**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 energyDiscuss the pros and cons of various renewable energy sourcesExplain the potential for renewable energy applicationsDescribe the world’s consumption of energy, current and projectedIdentify major energy – dependent sectors of the economyIdentify the major issues of centralized and decentralized energy generation and usageDiscuss the major points of energy politics and economicsDescribe 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 conceptsThe World Energy SceneTypes of Energy Energy sustainability Renewable EnergyAssessment of energy projects | 3 |  |  |  |  |
| 2 | **Topic 2: Energy from Sun**Solar ResourceEnergy Balance of the EarthGreenhouse Effect Solar Heating and CoolingPassive Heating and CoolingActive Heating and CoolingHybrid and OtherDrying Agricultural Products, LumberSolar CookersWater Purification | 2 | 1 |  |  |  |
| 3 | **Topic 3: Photovoltaics**IntroductionPhysics BasicsPhotovoltaic BasicsPerformanceDesign ConsiderationsApplicationsConcentrating Solar PowerSolar Systems | 2 |  | 1 |  |  |
| 4 | **Topic 4: Wind Energy**IntroductionWind ResourceWind TurbinesWind FarmsSmall Wind TurbinesPerformance | 3 | 1 | 1 |  |  |
| 5 | **Topic 5: Bioenergy**IntroductionConversionHeat and PowerBiogasBiofuels | 3 | 1 | 1 |  |  |
| 6 | **Topic 6: Geothermal Energy**IntroductionResourceTypes of Geothermal ResourcesDirect UseGeothermal Heat PumpsElectricity | 2 |  |  |  |  |
| 7 | **Topic 7: Hydroelectric**IntroductionWorld ResourceHydroelectricTurbinesWater FlowTidesOceanOther | 2 | 1 |  |  |  |
| 8 | **Topic 8: Storage**IntroductionPumped HydroCompressed AirFlywheelsBatteriesOther Storage SystemsHydrogen | 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.** IntroductionThe Costs of Electricity GenerationEconomic Optimization in Power SystemsExternal CostsEffects of Embedded GenerationSupport Mechanisms for Renewable EnergyElectricity 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 UniversityPress, 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 |