|  |  |  |
| --- | --- | --- |
| **Course Title** | **Course Structure** | **Pre-Requisite** |
| **Energy Storage and Conversion Technologies (DCC-14)**  B.Tech. (EP), 6th Sem Lesson Plan | |  |  |  | | --- | --- | --- | | **L** | **T** | **P** | | **3** | **0** | **2** | | **NIL** |

|  |
| --- |
| **Course Objectives:**  The course aims to provide a comprehensive understanding of renewable energy technologies, storage systems, and advanced energy conversion materials. |

|  |
| --- |
| **Course Outcomes (COs)**  Students will be able to   1. Create awareness among students about various non-conventional sources of energy technologies. 2. Enable students to understand various primary renewable energy technologies and engineering systems. 3. To impart the knowledge and process of solar, wind, and bio-fuel based systems and their applications  to society. 4. Equip the students with knowledge, principle and design of energy storage and conversion technologies from the autonomous renewable energy sources. 5. To impart knowledge of mechanical and thermal energy harvesting by studying various vibrations and thermal energy. |
|  |

|  |  |  |
| --- | --- | --- |
| **S. No.** | **Content** | **Contact Hours** |
| Unit 1 | **Introduction:** Overview of world energy scenario, Renewable energy resources, Sustainable Development Goals for Clean Energy (SDGS), **Solar Energy:** Solar Thermal systems: flat plate collector, concentrators, solar architecture, PTC Fundamentals of photovoltaic materials and technology, present status, Thin-film, multijunction photovoltaic cells, Materials challenges for high-efficiency solar cells. | **10** |
| Unit 2 | **Wind Energy:** Wind speed and power relation, power extracted from wind, wind distribution and wind speed measurement by anemometer, Wind power systems: system components, Types of wind turbines, wind turbine efficiencies, Betz limit. | **7** |
| Unit 3 | **Bio-Energy:** Biomass and its uses, Classification of biomass, wood composition, Characteristics of biomass, Biomass conversion processes, anaerobic digester, Gasification and combustion of biomass, Gasifiers, pyrolysis, biogas, bio-fuel, bio-diesel, ethanol production. | **7** |
| Unit 4 | **Energy storage & Conversion systems:** introduction to battery systems, rechargeable batteries: lithium - ion, Pb-acid, Ni-Metal hydride batteries, fuel cells; classification of fuel cells, AFC, SOFC, PAFC etc. their construction and working, Efficiency of fuel cells, super capacitors. | **12** |
| Unit 5 | **Advanced Energy Sources:** Electro-physical energy transformation processes. Materials challenges for piezoelectric generators and capacitors; the latest developments in new materials, Thermoelectricity: Transport of charge and heat, Thermoelectric Phenomena, Seebeck effect and power generation. | **6** |
|  | Total | **42 hrs** |

**Suggested Books:**

|  |  |  |
| --- | --- | --- |
| **S. No.** | **Name of Books/Authors/Publisher** | **Year of publication/Reprint** |
| 1. | Solar Cells by M. A. Green. | 1981/ Prentice Hall |
| 2. | Principles of Solar Engineering by D. Y. Goswami, F. Kreith and J. F. Kreider. | 2000/ Taylor & Francis |
| 3. | Fundamentals of renewable energy processes by Aldo Vieira da Rosa. | 2005/ Academic Press Elsevier) USA |
| 4. | Hand book of Energy Audits by Albert Thuman, P.E.,C.E.M. | 2003/ Fairmont Press Inc. |
| 5. | Bio fuels by David M. Mousdale | 2008/ CRC Press Taylor & Francis |
| 6. | Bio fuel Engineering by caye M. Drapcho etal. | 2008/ McGraw Hill |
| 7. | Piezoelectric Energy Harvesting by Alper Erturk, Daniel J. Inman | 2011/John Wiley & Sons |

**List of experiments for Energy Storage and Conversion Technology Lab**

1. To demonstrate the effect of shading on module output power of solar cell.
2. Workout power flow calculations of stand-alone PV system of DC/ AC load with battery.
3. Estimation of electric power from wind energy with variation in distance and height of wind turbine.
4. Forced mode of flow with fixed input and different inlet water temperature.
5. Changing tilt angle/ wind speed of the flat plate collector in both Thermosyphonic/forced mode of flow.
6. To draw the charging and discharging characteristics of battery.
7. Simulation of 1-D/2-D lithium-ion battery charging/ discharging characteristics.
8. To calculate the power generated by a piezoelectric material as a function of applied force.
9. V-I Characteristics of Low Temperature PEM Fuel Cell with Hydrogen as the Fuel.
10. To study the Seebeck effect and thermoelectric power generation by converting heat into electricity.