## NON-CONVENTIONAL ENERGY RESOURCES

| **Course Code** | 20EE2701A | **Year** | IV | **Semester** | I |
|---|---|---|---|---|---|
| **Course Category** | OE-III | **Branch** | Common to All | **Course Type** | Theory |
| **Credits** | 3 | **L-T-P** | 3-0-0 | **Prerequisites** | 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 | |
| CO1 | **Understand** the process of energy collection, quantification, storage, conversion and applications of non-conventional sources. **(L2)** |
| CO2 | **Apply** the knowledge of energy conversion for harvesting energy from different sources like light, heat, wind etc. **(L3)** |
| CO3 | **Apply** basic laws of physics for the production of energy from Solar, wind, ocean, biomass, geothermal, fuel cell and hydrogen energy sources. **(L3)** |
| CO4 | **Analyze** the theory and designing wind mills, MHD, Fuel cells. **(L4)** |
| CO5 | **Examine** the performance of solar and wind generating units and economic aspects of MHD biomass and Ocean energy sources. **(L4)** |
| CO6 | **Ability** to apply the various energy generation techniques and to measure the **basic** parameters and **submit a report.** |

| **Contribution Contribution of Course Outcomes towards achievement of Program Outcomes&bStrength of correlations (3: High, 2: Moderate, 1: Low)** | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | | | | | | | | | | | | | | |
| CO2 | 3 | | | | | | 3 | | | | | | 2 | 1 |
| CO3 | 3 | | | | | | 3 | | | | | | 2 | 1 |
| CO4 | | 3 | | | | | | | | | | | 2 | 1 |
| CO5 | | 3 | | | | | 3 | | | | | | 2 | 1 |
| CO6 | | | | | | | | | 3 | 2 | | 3 | 2 | 1 |

| **Syllabus** | | |
|---|---|---|
| **Unit No.** | **Contents** | **Mapped CO's** |
| I | PRINCIPLES OF SOLAR RADIATION: Role and potential of new and renewable source, the solar energy option, Environmental impact of solar power, physics of the sun, the solar constant, extra-terrestrial and terrestrial solar radiation, solar radiation on titled surface.<br>Measurement of Solar Radiation: Pyrometer, shading ring pyrheliometer, sunshine recorder, schematic diagrams and principle of working. | CO1, CO2, CO3, CO6 |
| II | SOLAR ENERGY COLLECTION AND STORAGE:<br>Solar Light Energy: Photovoltaic effect, characteristics of photovoltaic cells, conversion efficiency, solar batteries and applications of photovoltaic energy conversion. | CO1, CO2 CO3, CO5, |

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|---|---|---|
| | Solar Heat Energy: Sensible, latent heat of Heat storage, solar ponds. Applications- solar heating/cooling technique, solar distillation and drying. | CO6 |
| III | **WIND ENERGY**: Sources and potentials, horizontal and vertical axis windmills, performance characteristics, Betz criteria<br>**OCEAN ENERGY:** OTEC, types of OTEC plants, mini-hydel power plants | CO1, CO2, CO3, CO4, CO5, CO6 |
| IV | **BIO-MASS:** Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters.<br>**GEOTHERMAL ENERGY:** Resources, methods of harnessing the energy. | CO1, CO3, CO5, CO6 |
| V | **MHD Generators**: Basic principles of MHD generator and Hall Effect, different types of MHD generators.<br>**Fuel Cells:** Introduction, principle of fuel cells, thermodynamic analysis of fuel cells, types of fuel cells, fuel cell batteries, applications of fuel cells. | CO1, CO3, CO4, CO6 |

| **Learning Resources** |
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| **Text Books** |
| 1. G.D. Rai, Non-Conventional Energy Sources, Khanna publishers, 5th Ed., 2014.<br>2. S. Rao and B. B.Parulekar, Energy Technology- Non conventional, Renewable and Conventional , Khanna Pub ,3rd Ed., 1999. |
| **Reference Books** |
| 1. Ashok V Desai, Non-Conventional Energy, New age publishers, 1st Ed., 1990.<br>2. B.H.Khan, Non-Conventional Energy Sources, Tata Mc Graw-hill Publishing Company, 2nd Ed., 2013.<br>3. B.T. Nijaguna, Biogas Technology, New Age International Pub, First edition 2002.<br>4. Tiwari and Ghosal, Renewable Energy resources, Narosa, 2nd Ed., 2005 |
| Web links |
| 1. https://www.coursera.org/learn/renewable-energy-technology-fundamentals<br>2. https://nptel.ac.in/courses/121106014 |