# RENEWABLE ENERGY TECHNOLOGIES

**Professional Elective – I**

| Course Code | 23ME4501C | Year | III | Semester | I |
|---|---|---|---|---|---|
| Course Category | Professional Elective-I | Branch | Mechanical | Course Type | Theory |
| Credits | 3 | L-T-P | 3-0-0 | Pre-requisites | NIL |
| Continuous Internal Evaluation: | 30 | Semester End Evaluation: | 70 | Total Marks: | 100 |

| Course Outcomes | | |
|---|---|---|
| Upon successful completion of the course, the student will be able-to | | Blooms Level |
| CO1 | Describe the importance of solar radiation. | L2 |
| CO2 | Analyze the PV Module Circuit Design and storage methods in PV systems. | L3 |
| CO3 | Analyze the solar energy storage for different applications | L3 |
| CO4 | Discuss the principles of wind energy, and bio-mass energy. | L2 |
| CO5 | Summarize knowledge in geothermal energy, ocean energy and fuel cells. | L3 |

| CO-PO Mapping | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 3 | 2 | | | | 3 | 3 | | 2 | | 2 | 2 | 2 |
| CO-2 | 3 | 3 | | | | 3 | 3 | | 2 | | 2 | 3 | 3 |
| CO-3 | 3 | 3 | | | | 3 | 3 | | 2 | | 2 | 3 | 3 |
| CO-4 | 2 | 2 | | | | 3 | 3 | | 2 | | 2 | 2 | 2 |
| CO-5 | 2 | 2 | | | | 3 | 3 | | 2 | | 2 | 2 | 2 |

**SYLLABUS**

| Unit No. | Contents | Mapped CO |
|---|---|---|
| I | **SOLAR RADIATION**: Role and potential of new and renewable sources, Environmental impact of solar power, structure of the sun, the solar constant, sun-earth relationships, coordinate systems and coordinates of the sun, extraterrestrial and terrestrial solar radiation, solar radiation on tilted surface, instruments for measuring solar radiation and sun shine, solar radiation data, numerical problems. | CO1 |
| II | **SOLAR PV MODULES:**<br>PV Module Circuit Design & Structure, Interconnections, Mismatch & Temperature Effects, PV Module Parameters & Efficiency, Lifetime, Degradation & Failure, Installation and Maintenance Electrical and Mechanical Insulation, Solar PV Systems-Design of Off Grid Solar Power Plant. Installation and Maintenance.<br>**STORAGE IN PV SYSTEMS:**<br>Battery Operation & Types, Application, Selection & Basic Parameters, Battery Maintenance and Measurements, Battery Installation for PV System. | CO2 |

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|---|---|---|
| **III** | **SOLAR ENERGY COLLECTION**: Flat plate and concentrating collectors, classification of concentrating collectors, orientation.<br>**SOLAR ENERGY STORAGE AND APPLICATIONS**: Different methods, sensible, latent heat and stratified storage, solar ponds, solar applications- solar heating/cooling technique, solar distillation and drying, solar cookers, central power tower concept and solar chimney. | **CO3** |
| **IV** | **WIND ENERGY**: Sources and potentials, horizontal and vertical axis windmills, performance characteristics, betz criteria, types of winds, wind data measurement.<br>**BIO-MASS**: Principles of bio-conversion, anaerobic/aerobic digestion, types of bio-gas digesters, gas yield, utilization for cooking, bio fuels, I.C. engine operation and economic aspects. | **CO4** |
| **V** | **GEOTHERMAL ENERGY:** Origin, Applications, Types of Geothermal Resources, Relative Merits<br>**OCEAN ENERGY:** Ocean Thermal Energy; Open Cycle & Closed Cycle OTEC Plants, Environmental Impacts, Challenges<br>**FUEL CELLS:** Introduction, Applications, Classification, Different Types of Fuel Cells Such as Phosphoric Acid Fuel Cell, Alkaline Fuel Cell, PEM Fuel Cell, MC Fuel Cell. | **CO5** |

**Text Books:**

1.Solar Energy – Principles of Thermal Collection and Storage/Sukhatme S.P. and J.K.Nayak/TMH
2. Non-Conventional Energy Resources- Khan B.H/ Tata McGraw Hill, New Delhi, 2006
3. Green Manufacturing Processes and Systems - J. Paulo Davim/Springer 2013
4. Non-Conventional Energy Sources, G.D.Rai, Khanna publishers

**References:**

1. Principles of Solar Engineering - D.YogiGoswami, Frank Krieth& John F Kreider / Taylor &Francis
2. Non-Conventional Energy - Ashok V Desai /New Age International (P) Ltd
3. Renewable Energy Technologies -Ramesh & Kumar /Narosa
4. Non-conventional Energy Source- G.D Roy/Standard Publishers

**e- Resources & other digital material**

1.https://nptel.ac.in/courses/121/106/121106014/
2. https://nptel.ac.in/courses/112/105/112105050/
3. https://nptel.ac.in/courses/108/108/108108078/