Program:
13.04.02 Electric Power Engineering, MSc

South Ural State University
National Research University

Form of training: Full-time

RENEWABLE ENERGY

Professor: Evgeny Solomin, PhD
Department: Electric Stations, Grids and Systems of Power Supply,
Chelyabinsk, Russian Federation

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Course: Renewable Energy Sources

LEARNING Outcomes

Upon completion of the course, you are expected to gain knowledge necessary to make calculations and design distributed energy supply systems based on renewable energy generation; you will have a good understanding of how renewable energy system works, about different storage technologies and smart distribution.

Upon completion of the course, you are expected to acquire skills necessary to offer managerial and engineering solutions to the problems connected with distributed energy systems; you will be able to analyze and predict the consequences of changes in any of the components of a grid.

Upon completion of the course, you will be able to make data-driven calculations for solar plant, hydropower plant, geothermal plant operations; to operate and maintain wind turbines, to offer your own design of a wind turbine in order to improve its efficiency.

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Course: Renewable Energy Sources

The Program is intended for the students, scholars and engineers interested in renewable energy generation, storage and transfer.

	Modules
1	Introduction: Environmental impacts of renewable energy
2	Solar energy
3	Biomass energy
4	Geothermal energy
5	Hydro energy
6	Wind energy
7	Distributed power generation
8	Energy storage
9	Energy saving

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Table Of Contents

1 Introduction	Expert in Renewables – required skills Harnessing renewable energy sources since Ancient Times to the Modern Age World energy consumption Greenhouse effect, CO2 emissions, climate global change – environmental impacts of renewable energy technologies Fossil fuels reserves Advantages and disadvantages of renewable energy Global and local indicators of renewable energy Regimes and problems of renewable energy operations
2 Solar energy	Solar energy usage Global solar thermal, photovoltaic and concentrator statistics Solar thermal, photovoltaic and concentrator plant calculation and development
3 Biomass energy	Biomass energy usage Global biomass statistics Biogas plant calculation and development Ethanol plant calculation and development
4 Geothermal energy	Geothermal energy usage Global geothermal statistics Geothermal plant calculation and development
5 Hydro energy	Hydro energy usage Global hydro power statistics Hydro power turbine calculation and development Garland hydro power turbine calculation and development
6 Wind energy	Wind energy usage Global wind power statistics Theory of wind power Typology of wind turbines Advantages and disadvantages of large and small HAWT and VAWT wind turbines Methodologies of wind turbine components calculation and development Wind power special usage
7 Distributed power	Distributed power statistics
8 Energy storage	Energy storage Energy storage classifications Energy storage calculations for standalone/autonomous power plants
9 Energy saving	Energy saving classifications Calculations aimed at optimization of energy consumption in household appliances Hydrogen in energy saving

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Practice

1 Introduction	Renewable Energy Sources Student Energy Chapters
2 Solar energy	Solar Thermal Energy Photovoltaic converter
3 Biomass energy	Biomass
4 Geothermal energy	Geothermal energy
5 Hydro energy	Hydropower and hydroelectric power plants Hydropower Tidal Power Plants Hydroelectricity Power Wave (Oscillation of the waves and the wind combined)
6 Wind energy	Wind energy Design, operation and maintenance of small wind turbines Design, operation and maintenance of large wind turbines
7 Distributed power	Statistics on distributed energy generation
8 Energy storage	Energy storage calculations for autonomous power plants
9 Energy saving/energy efficiency	Energy saving Animals save the world

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Summary of laboratory classes

1	Introduction	Lab 1: Renewable sources of energy in our lives
2	Solar energy	Lab 2: Solar panels: properties and dimensions
5	Hydro energy	Lab 3: Data-driven analysis and measurement of parameters of hydraulic turbines (3 types)
6	Wind energy	Lab 4: Predicting and testing the efficiency of a wind turbine (determination of OK. efficiency of KP of turbine type on drawing)
	Hydro energy	Lab 5: Data-driven analysis and measurement of wind turbine parameters (3 types)
8	Energy saving/energy efficiency	Lab 5: Batteries (3 types)

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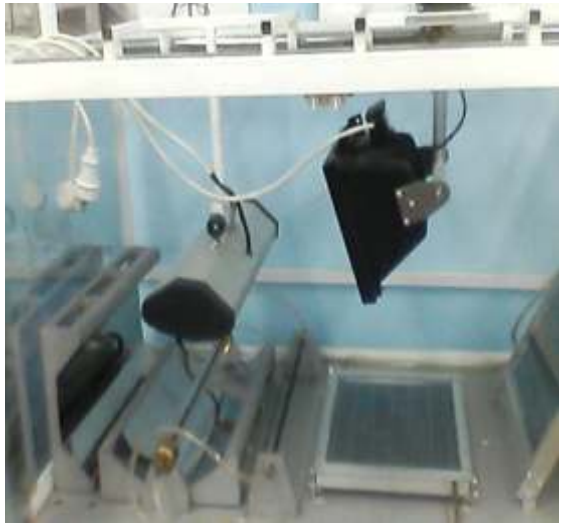
Laboratory Stands

Stand “Hydropower”

Model of Biofuel Plant



Stand “Solar energy”

Stand “Heat pump”

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Industrial Applications I

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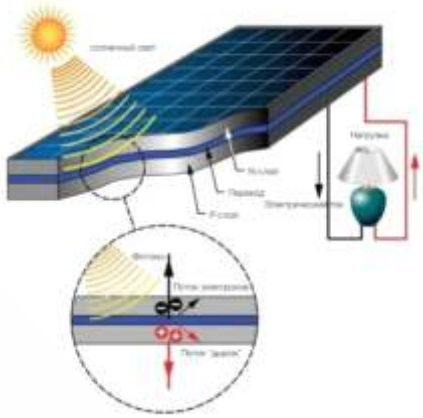
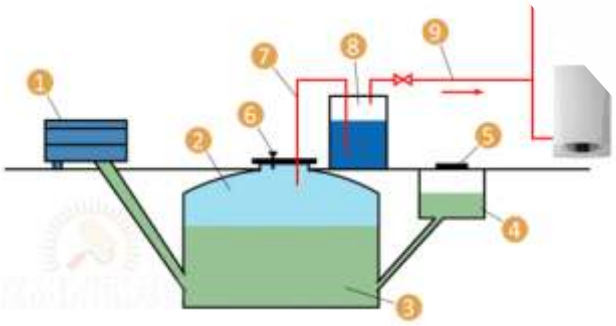
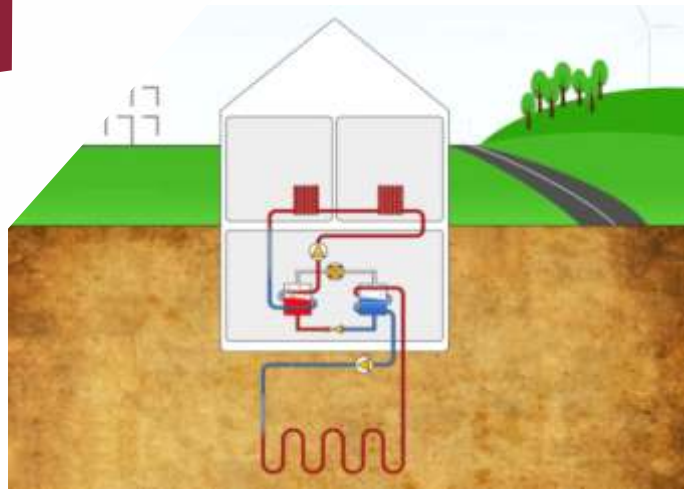
Industrial Applications II







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Industrial Applications III