**COURSE SYLLABUS**

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| **Subject: Introduction to Renewable Energy** | **Academic field: Energy** |
| **Lecturer: Dr. Minh HA-DUONG** |  |
| **Phone:** | **E-mail: minh.haduong@gmail.com** |
| **Academic year: 2015-2016** |  |

**COURSE DESCRIPTION**

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| **Credit points** | 3 ECTS | |
| **Level** | Undergraduate | |
| **Teaching time**  **Location** | University of Science and Technology of Hanoi | |
| **Time Commitment** | Lecture | 22 hrs |
| Exercises | 5 hrs |
| Practical | 3 hrs |
| Total | 30 hrs |
| **Prerequisites** |  | |
| **Recommended background knowledge** | Electrical engineering | |
| **Subject description:** | This is an engineering introduction to renewable energy technologies and potentials. The course aims to introduce students of the bachelor program in energy to the basic concepts of renewable energy. | |
| **Objectives & Out-come** | Identify the various sources of renewable energy  Discuss the pros and cons of various renewable energy sources  Explain the potential for renewable energy applications  Describe the world’s consumption of energy, current and projected  Identify major energy – dependent sectors of the economy  Identify the major issues of centralized and decentralized energy generation and usage  Discuss the major points of energy politics and economics  Describe the major environmental factors associated with energy production, distribution and consumption. | |
| **Assessment/ Evaluation** | Attendance/Attitude | 10 % |
| Exercise(s) | 20 % |
| Practicals | 10 % |
| Mid-term test | 20 % |
| Final exam | 40 % |
| **Prescribed Textbook(s)** | [1] Kaltschmitt, Martin, Streicher, Wolfgang, Wiese, Andreas, 2007: Renewable Energy: Technology, Economics and Environment, Springer-Verlag Berlin Heidelberg: DOI 10.1007/3-540-70949-5  [2] Vaughn C. Nelson: Introduction to Renewable energy, CRC Press, 2011.  [3] Leon Freris, David Infield: Renewable Energy in Power Systems, John Wiley & Sons, Ltd, 2008 | |

**COURSE CONTENTS & SCHEDULE**

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| --- | --- | --- | --- | --- | --- | --- |
| **Class** | **Contents** | **Hours** | | | **Ref./Resources** | **Assignment(s)** |
| **Lect.** | **Exr.** | **Prc.** |
| 1 | **Topic 1: Introduction**  Energy: basic concepts  The World Energy Scene  Types of Energy  Energy sustainability  Renewable Energy  Assessment of energy projects | 3 |  |  |  |  |
| 2 | **Topic 2: Energy from Sun**  Solar Resource  Energy Balance of the Earth  Greenhouse Effect  Solar Heating and Cooling  Passive Heating and Cooling  Active Heating and Cooling  Hybrid and Other  Drying Agricultural Products, Lumber  Solar Cookers  Water Purification | 2 | 1 |  |  |  |
| 3 | **Topic 3: Photovoltaics**  Introduction  Physics Basics  Photovoltaic Basics  Performance  Design Considerations  Applications  Concentrating Solar Power  Solar Systems | 2 |  | 1 |  |  |
| 4 | **Topic 4: Wind Energy**  Introduction  Wind Resource  Wind Turbines  Wind Farms  Small Wind Turbines  Performance | 3 | 1 | 1 |  |  |
| 5 | **Topic 5: Bioenergy**  Introduction  Conversion  Heat and Power  Biogas  Biofuels | 3 | 1 | 1 |  |  |
| 6 | **Topic 6: Geothermal Energy**  Introduction  Resource  Types of Geothermal Resources  Direct Use  Geothermal Heat Pumps  Electricity | 2 |  |  |  |  |
| 7 | **Topic 7: Hydroelectric**  Introduction  World Resource  Hydroelectric  Turbines  Water Flow  Tides  Ocean  Other | 2 | 1 |  |  |  |
| 8 | **Topic 8: Storage**  Introduction  Pumped Hydro  Compressed Air  Flywheels  Batteries  Other Storage Systems  Hydrogen | 1 |  |  |  |  |
| 9 | **Topic 9: Renewable Energy Generation in Power Systems.**  Distributed Generation.  Voltage Effects.  Thermal Limits.  Other Embedded Generation Issues.  Islanding.  Fault Ride-through.  Generator and Converter Characteristics. | 2 |  |  |  |  |
| 10 | **Topic 10: Power System Economics and the Electricity Market.**  Introduction  The Costs of Electricity Generation  Economic Optimization in Power Systems  External Costs  Effects of Embedded Generation  Support Mechanisms for Renewable Energy  Electricity Trading | 2 | 1 |  |  |  |
|  | **Total** | 22 | 5 | 3 |  |  |

*Notes:*

* *Abbreviation: Lect. (lecture), Exr. (Exercise), Prc. (Practise).*
* *Exercises may include assignment, reports, student’s presentation, homework, class exercises ...for each class sessions*
* *Practicals mostly refer to Lab- work or outside practice such as field trip.*

**Reference Literature:**

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| [1]. Anne E. Maczulak: Renewable Energy: Sources and Methods (Green Technology), 2010 |
| [2]. Michel A.Laughton: Renewable energy sources, Taylor & Francis Books, Inc. 2003 |
| [3]. Godfrey Boyle, “ Renewable Energy, Power for a sustainable future”, Oxford University  Press, 2004 |
| [4]. Martin Kaltschmitt, Wolfgang Streicher, Andreas Wiese: Renewable Energy: Technology, Economics and Environment:Springer-Verlag Berlin Heidelberg 2007 |
| [5]. Volker Quaschning: Understanding Renewable Energy Systems, Carl Hanser Verlag GmbH & Co KG, 2005 |
| [6] Kaltschmitt, Martin, Streicher, Wolfgang, Wiese, Andreas, 2007: Renewable Energy: Technology, Economics and Environment, Springer-Verlag Berlin Heidelberg: DOI 10.1007/3-540-70949-5 |