

## DESCRIPTION OF THE COURSES

- Course code: ELR2312
- Course title: Renewable Energy Sources
- Language of the lecturer: english

<i>Course form</i>	<i>Lecture</i>	<i>Classes</i>	<i>Laboratory</i>	<i>Project</i>	<i>Seminar</i>
<i>Number of hours/week*</i>	2				1
<i>Number of hours/semester*</i>	30				15
<i>Form of the course completion</i>	<i>Credit of the lecture</i>				<i>Credit of the seminar</i>
<b>ECTS credits</b>	3(2,1)				
<b>Total Student's Workload</b>	60				30

- Level of the course (basic/advanced): advanced
- Prerequisites:
- Name, first name and degree of the lecturer/supervisor: Prof. Zbigniew Styczyński
- Names, first names and degrees of the team's members: Waldemar Dołęga, Dr.
- Year:.....I..... Semester:.....II.....
- Type of the course (obligatory/optional): obligatory
- Aims of the course (effects of the course): understanding of problems concerned with renewable energy sources
- Form of the teaching (traditional/e-learning): traditional
- Course description: The course contains the basic problems and practical aspects of renewable energy sources. After an introduction and general theoretical basis, the following problems are presented: wind energy, solar energy, biomass energy, geothermal energy and wave energy. Presentations contains: introduction, scientific principles of work, energy conversion, advantages and disadvantages, technology, applications, examples of energy projects, economics, environmental impacts and benefits. A seminar supplements the course.
- Lecture:

<i>Particular lectures contents</i>	<i>Number of hours</i>
1. Renewable energy sources – introduction, historical perspective, fundamentals, definitions, glossary, classification of renewable energy sources, the potential of renewable energy, development of renewable energy, scientific principles of renewable energy, technical implications.	2
2. Wind Energy – introduction, historical background, the potential of wind power, meteorology, energy in the wind, wind speeds and energy, measurement of wind in practise, the wind rose, wind speed calculation, analysis of wind conditions for wind turbine, wind map - Europe, wind map – Poland, translating wind power machines.	2
3. Wind Energy - the Weibull distribution, power curves of wind turbine, power calculator, annual energy output, principles of wind turbine work, turbine design, horizontal/vertical wind turbines, upwind/downwind wind turbines, optimising wind turbines, towers,	2

generators, indirect grid connection, wind power plant connection with electrical grid.	1
4. Wind Energy – environmental aspects, landscape and turbines, sound from turbines, birds and wind turbines, economics of wind energy, turbine costs, turbine installation costs, income from wind energy, tariffs, investment in wind power, economics calculator.	2
5. Wind Energy – wind energy productions systems, system design, technical aspects, small wind power plant, medium wind power plant, examples of wind farm in Poland, examples of wind farm in Germany, wind energy markets, future of wind energy.	2
6. Solar Energy – glossary, history of photovoltaic, photovoltaic fundamentals, current PV technology, principles of PV cells work, PV cells, modules and arrays, principles of PV systems work, types of PV systems, principles of PV cells made, thin-film photovoltaics.	2
7. Solar Energy – interconnecting photovoltaic systems to the utility grid, operation of photovoltaic systems in grid connected mode, photovoltaic installation, codes and standards for photovoltaic systems and equipment, current photovoltaic projects – distributed generation.	2
8. Solar Energy – solar house, solar thermal energy, solar power panels, solar electric power systems, solar electric heating systems, solar pool heating systems, solar water pumping systems, solar system design.	2
9. Hydro Energy – introduction, definitions, historical background, principles of hydropower plants work, energy conversion, hydroelectric power plant.	2
10. Hydro Energy – advantages and disadvantages of hydropower, Poland hydropower resource potential, advanced hydropower technology, hydro energy production equipment.	2
11. Hydro Energy – large hydro energy systems, small- and micro- scale hydroelectric systems, components of small hydrosystem, small and large hydro applications, environmental aspects of small hydro, environmental aspects of large hydro.	2
12. Biomass Energy – definitions, glossary, types of biomass, analysis of existing biomass, the potential of biomass, converting biomass to energy, biomass technology.	2
13. Biomass Energy – applications, examples of biomass energy projects, environmental aspects, economics, advantages and disadvantages, european biomass policy.	2
14. Geothermal Energy – introduction, technical potential in the world, earth heat, technology and resource type, technology overview – power generation, technology overview – direct use, applications, examples of geothermal projects.	1
15. Geothermal Energy – national policies, financial, economics, geothermal energy costs, environmental regulations, existing environmental criteria and guidelines, impact of geothermal developments, social risks and limitations.	2
16. Wave energy – introduction, scientific principles of work, wave energy conversion, advantages and disadvantages, technology, market barriers, environmental impacts and benefits, shoreline, nearshore and offshore devices, approaches to capturing wave energy.	

- Classes – the contents: isn't concerned
- Seminars – the contents:
  1. Analysis of technical and economical conditions for wind power plant.
  2. Analysis of wind and geographical conditions for wind power plant.
  3. Review of most popular wind turbines in Europe.
  4. Analysis of connection wind farm to electrical grid.
  5. Analysis of costs for wind power plant.
  6. Some aspects of wind farm project.
  7. Schedule of investor's procedure at build wind power plant.
  8. Photovoltaic system design.
  9. Review of current photovoltaic projects.
  10. Review of solar heating systems.
  11. Some aspects of solar house project.
  12. Analysis of large hydro energy system.
  13. Analysis of small-scale hydro energy system.
  14. Review of current biomass energy projects.
  15. Biomass case study.
  16. Analysis of costs for geothermal power project.
  17. Review of World Bank geothermal projects.
  18. Review of commercial-scale wave energy devices.
  19. Analysis of legislation for renewable energy sources.
  20. Future of renewable energy sources.
- Laboratory – the contents: isn't concerned
- Project – the contents: isn't concerned
- Basic literature:
  1. J. Twidell, T. Weir: Renewable Energy Resources, Seventh Edition, Spon Press, London, 2005.
  2. T. Burton, D. Sharpe, N. Jenkins, E. Bossanyi: Wind Energy Handbook, John Wiley and Sons Ltd. Chichester, England, 2001.
  3. Luque, S. Hegedus: Handbook of photovoltaic science and engineering, John Wiley and Sons Ltd. Chichester, England, 2003.
- Additional literature:
  1. G. Boyle: Renewable Energy – Power for a sustainable future, Second Edition, Oxford University Press Inc. New York, 2004
  2. J.F. Manwell, J.G. McGowan, A.L. Rogers: Wind Energy Explained: Theory, Design and Application, John Wiley and Sons Ltd. Chichester, England, 2002.
  3. T. Markvart: Solar electricity, Second Edition, UNESCO, John Wiley and Sons Ltd. New York, 2000.
- Conditions of the course acceptance/creditation: positive result of the test (lecture), positive estimation of the presentation (seminar)

\* - depending on a system of studies