar thermal systems like solar drier, solar still and solar flat plate collector
6	Hands-on experiments to find various performance parameters of PV panels would be done.

H. Text Books & Reference Books:

1	Non-Conventional Energy Resources by B.H. Khan; Third Edition; McGraw Hill Publication
2	Duffie J. A. & Beckman W.A., Solar engineering of thermal processes, Wiley- international Publication
3	Non- Conventional Energy Source by G. D. Rai , Khanna Pub.
4	Solar Energy by S. P. Sukhatme , Tata Mc Graw Hill
5	Non- Conventional Energy Source by Dr. G S Sawhney, PHI Learning.