EE546: Renewable Electric Energy Systems

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| **Lecture Schedule** | | See Time Table | **Semester** | Spring 2019 | | |
| **Credit Hours** | | Three | **Pre-requisite** | Nil | | |
| **Instructor** | | Dr. Muhammad Imran | **Contact** | drimran@uet.edu.pk | | |
| Tel. (Office): 042-9902 9229 | | |
| **Office** | | Electrical Engineering Department | **Office Hours** | Monday - Thursday  12:00 pm – 0:00 pm | | |
| **Course Description** | | The main aim of our curse is to explain renewable energy resources and technologies from fundamental engineering principles. It introduces the features of renewable energy (RE) that distinguish it from other energy sources. Then it considers the significant renewable energy technologies (solar, wind, etc.), the resources available and analysis of their basic operation Than we consider aspects common to all energy resources the distribution and storage of energy, the efficient use of energy, and if time permits institutional and economic factors. | | | | |
| **Measurable Learning Outcomes** | **CLOs** | **Description** | | | **Domains & Levels** | **PLOs**  **Levels** |
| CLO1 | To learn why it is necessary to replace conventional energy with renewable energy, potential in several renewable energy resources of earth. | | | Cognitive, 3 | PLO2  High |
| CLO2 | To understand how to harness energy from different renewable energy resources. | | | Cognitive, 4 | PLO3  Medium |
| CLO3 | To learn how to design a standalone generating unit using these renewable energy resources. | | | Cognitive, 5 | PLO4  High |
| CLO4 | To learn how to integrate, distribute and store energy to have a reliable power system | | | Cognitive, 3 | PLO1  High |
|  | CLO5 | Assignments and presentations | | | Cognitive, 5 | PLO5/PLO9  High |
| **Textbook(s)** | | Renewable Energy Resources by John Twidell and Tony Weir, third edition 2015, Renewable Energy by Bent Sorensen, Third Edition, Elsevier, 2004 and Understanding Renewable Energy Systems by Volker Quaschning, Earthscan Publications, 2005. | | | | |
| **Grading Policy** | | * Assignments & Project 15% * Quizzes 15% * Midterm 30% * Final 40% | | | | |

**Lecture Plan**

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| **Weeks** | Topics | **Readings and CLOs** |
| **3\*** | **Solar Thermal and Geothermal Energy Generation**  Extra-terrestrial solar radiation, Geometry of the Earth and the Sun, Geometry of collector and the solar beam, measuring solar radiation, Site estimation of solar radiation, Solar thermal refrigeration and cooling, Water desalination, Solar salt-gradient ponds, Solar concentrators, Concentrated Solar Thermal Power (CSTP) for electricity generation  Dry rock and hot aquifer analysis, Harnessing geothermal resources, Ground-source heat pumps | **Ch. 2, 4**  **CLO1, CLO2** |
| **2\*** | **Photovoltaic (PV) power technology**  Photovoltaic circuit properties, Applications and systems, Maximizing cell efficiency (Si cells), Solar cell and module manufacture, Types and adaptations of photovoltaics, Social, economic and environmental aspects | **Ch. 5**  **CLO3** |
| **1\*** | **Hydropower,**  Principles, Assessing the resource, Impulse turbines, Reaction turbines, Hydroelectric systems, Pumped hydro storage | **Ch. 6**  **CLO3** |
| **3\*** | **Wind and Tidal-current power technology**  Turbine types and terms, Linear momentum theory, Angular momentum theory, Dynamic matching, Blade element theory, Power extraction by a turbine, Electricity generation, Mechanical power  The cause of tides, Enhancement of tides, Tidal-current/stream power, Tidal-range power, Pakistan / World tidal power sites | **Ch. 7, 8, 12**  **CLO3** |
| **3\*** | **Energy systems: integration, distribution and storage**  Energy systems, Distribution technologies, Electricity supply and networks, Comparison of technologies for energy storage, Energy storage for grid electricity, Batteries, Fuel cells, Chemicals as energy stores, Storage for heating and cooling systems, Transport systems | **Ch. 15**  **CLO4** |
| **1\*** | **Wave Power**  Wave motion, Wave energy and power, Real (irregular) sea waves: patterns and power, Energy extraction from devices, Wave power devices | **Ch. 11**  **CLO3** |
| **1\*** | **Ocean gradient energy: Ocean Thermal Energy Conversion (OTEC), osmotic power**  OTEC principles, Practical considerations about OTEC Devices, Related technologies, Osmotic power from salinity gradients | **Ch. 13**  **CLO3** |
| **2** | **Using energy efficiently, Institutional and economic factors,** Energy services, Energy end-use by sector, Energy-efficient solar buildings, Transport, Manufacturing industry, Domestic energy use, Socio-political factors, Life cycle analysis, Policy tools, Present status of renewable energy, The way ahead | **Ch. 15, 16**  **CLO4** |

**\* -** Tentative