| Program : **Diploma in Civil Engineering** | |
|---|---|
| Course Code : **6012A** | Course Title: **Renewable Energy and Environment** |
| Semester : **6** | Credits: **4** |
| Course Category: **Program Elective** | |
| Periods per week: **4 (L:3, T:1, P:0)** | Periods per semester:**60** |

**Course Objectives:**

- Enable students to identify different available non-conventional energy sources, present and future scenario of world energy use
- Impart fundamental knowledge of Renewable Energy-(solar energy, wind energy, geo thermal and small hydro-power energy projects and its usage in different ways.
- Evaluate bio energy from various bio wastes.

**Course Prerequisites:**

| Topic | Course code | Course name | Semester |
|---|---|---|---|
| Environmental science | | Environmental science | 2 |

**Course Outcomes:**

| COn | Description | Duration (Hours) | Cognitive level |
|---|---|---|---|
| CO1 | Identify present and future energy scenario of the world. | 13 | Understanding |
| CO2 | Understand various methods of solar energy harvesting. | 15 | Understanding |
| CO3 | Identify various wind energy systems, geo-thermal, small hydro-energy systems | 15 | Understanding |
| CO4 | Evaluate appropriate methods for Bio energy generations from various Bio wastes. | 15 | Understanding |

| | | | |
|---|---|---|---|
| | Series Test | 2 | |

**CO – PO Mapping:**

| Course Outcomes | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | | | | | 3 | | |
| **CO2** | | | | | 3 | | |
| **CO3** | | | | | 3 | | |
| **CO4** | | | | | 3 | | |

3-Strongly mapped, 2-Moderately mapped, 1-Weakly mapped

**Course Outline:**

On completion of the course, the student will be able to:

| Module Outcomes | Description | Duration (Hours) | Cognitive level |
|---|---|---|---|
| **CO1** | **Understand present and future energy scenario of the world.** | | |
| M1.01 | Understand World Energy Use; Reserves of Energy Resources; Environmental Aspects of Energy utilization. | 4 | Understanding |
| M1.02 | Identify the Potentials of Renewable Energy Scenario in India and around the World | 3 | Understanding |
| M1.03 | Summarize wind energy, solar, bio, thermal, small hydro-power energy projects. | 3 | Understanding |
| M1.04 | Enlist the Achievements, Applications, Economics of renewable energy systems. | 3 | Understanding |
| **Contents:** World Energy Use; Reserves of Energy Resources; Environmental Aspects of Energy utilization; Renewable Energy Scenario in India and around the World; An overview and brief description, including fundamentals, of the different renewable energy technologies, wind, solar, bioenergy, hydro, and geothermal energy. Potentials; Achievements / Applications; Economics of renewable energy systems. | | | |
| **CO2** | **Understand various methods of solar energy harvesting.** | | |
| M2.01 | Define Solar Radiation | 3 | Understanding |
| M2.02 | Explain Photovoltaic electric conversion. | 4 | Understanding |
| M2.03 | Differentiate solar thermal and PV | 4 | Understanding |
| M2.04 | Explain the Applications of solar energy | 4 | Understanding |

| | | | |
|---|---|---|---|
| | Series Test – I | 1 | |

**Contents:**

Solar energy classification schematic diagram, applications. Strength and weakness of PV system.

Similarities and differences between solar thermal and PV. Four different PV technologies in use today. - different services that solar thermal systems can provide. Rooftop solar PV power system, cost of solar energy systems.

| **CO3** | **Identify various wind energy systems, geo-thermal, small hydro-energy systems** | | |
|---|---|---|---|
| M3.01 | Explain Wind Map of India: Wind Data and Energy Estimation | 3 | Understanding |
| M3.02 | Outline the working of Wing turbine generators | 4 | Understanding |
| M3.03 | Identify Tidal energy, Wave Energy, Small Hydro, Geothermal Energy. | 4 | Understanding |
| M3.04 | Summarize the cost of the different technologies and common barriers and issues limiting widespread use/dissemination of renewable energy | 4 | Understanding |

**Contents:**

Wind Map of India: Wind Data and Energy Estimation; Types of Wind Energy Systems; Performance; Site Selection. Details of Wind Turbine Generator; Safety and Environmental Aspects. advantages and disadvantages of wind energy technology. Key differences in the requirements for a wind pump for irrigation and a wind pump for water supply.

Other Renewable Energy Sources: Tidal energy; Wave Energy; Small Hydro and Geothermal Energy.

| **CO4** | **Evaluate appropriate methods for Bio energy generations from various Bio wastes.** | | |
|---|---|---|---|
| M4.01 | Explain the applications of Bio energy | 3 | Understanding |
| M4.02 | Outline the properties of solid, liquid and gaseous fuel for biomass power plants | 4 | Understanding |
| M4.03 | Illustrate the layout of a Bio-chemical based and Thermo-chemical based power plants. | 4 | Understanding |
| M4.04 | Illustrate the layout of Agro-chemical based power plant. | 4 | Understanding |
| | Series Test – II | 1 | |

**Contents:**

Bio-Energy: Biomass direct combustion; Biomass gasifiers; Biogas plants; Digesters; Ethanol production; Bio diesel; Cogeneration; Biomass Applications. Layout of a Bio-chemical based (e.g. biogas) power plant, Thermo-chemical based (e.g. Municipal waste) power plant.

Agro-chemical based (e.g. bio-diesel) power plant Properties of solid fuel for biomass power

plants: bagasse, wood chips, rice husk, municipal waste. Properties of liquid and gaseous fuel for biomass power plants: Jatropha, bio-diesel gobar gas.

**Text / Reference:**

| T/R | Book Title/Author |
|---|---|
| T1 | O.P. Gupta, Energy Technology, Khanna Publishing House, Delhi (ed. 2018 |
| T2 | Renewable Energy Sources, Twidell, J.W. & Weir, A., EFN Spon Ltd., UK, 2006 |
| T3 | Solar Energy, Sukhatme. S.P., Tata McGraw Hill Publishing Company Ltd., New Delhi, 1997 |
| T4 | Renewable Energy, Power for a Sustainable Future, Godfrey Boyle, Oxford University Press, U.K., 1996. |
| T5 | Fundamental of Renewable Energy Sources, GN Tiwari and MK Ghoshal, Narosa, New Delhi, 2007. |
| T6 | Renewable Energy and Environment-A Policy Analysis for India, NH Ravindranath, UK Rao, B Natarajan, P Monga, Tata McGraw Hill. |
| T7 | Energy and The Environment, RA Ristinen and J J Kraushaar, Second Edition, John Willey & Sons, New York, 2006. |
| T8 | Renewable Energy Resources, JW Twidell and AD Weir, ELBS, 2006. |

**Online Resources:**

| Sl.No | Website Link |
|---|---|
| 1 | International Energy Agency: www.iea.org |
| 2 | United Nations Development Programme - Energy: www.undp.org/energy |
| 3 | worldbank.org/energy |
| 4 | Renewable Energy Policy Network for the 21st Century: www.ren21.ne |
| 5 | Danish Wind Industry Association: www.windpower.org/en/core.htm |
| 6 | Power website, international section: www.itpower.co.uk |
| 7 | Renewable Energy Case Studies: www.martinot.info/case_studies.htm<br>Renewable Energy for rural schools, health clinics and water applicatin |