Co-funded by the Erasmus+ Programme of the European Union

Engineering curricula modernization in renewable energy in Albanian Universities

ENGINE

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(Deliverable 2.2)

Updated BSc programs (at least 6 courses)

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CONTENTS

*In total for this deliverable, we have 12 new courses and 12 updated courses.

The learning outcomes and syllabi of the courses of each partner are as follows.

1.BACHELOR COURSES OF POLYTECHNIC UNIVERSITY OF TIRANA (PUT)

The courses of PUT for existing relevant bachelor in study programs Electrical Engineering-profile Power System are as follows.

1. Power distribution network and the impact of RES (New compulsory bachelor level course)
2. Smart Grid Communications and Measurement Technology (New elective bachelor level course)
3. Application of the Smart Grid Technology (New elective bachelor level course)
4. Energy Efficiency & Positive Energy building (New elective bachelor level course)
5. Data Transmission Networks (New compulsory bachelor level course)
6. Energy Management Systems (New elective bachelor level course)

The learning outcomes of the courses of PUT are described in the table below.

No	Course	Knowledge	Skills	Competences
1.	**Power distribution network and the impact of RES** New compulsory bachelor level course	Gaining knowledge on various issues and impact that distribution system has to address for RES integration in the power system. Explain pertinent issues such as voltage fluctuation, voltage rise, voltage balance, loading, relay protection, and harmonics and their effect on the system. Discussion and clarification of the islanding issues, the stability and integrity of the distribution system.	Evaluation and analyze of the issues faced with the expansion and penetration of RES into the distribution and transmission system. Calculation and verification of relay settings	Identify the important issues affecting the distribution system as a result of RES penetration and coordinate the Project for mitigation of such issues and giving the appropriate solution. Knowing what for an employee must be trained to address appropriately issues regarding the RES penetration on distribution system.
2.	**Smart Grid Communications and Measurement Technology** New elective bachelor level course	Gaining a good understanding of Communication and Measurement for Monitoring, PMU, Smart Meters, and Measurements Technologies	.Ability to simulate and, analyze through appropriate software: • Operation and control communications from Supervisory	The ability to identify and apply the most advanced solutions available to distribution and transmission utilities in order to reduce substation operating expenses by

		Explain the technical definition for Communication and Measurement. Knowing and discussing the basic equipment and standards order of selection of appropriate for Communication and Measurement in electric power system.	Control and Data Acquisition (SCADA) systems, how to collect data on substation operations; • communication between substations and control centers; • remote engineering access communications. Ability to analyze the role and function of PMU, smart meters	improving reliability and optimizing the integration of distributed energy resources Able to identify, select and apply technologies in order to ensure a more observable, controllable, automated and integrated grid Able to embed processing and digital communications on top of the analog power grid, with the resultant communications and measurements infrastructure capable of handling greater data volumes, and managing the greater data velocity. Knowing what for an employee must be trained to implement on site the appropriate for Communication and Measurement

3.	**Application of the Smart Grid Technology** New elective bachelor level course	Knowledge through Case studies and implemented Projects of the challenges for the sustainable development of Smart Grid including: electrical problems, human capacity, technology and political policies. Gaining a good understanding of the smart grid application demonstrated projects of advanced metering, micro grid with renewable energy, approach for smart grid application Knowing the basic order of projects in the Smart Grid Environment. Explain the technical definition for the Smart Grid project	Ability to design a Smart Grid Project for a selected area of distribution system Ability to calculate and simulate the load flow and voltage profile in a Smart Grid project. Ability to measure the load, current and to identify the correct switches to be used in a smart Project	Ability to introduce all benefit for a specific proposed smart grid Project that can manage direct interaction and communication among consumers, households or companies, other grid users and energy suppliers. Able to justify the necessity for an upgraded electricity network to which two-way digital communication between supplier and consumer, intelligent metering and monitoring systems have been added. Knowing what for an employee must be trained to implement on site the Smart Grid

4.	**Energy Efficiency &** **Positive Energy building** New elective bachelor level course	To introduce the concept and benefits of energy efficiency in buildings. To give an overview of the methodology used to determine the energy efficiency of buildings. To describe the different mechanisms for financing energy efficiency measures in buildings. To give a summary of legislative and policy tools that have been successful in promoting energy efficiency in buildings. Explain the technical definition for a positive energy building	Ability to appreciate the significance and benefits of energy efficiency in buildings. Ability to calculate the thermal load of a building. Ability to calculate analyze and design the basic order of magnitudes of the energy consumption reduction when insulating the facades. Ability to perform cost benefit analyzes for different insulation materials to be used in a proposed Project for Energy Efficiency	To be able to identify the different opportunities for improving the energy efficiency of buildings and the potential savings without sacrificing comfort levels. Ability to identify and apply the different mechanisms for financing energy efficiency measures. Ability to introduce and implement policies to facilitate energy efficiency in buildings in the country. Knowing what for an employee must be trained to implement on site the selected insulation material

5.	**Data Transmission Networks** New compulsory bachelor level course	Gaining the most important basic concepts about technologies and protocols used in today's networks of data transmission, with special attention to the network architecture, network layers, elements and services of modern networks with packet switching, protocols and transport.	Ability to analyze and identify the basic order of projects about data transmission networks. Ability to perform, simulation with the appropriate software for the energy management system. Ability to design the network architecture, network layers elements and packet switching.	Ability to introduce and realize the control of home energy consumption and consumer participation on energy-efficient behavior. Emerging trends in this area. Ability to propose solution and implement Projects in respect of turning the existing networks in a modern network with the integration of data transmissions, interferences with the different network layers, adaption and integration of new technologies and protocols with the existing network.
6.	**Energy Management Systems**	Gaining a basic knowledge on Energy management (EM) systems, requirements for EM systems,	Ability to perform, simulation with the appropriate software for the energy management system.	Able to introduce and expand in practice the technical definition for EM systems, applications, and frameworks.

	New elective bachelor level course	integration with home automation systems. Explain the technical definition for the data transmission networks Understanding EM systems, utilizing advanced analytics and communication technologies to provide customers with operational information and control features, while ensuring ease of use, availability, security and privacy.	Ability to evaluate and compare several EM systems	Ability to introduce realize and implement the communication technologies to provide customers with operational information and control features and to turn them into pro consumers Knowing what for an employee must be trained to implement on site EM systems.

The syllabi of the courses in Bachelor in Electric Engineering Profile Power System are as follows:

Syllabus

1. **Power distribution network and the impact of RES**

Course topic

Bachelor in Electric Engineering Profile Power System

Number of credits

5 ECTS

Co-funded by the Erasmus+ Programme of the European Union

Course responsible

Polytechnic University of Tirana

Department of Electric Power System

Rajmonda Buhaljoti

Course lecturer

Andi Hida

Prerequisites

The student must have basic knowledge in the subjects of physics, mathematics, electrotechnics and renewable energy sources.

Learning outcomes

Upon successful completion of this course students should be able to:

- Gaining knowledge on various issues and impact that distribution system has to address for RES integration in the power system.
- Explain pertinent issues such as voltage fluctuation, voltage rise, voltage balance, loading, relay protection, and harmonics and their effect on the system.
- Discussion and clarification of the islanding issues, the stability and integrity of the distribution system.
- Evaluation and analyze of the issues faced with the expansion and penetration of RES into the distribution and transmission system.
- Calculation and verification of relay settings
- Identify the important issues affecting the distribution system as a result of RES penetration and coordinate the Project for mitigation of such issues and giving the appropriate solution.

- Knowing what for an employee must be trained to address appropriately issues regarding the RES penetration on distribution system.

Abstract

The main objective of the course is to introduce students to the impact of the integration of RES (renewable energy sources) in the energy system. The course covers aspects of calculation and verification of voltage parameters, protection of relays and harmonics in the system.

Content

Introduction. Renewable energy sources.

Expected energy production from different sources. Distribution of energy produced.

Network connection. Local control of distributed generation.

Distribution system performance. Impact of renewable energy sources. Energy Quality.

Overload and losses. Radial distribution networks. Surplus in distribution networks.

Losses. Case studies. Demand control. Renewable Energy Priority.

Changes in voltage level. Voltage Control in Distribution Systems. Choosing the overvoltage limit.

Energy quality problems. Rapid voltage fluctuations. Voltage imbalance. The best distribution system.

Harmonics. Their effects on the system. Example of measurement.

Protection. Impact of distributed generation. Overcurrent protection. Calculation of currents during faults.

Teaching methods

Face-to-face classes

Laboratory practice

Assessment

The course is evaluated 80% according to the final exam and 20% according to the results of controls and assignments.

Recommended reading

Literature lists

- Tomás Gómez San Román, José Pablo Chaves-Áila, Integration of Renewable and Distributed Energy Resources in Power Systems, 2020, MDPI
- Management Association, Sustainable Infrastructure: Breakthroughs in Research and Practice, 2020, IGI Global

Syllabus

2. Smart Grid Communications and Measurement Technology

Course topic

Bachelor in Electric Engineering Profile Power System

Number of credits

5 ECTS

Course responsible

Polytechnic University of Tirana

Department of Electric Powe System

Marialis Çelo

Course lecturer

Aldi Muçka

Prerequisites

The student must have basic knowledge in the subjects of physics, mathematics and electrotechnics.

Learning outcomes

Upon successful completion of this course students should be able to:

- Gaining a good understanding of Communication and Measurement for Monitoring, PMU, Smart Meters, and Measurements Technologies
- Explain the technical definition for Communication and Measurement.
- Knowing and discussing the basic equipment and standards order of selection of appropriate for Communication and Measurement in electric power system.
- Ability to simulate and analyze through appropriate software:

Operation and control communications from Supervisory Control and Data Acquisition (SCADA) systems, how to collect data on substation operations;

Communication between substations and control centers;

Remote engineering access communications.

- Ability to analyze the role and function of PMU, smart meters
- The ability to identify and apply the most advanced solutions available to distribution and transmission utilities in order to reduce substation operating expenses by improving reliability and optimizing the integration of distributed energy resources
- Able to identify, select and apply technologies in order to ensure a more observable, controllable, automated and integrated grid
- Able to embed processing and digital communications on top of the analog power grid, with the resultant communications and measurements infrastructure capable of handling greater data volumes, and managing the greater data velocity.

- Knowing what for an employee must be trained to implement on site the appropriate for Communication and Measurement

Abstract

The objective of the course is to introduce students to the basics of Smart Grid technology and its use in renewable energy. The course covers technical aspects of metering systems and communication systems of Smart Grid technology. The course will provide knowledge on the construction and operation of intelligent energy meters (Smart meter), systems and their communication. Aautomatic Meter Reading (AMR) systems. Familiar with advanced metering infrastructures (AMI) and automated energy meter management systems. Knowledge of smart meters as well as communication and management technologies.

Content

Introduction to SMART metering systems and SMART networks

Computer intelligence its impact on the performance of the power system.

Communication protocols and standards

Overview of smart grid market manufacturers and brands

Definition of intelligent network operation based on performance and operation measures.

Typical smart grid architecture and component components functions.

Measuring devices and smart network communication

Monitoring, PMU and measurement technologies

Intelligent electricity meters (Smart meter), construction, types and functions.

Remote reading (AMR) systems of energy meters, topologies, architecture and functions.

Measurement data management (AMI) systems, topologies, architectures and functions.

GIS and google mapping systems, microgrid networks and smart grid networks.

Teaching methods

Face-to-face classes

Laboratory practice

Assessment

The course is evaluated 75% according to the final exam and 25% according to the results of controls and assignments.

Recommended reading

Literature lists

Janaka Ekanayake, Smart Grid Technology and Applications, Wiley, 2012, ISBN: 978-0-470-97409-4

Syllabus

3. Application of the Smart Grid Technology

Course topic

Bachelor in Electric Engineering Profile Power System

Number of credits

5 ECTS

Course responsible

Polytechnic University of Tirana

Department of Electric Powe System

Nike Shanku

Course lecturer

Olsi Karapici

Prerequisites

The student must have basic knowledge in the subjects of physics, mathematics and electrotechnics.

Learning outcomes

Upon successful completion of this course students should be able to:

- Knowledge through Case studies and implemented Projects of the challenges for the sustainable development of Smart Grid including: electrical problems, human capacity, technology and political policies.
- Gaining a good understanding of the smart grid application demonstrated projects of advanced metering, micro grid with renewable energy, approach for smart grid application
- Knowing the basic order of projects in the Smart Grid Environment.
- Explain the technical definition for the Smart Grid project
- Ability to design a Smart Grid Project for a selected area of distribution system
- Ability to calculate and simulate the load flow and voltage profile in a Smart Grid project.
- Ability to measure the load, current and to identify the correct switches to be used in a smart Project
- Ability to introduce all benefit for a specific proposed smart grid Project that can manage direct interaction and communication among consumers, households or companies, other grid users and energy suppliers
- Able to justify the necessity for an upgraded electricity network to which two-way digital communication between supplier and consumer, intelligent metering and monitoring systems have been added.
- Knowing what for an employee must be trained to implement on site the Smart Grid

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Abstract

The course aims to provide basic knowledge on smart grid technology in electrical systems. The main architectures of smart grid technology are provided at all levels of the power system from the consumer to power plants and power plants, to renewable sources of electricity. Components of smart networks. smart network security problems.

Content

Access to smart grids and the post-carbon economy

The constituent elements of Intelligent Networks

Intelligent Network Applications:

o Government

o Industry

o Standardization

Activation Technologies

• Communications in the Intelligent Network

• Network Architectures, Communications across Power Lines

• Network Architectures, Advanced Metering Infrastructure, Sensor Technologies.

Cyber security

• Enter false data

• Entering incorrect data

• Load modification

• Protection mechanisms

Confidentiality in Intelligent Networks

Large-scale power systems

• Applications and challenges

• Phase measurement blocks

• Defect detection and self-repair systems

Social, political and regulatory issues.

• Roadmap for the Albanian Intelligence Network

Teaching methods

Face-to-face classes

Laboratory practice

Assessment

The course is evaluated 80% according to the final exam and 20% according to the results of controls and assignments.

Recommended reading

Literature lists

• Bernd M. Buchholz, Zbigniew Styczynski, Smart Grids – Fundamentals and Technologies in Electricity Networks, 1st Edition, Vieweg+Teubner Verlag, 2014, ISBN 13: 9783642451201

• Andres Carvallo, John Cooper, The Advanced Smart Grid: Edge Power Driving Sustainability, 2nd Edition, Artech House, 2015, ISBN-13: 9781608079643.

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Syllabus

4. Energy Efficiency & Positive Energy Building

Course topic

Bachelor in Electric Engineering Profile Power System

Number of credits

5 ECTS

Course responsible

Polytechnic University of Tirana

Department of Electric Powe System

Rajmonda Buhaljoti

Course lecturer

Andi Hida

Prerequisites

The student must have basic knowledge in the subjects of physics, mathematics and electrotechnics.

Learning outcomes

Upon successful completion of this course students should be able to:

- To introduce the concept and benefits of energy efficiency in buildings.
- To give an overview of the methodology used to determine the energy efficiency of buildings.
- To describe the different mechanisms for financing energy efficiency measures in buildings.
- To give a summary of legislative and policy tools that have been successful in promoting energy efficiency in buildings.
- Explain the technical definition for a positive energy building

- Ability to appreciate the significance and benefits of energy efficiency in buildings.
- Ability to calculate the thermal load of a building.
- Ability to calculate analyze and design the basic order of magnitudes of the energy consumption reduction when insulating the facades.
- Ability to perform cost benefit analyzes for different insulation materials to be used in a proposed Project for Energy Efficiency
- To be able to identify the different opportunities for improving the energy efficiency of buildings and the potential savings without sacrificing comfort levels.
- Ability to identify and apply the different mechanisms for financing energy efficiency measures.
- Ability to introduce and implement policies to facilitate energy efficiency in buildings in the country.
- Knowing what for an employee must be trained to implement on site the selected insulation material

Abstract

The main objective of the course is to introduce students to the basics of energy efficiency in buildings, applying theory in practice. The course covers technical, legal, financial and practical aspects of energy efficiency in buildings. Importance and benefits of energy efficiency in buildings.

Content

Energy efficiency. Objectives.

Introduction to energy efficiency in buildings. Energy efficiency potential in buildings.

Design of energy efficient buildings. Energy efficient building technologies.

Key measures to improve energy efficiency. Use of renewable energy sources. Energy control and good management.

Implementing energy efficiency. Energy efficiency policies.

Setting goals and engaging stakeholders. Building codes and standards.

Energy efficient operation of the building. Measuring energy efficiency. Energy efficiency data and indicators.

Energy efficiency assessment. Numerous energy efficiency benefits.

Enabling investments in energy efficiency. Investing in energy efficiency. Enabling investment through policies. Enabling investments through project standardization.

Enabling investments through procurement. Enabling investments through financing, finance and fiscal instruments. Enabling investment through energy markets.

Teaching methods

Face-to-face classes

Laboratory practice

Assessment

The course is evaluated 80% according to the final exam and 20% according to the results of controls and assignments.

Recommended reading

Literature lists

- Eng Hwa Yap, Energy Efficient Buildings, 2017, IntechOpen

Syllabus

5. Data Transmission Networks

Course topic

Bachelor in Electric Engineering Profile Power System

Number of credits

5 ECTS

Course responsible

Polytechnic University of Tirana

Department of Electric Powe System

Nike Shanku

Course lecturer

Aldi Muçka

Prerequisites

The student must have basic knowledge in the subjects of physics, mathematics and electrotechnics.

Learning outcomes

Upon successful completion of this course students should be able to:

- Gaining the most important basic concepts about technologies and protocols used in today's networks of data transmission, with special attention to the network architecture, network layers, elements and services of modern networks with packet switching, protocols and transport.
- Ability to analyze and identify the basic order of projects about data transmission networks.
- Ability to perform, simulation with the appropriate software for the energy management system.
- Ability to design the network architecture, network layers elements and packet switching.
- Ability to introduce and realize the control of home energy consumption and consumer participation on energy-efficient behavior. Emerging trends in this area.
- Ability to propose solution and implement Projects in respect of turning the existing networks in a modern network with the integration of data transmissions, interferences with the different network layers, adaption and integration of new technologies and protocols with the existing network.

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Abstract

The course aims to provide basic knowledge on computer networks and data transmission from various devices and equipment of electrical installations and electrical networks. The aim of the course is to get acquainted with the different types and standards of data transmission networks from different devices used for supervision, control in power plants and installations and their storage and security.

Content

Introduction to communication and data transmission systems

Data communications, data networks and the Internet

TCP / IP network architecture and topologies and Ethernet-based applications.

Data transmission, concepts and terminology, Analog and digital transmission

Mobile telephony networks, working principle, first and third generation.

LANs, logins, LAN network topologies, LAN network protocols.

Wireless networks, access, technology and wireless network topologies.

Modulation and demodulation signal losses

Electric cable communications

Fiber optic communications and wireless communication systems

Data communications equipment, technology and their use in the electrical network

Communications protocols of industrial equipment

Teaching methods

Face-to-face classes

Laboratory practice

Assessment

The course is evaluated 75% according to the final exam and 25% according to the results of controls and assignments.

Recommended reading

Literature lists

- William Stallings, Data and Computer Communications, Pearson Prentice Hall 2007, ISBN: 0-13-243310-9
- Behrouz A Forouzan, Data Communications and Networking, MC GRAW HIL, 2006, ISBN: 978-0070634145

Syllabus

6. Energy Management Systems

Course topic

Bachelor in Electric Engineering Profile Power System

Number of credits

5 ECTS

Course responsible

Polytechnic University of Tirana

Department of Electric Powe System

Marialis Çelo

Course lecturer

Klajdi Kamberi

Prerequisites

The student must have basic knowledge in the subjects of physics, mathematics and electrotechnics.

Learning outcomes

Upon successful completion of this course students should be able to:

- Gaining a basic knowledge on Energy management (EM) systems, requirements for EM systems, integration with home automation systems.
- Explain the technical definition for the data transmission networks
- Understanding EM systems, utilizing advanced analytics and communication technologies to provide customers with operational information and control features, while ensuring ease of use, availability, security and privacy.
- Ability to perform, simulation with the appropriate software for the energy management system.
- Ability to evaluate and compare several EM systems. Able to introduce and expand in practice the technical definition for EM systems, applications, and frameworks.
- Ability to introduce realize and implement the communication technologies to provide customers with operational information and control features and to turn them into pro consumers
- Knowing what for an employee must be trained to implement on site EM systems.

Abstract

To give students an overview of the importance of energy and its conservation, management of energy systems, analysis and remote control of the system using communication technologies.

Content

Energy management systems (EMS), advantages, requirements and tasks of EM systems, the possibilities of their integration into the existing network.

Performance and engineering aspects of EMS operation, computer applications in power management.

Energy efficient technologies used in EMS, the role of EMS in controlling maximum demand, power factor and lighting. The energy saving potential of any technology.

Typical functions of EMS control center, system monitoring and security, minimum operating cost, minimum deviation from a specific operating point.

Power system control center: hardware structure, real-time grid computer system, SCADA performance.

Power system control center: software structure, data acquisition subsystem, real-time data diversity management, communication and interconnection system.

EMS control center: dispatcher operator activities, main characteristics of the operator activity.

A conceptual model of the activity of the dispatcher operator, requirements and trends in the activity of the dispatcher operator.

Implementation of the energy management system in the existing energy management system, features of the new system, hierarchical control concept, extended control and safety assessment.

EMS project management, implementation phases of a new control center, feasibility study, functional requirements and preliminary specifications, system development and integration, development and maintenance of EMS software.

EMS expert systems for the operation of the power system, security monitoring and control, expert system structure, possibilities and limits of expert systems, its applications.

Teaching methods

Face-to-face classes

Laboratory practice

Assessment

The course is evaluated 80% according to the final exam and 20% according to the results of controls and assignments.

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Recommended reading

Literature lists

Richard A. Panke, Energy Management Systems and Direct Digital Control, River Publishers, 2002.

Barney L. Capehart; Lynne C. Capehart; Paul J. Allen; David C. Green, Web Based Energy Information and Control Systems: Case Studies and Applications, River Publishers, 2005.

E. Handschin . A. Petroianu, Energy Management Systems , Springer, 1991.

Marvin T. Howell, Energy Centered Management: A Guide to Reducing Energy Consumption and Cost, River Publishers, 2015.

Klaus-Dieter E. Pawlik, Solutions Manual for Guide to Energy Management, River Publishers, 2016.

2.BACHELOR COURSES OF 'ALEKSANDER MOISIU' UNIVERSITY OF DURRES (UAMD)

The six courses of UAMD are as follows:

1. Wireless Systems
2. Renewable Energy Technologies
3. Alternative energy plants
4. Renewable Energy Sources
5. Basics of Energy Efficiency ("Construction Management" study program)
6. Basics of Energy Efficiency ("Air Conditioning Systems Specialist" study program)

The learning outcomes of the courses of UAMD are described in the following Table.

Course	Knowledge	Skills	Competences
Wireless Systems Updated elective professional level course, which takes place in the "Computer networking specialist"	At the end of the course, students will: • understand the technical functioning and principles of various techniques; equipment of Wireless systems and its implementation terrain. • discuss on strong and weak points of types of	At the end of the course, students will: • design a Small Wireless network • follow thoroughly the	At the end of the course, students will: • show, autonomy and initiative to the implementation of new methods and planning rules through rolling out the network ensuring proper coverage in compliance with requested Grade of Service.

professional study program/ **(6 ETCS)**	coverage to be implemented. • explain the compliance of each antenna in better solving the problems mention for coverage. • classify under given constrain of distance and radiation the site selections. • list a number of antennas that can be suitable to be used in the realization of the requested coverage.	constructing phases; • test all the KPIs requested for the network. On the other side students can: • work with different types of antennas in compliance with the terrain diversity • handle any problem related to quality especially of Call drop rate, level of coverage etc. • evaluate and test all the other parameters requested for	• manage a variety of traffic handling, coverage situations and projects in using most recent equipment and the ways of coverage for different terrains.

		the proper coverage.	
Renewable Energy Technologies New elective course, which takes place in the "Information Technology" bachelor study program/ **(6 ETCS)**	At the end of the course, students will: • understand the technical functioning and principles of various techniques of renewable energy, and how these technologies interact in larger systems. • discuss on strong and weak points of each power source • explain the compliance of each source in better solving the problems mention in the working order • classify under given constraints the utilization and conversion of one or more renewable energy resources. • know power sources according to the technical benefits based on resource availability, energy demand and market conditions.	At the end of the course, students will: • be able to design a low power solar. • construct it thoroughly. • test all the parameters requested for the proper functioning. On the other side the students can • work with other types of row material such as biomass, etc., that produce power and compare the efficiency between them. • deal with its proper	At the end of the course, students will: • demonstrate innovation, autonomy, scholarly to the development of new modelling and design rules at the forefront of work or study contexts including research in using solar energy for small telecommunication sites such as repeaters, external alarms boxes or micro antennas and in using wind energy in macro telecommunication sites. • manage complex technical and professional activities and projects in using new materials for supplying power to small consumers (equipment) belonging to industrial and house holders.

		maintenance ensuring the output quality • solve problems related to quality requested in order to ensure reliable working mode.	
Alternative energy plants Updated elective professional level course, which takes place in the "Mechanic of agricultural industrial plants" professional study program/ **(6 ETCS)**	At the end of the course, students should: - understand and use for problem solving the main concepts of electric power calculations for one and tree phase systems: complex power, power factor, power triangle, power quality and harmonic distortion. - understand the main concepts of heat engine and Carnot efficiency. - calculate the efficiency of a fossil fuel steam cycle power plant and its pollution parameters.	At the end of the course, students will be able to: - evaluate and compare small scale renewable energy projects using major economic measures of pay-back period, simple rate of return, net present value, internal rate of return. - calculate wind turbine	At the end of the course, students will: - demonstrate the ability to use critical thinking and problem-solving skills, how and when to apply renewable energy solutions - manage the problems and obstacles associated with implementation of renewable energy systems - demonstrate the understanding and familiarity with engineering and financial aspects of projects - demonstrate the understanding and familiarity

	-understand different types of steam cycle plants (base load and others) and calculate the optimal mix of combined cycle plants for a given load duration distribution - understand the concept of distributed generation and know its main types. - understand principle of work of micro-combustion turbines and Stirling engines. - understand the concept of fuel cells. Calculate efficiency, fuel consumption and electric parameters of a simple fuel cell - understand the concept of micro hydro-electric systems. Calculate efficiency, and parameters of a micro hydro system. Design a consumer micro hydro installation for a given site and performance parameters	performance parameters (efficiency, energy produced, capacity factor) for a turbine with given power curve and for a given location with given wind speed distribution function -Calculate the major parameters of sun movement, solar radiation, and tracking systems. -Design the parameters of a consumer scale stand alone and grid connected photovoltaic system for a given site location and	with the regulatory aspects of renewable energy projects

	- understand major concepts of wind energy. - calculate air parameters at different conditions, impact of installation height, wind power and average wind power • know the operation and comparative analysis of different concentrating solar power systems - understand concepts of nuclear power systems. - understand concepts of geothermal and marine power systems.	performance specification.	
Renewable Energy Sources Updated <u>compulsory professional</u> level course, which takes place in "Electrical Technical"	At the end of the course, students should: - understand the principles of operation of the broad spectrum of renewable energy sources; - explain basic characteristics of renewable energy supply (solar radiation,	At the end of the course, students will be able to: - work with different devices and to apply basic methods for	At the end of the course, students will: - manage the technical and professional activities for the renewable energy technologies; - demonstrate the technical challenges for each of the renewable sources;

professional study program/ **(6 ETCS)**	wind energy, geothermal, etc.) and principles of related technical systems (photovoltaic, wind, hydroelectric power generation, etc.). - discuss economic, technical, and sustainability issues involved in the integration of renewable energy systems. - explain the impact on the environment from the use of different sources of renewable energy	producing of different energy sources - solve problems related to renewable energy applications	- manage the use of renewable technologies for electricity generation in buildings as well as in public and private institutions.
Basics of energy efficiency Updated <u>compulsory professional</u> level course, which takes place in the "Construction Management" professional study program/ **(8 ETCS)**	At the end of the course, students should: - understand the application of dynamic simulation software for design of energy supply and climate systems, and for evaluation of indoor environment and energy efficiency - discuss system solutions for renewable energy production and heat storage	At the end of the course, students will be able to: -test the thermal load of a building and air durability; - define the right way to reduce energy consumption	- At the end of the course, students will: - manage the right materials and methods that realize a building with minimal energy consumption. - demonstrate the knowledge and the skills for analyzing, selecting and designing solutions for renewable energy supply, heat storage, technical installations for air

	- discuss system solutions for ventilation and tempering of rooms - system solutions for domestic hot water supply, sewerage and preparation of domestic hot water - classify methods for sizing of ventilation, heating and cooling - understand principles of natural ventilation - classify methods for sizing of central heating systems - understand functional principles of components of air conditioning plants; filters, dampers, fans, ducts, pumps, valves, pipes, heat exchangers and control components - discuss solutions for monitoring and control of air conditioning plants	through facade insulation. - test the required capacity for renewable energy supply and heat storage - test the required capacity for technical installations for ventilation, heating, cooling and domestic hot water - design system solutions for renewable energy supply, heat storage, ventilation, tempering of rooms, domestic water supply, sewerage and the preparation	conditioning, and the domestic water systems in buildings based on requirements for indoor environment and energy efficiency.

		of domestic hot water - work with dynamic simulation programs for dimensioning of energy supply and air conditioning systems, and evaluation of indoor climate and energy efficiency - work independently and in interdisciplinary groups	
Basics of Energy Efficiency Updated <u>compulsory professional</u> level course, which takes place in "Air Conditioning	At the end of the course, students should: - understand the performance and energy efficiency in systems installed in buildings and transport, greater usage of energy efficient technologies	At the end of the course, students will be able to: - test the reduced energy consumed in the case of insulated buildings or	At the end of the course, students will: - manage the energy efficient systems - demonstrate the energy efficiency /conservation methods available for energy use reduction in residential and commercial settings.

Systems Specialist" professional study program/ **(8 ETCS)**	- understand basic areas of energy efficiency and conservation methods. - explain the proper usage of the equipment necessary to gather energy efficiency data. - explain the energy conservation measures pertaining to HVAC systems, building equipment, building envelope, sustainable building design and electrical systems. - explain the math and science principles used to design, develop, test, and supervise production/construction energy efficiency and conservation methods. - classify the various types of energy suppliers and methods of fuel acquisition. - understand basic engineering principles and physical laws that they will use in their education and/or profession.	from the use of other energy efficient methods - test conservation methods used to reduce energy consumption in the built environment. - work with residential and commercial objects for implementing energy savings measures. - work with of energy monitoring and measuring equipment used for energy auditing. - solve problems with energy savings	- demonstrate energy savings and environmental impacts for most energy efficiency methods - demonstrate the appropriate usage of energy monitoring and measuring equipment commonly used by energy specialists and energy auditors - use, maintain and serve the energy efficient systems

		and determining environmental impacts of these energy saving methods	

The syllabi of the courses are as follows:

Syllabus

1. "Wireless Systems"

Course topic:

Fundamental of wireless communication, models of systems wireless systems and networks

Duration:

45 learning hours

Participants of the course:

The course is recommended for students of professional study program "Computer networking specialist", who are interested in gaining an overview of wireless systems.

Educational background:

High school

Co-funded by the Erasmus+ Programme of the European Union

Course responsible:

Aleksander Moisiu University - Durrës

Information Technology Department

Dr. Fatmira Prodani

Course lecturers:

Dr. Frida Gjermen

Educational prerequisites

Fundamental knowledge in Energy Sources

Learning outcomes

Upon successful completion of this course students should be able to:

Knowledge

- Understand the purpose and principles of Wireless systems and its implementation terrain.
- Explain the compliance of each source in better solving the problems mention in the working order;

Skills

- Design a small Wireless network
- Follow all the constructing phases;
- Use different types of antennas in complience with the terrain diversity
- Evaluate and test all the parameters requested for the proper coverage;

Competence

- Demonstrate innovation, autonomy, scholarly to the development of new

modelling and design rules through performing proper network coverage in compliance with requested Grade of Service.

Abstract

This course presents the fundaments of Wireless systems, network roll-out and maintenance. Planning and implementation of a small network using different types of antennas according to the terrain. Latest development in Wireless technology will be explained in details as well.

Content

I. Part one:

- Wireless Communication: Introduction, Types and Applications. *
- Modern Wireless Comunication Systems: 2G cellular networks, 3G, wireless local area networks (WLANs), Bluetooth and personal area networks (PANs).
- Radio and propagation model with path-loss. Multipath channel characteristics.
- Basic features of mobile communication. Cellular coverage, interference between channels. Use of codes.
- Signal processing and adaptation for communication, interference avoidance techniques, and detection of multiple users.
- Client-server model in mobile systems. Peer-to-peer and Ad-Hoc model in mobile systems Addressing and routing in Ad-Hoc mobile networks
- Practical planning of a mobile system. Code planning. Intermediate Exam

II. Part two:

- Multiple Access Modes: FDMA, TDMA, CDM, SDMA and OFDM.
- Milticarrier Access Mode: CDMA (MC-CDMA). Metodat e aksesit te rastësishëm.
- End-to-end performance on wireless mobile systems.

- Other wireless systems: IEEE 802.11 WLAN (WI-FI) si dhe WI-MAX.
- Wireless Area Networs(WANs). Other wireless technology: GSM, UMTS, CDMA-2000.
- LTE (Long Term Evolution). MIMO Channels. Space-time coding.
- Prepare a course assignment in wireless network planning using the method of directional antennas. Code planning.
- Presentation of the course assignment using. Final Exam

Teaching methods

Consists of presentation in the class, practical and video demonstration. In case of on-line video of demonstration of some process, video of equipment in clean room etc. will be used.

Assessment

The course grade consists of these components:

40% – Intermediate exam

50% – Final exam

10% - Duty course

Recommended reading

- Wireless communications, Andrea Goldsmith, Stanford University
- Wireless Communications Systems Design, Haesik Kim
- Wireless Communications and networking , Williant Stallings
- Mobile Wireless Communications. Mischa Schwartz. Paperback (2013) ISBN: 9781107412712. Cambridge University Press.

Co-funded by the
Erasmus+ Programme
of the European Union

Syllabus

2. "Renewable Energy Technology"

Course topic:

Use of Renewable Energy Sources in the existing technologies

Duration:

45 learning hours

Participants of the course:

The course is recommended for students not majoring in the field, who are interested in gaining an overview of renewable energy systems. Bachelor degree students in Information technology or Information Systems, and others.

Educational background:

High school

Course responsible:

Alexander Moisiu University - Durrës

Information Technology Department

Dr. Fatmira Prodani

Course lecturers:

Dr. Nikollaq Terezi

Educational prerequisites

Fundamental knowledge in Energy Sources

Learning outcomes

Upon successful completion of this course students should be able to:

Knowledge

- Understand the technical functioning and principles of various techniques of renewable energy
- Explain the compliance of each source in better solving the problems mention in the working order;

Skills

- Design a low power solar cell plant
- Construct it thoroughly and;
- Test all the parameters requested for the propoer functioning;

Competence

- Demonstrate innovation, autonomy, scholarly to the development of new

modelling and design rules through performing the design of power solar cell plant.

Abstract

Building on the historical development of energy sources, this course offers an insight into renewable energy sources, and the existing technologies to use them. It also looks to present the framework of renewable energy technology, as well as social and ecological aspects from a global point of view.

Content

III. Part one:

1. Fundamentals (historical overview, power plant fundamentals, climate, energy consumptions and forecasts, energy economics, electricity control, fossil and nuclear energy)

2. Energy from Biomass (properties of biomass, biomass potentials, fuel properties, heat production, power production by means of combustion, power production by means of gasification, biogas production by means of anaerobic fermentation)

3. Geothermal Energy (potential, exploitation, direct utilization, central heating, district heating, deep geothermal systems, power generation, combined heat and power, economic aspects, risks)

4. Hydropower (hydrodynamics of water power, pumped storage power plants, examples of power plants and turbines, ocean current turbines)

IV. Part two:

1. Solar Thermal Energy (basics, collectors and concentrators, thermodynamic cycles, heat transfer fluids)

2. Photovoltaics (solar radiation, introduction to solar cells, technology of solar cells, application of solar cells)

3. Wind Energy (basic facts, introduction to wind turbine aerodynamics, the wind resource, wind turbine types, configurations, components)

Teaching methods

Consists of presentation in the class, practical and video demonstration. In case of on-line video of demonstration of some process, video of equipment in clean room etc. will be used.

Assessment

The course grade consists of these components:

40% – Intermediate exam

50% – Final exam

10% - Duty course

Recommended reading

- Chen, G.; Andries, J.; Spliethoff, H.; Fang, M.; van de Enden, P. J.: Biomass gasification integrated with pyrolysis in a circualting fluidised bed. Solar Energy 76 (1-3), 2004, 345--349

- Wilhelm, S.; Fendt, S.; Spliethoff, H.: CFD Modeling of Biomass Entrained Flow Gasification: Influence of the Devolatilization Model on the Overall Gasification Process. European Biomass Conference & Exhibition, 2021

- Kahlert, S.; Spliethoff, H.: Investigation of Different Operation Strategies to Provide Balance Energy With an Industrial Combined Heat and Power Plant Using Dynamic Simulation. Journal of Engineering for Gas Turbines and Power 139 (1), 2016,

- Irl, M.; Lambert, J.; Wieland, C.; Spliethoff, H.: Development of an Operational Planning Tool for Geothermal Plants With Heat and Power Production. Journal of Energy Resources Technology 142 (9), 2020

- Ostermeier, P.; Vandersickel, A.; Spliethoff, H.: Thermochemische Energiespeicher für Industrie und Kraftwerke. Book: Fachkongress SolarChemieR, 2019

- Buttler, A.; Dinkel, F.; Franz, S.; Spliethoff, H.: Variability of wind and solar power – An assessment of the current situation in the European Union based on the year 2014. Energy 106, 2016, 147-161

- Vandersickel, A.: Advanced thermal storages - towards higher energy densities, long term storage and broader operating ranges. shc solar update newsletter 68, 2018, 12-14

Syllabus

3. "Renewable Energy Sources"

Course topic

Renewable energy technologies

Duration:

60 learning hours

Participants of the course:

Electrical technical students (2-year professional program)

Educational background:

High school

Course responsible

Aleksander Moisiu University, Durres

Professional Studies Faculty,

Department of Marine and Engineering Sciences,

Dr. Alma Golgota

Course lecturer / tutor

Msc. Stela Sefa

Educational Prerequisites

General knowledge in the field of energy

Learning outcomes

Upon successful completion of this course students should be able to:

Knowledge:

- to understand the principles of operation of the broad spectrum of renewable energy technologies;
- to explain basic aspects of renewable energy supply presenting fundamental characteristics of the resource base (solar radiation, wind energy, geothermal, etc.) and principles of related technical systems (photovoltaic, wind, hydroelectric power generation, etc.).

- discuss economic, technical, and sustainability issues involved in the integration of renewable energy systems.
- explain the impact on the environment from the use of different sources of renewable energy

Skills:

- to solve problems related to renewable energy applications
- to work with different devices and applying basic methodology for evaluating the use of different energy sources

Competence:

- manage the technical and professional activities for the renewable energy technologies;
- to demonstrate the technical challenges for each of the renewable sources;
- to manage the use of renewable technologies for electricity generation in buildings as well as in public and private institutions.

Abstract

The actual energy resources and requests of the world will be surveyed and renewable energy scenarios that are technologically feasible and economically viable for the future will be investigated. Students will evaluate the practical possibilities and limitations of renewable energies and compare it with conventional carbon-based energy systems. The training course will give the students a full understanding of the basic concepts of energy, mechanical work and Heat and the science underpinning RES.

Content

1. Introduction

Global resources, Resources and requests of energy in the world; future renewable energy scenarios. Hydrocarbon stocks. Carbon footprint and taxes. Energy usage monitoring and recovery. Electricity

generation: cost per unit: nuclear, oil, hydro, biomass etc. Nett benefit analysis: production cost versus energy benefit. Insulation. Efficient use of electricity - CFL bulbs, LEDs etc.

2. Wind Power

Turbine design: single phase versus three phase. Connecting to the national grid. Wind maps. Noise considerations, efficiency and load consideration. Battery storage.

3. Ocean Power

Physics of waves. Wave maps. Generation capacity. Material specification and turbine design. Operating environment. Safety and maintenance.

4. Solar Power

Physics of solar energy. Solar water heating, principles and technologies of photovoltaic cells (PV) and solar-thermal generation of electricity. Thermal panels versus evacuated tube. Science of PV technologies (silicon, thin film, organic, III-V, CPV, etc)

5. Geothermal

Principle of operation and design considerations. Heat pumps and heat transfer, horizontal versus vertical geometry. Performance specifications.

6. Bio-fuels

Varieties of bio-fuels. Calorific values of grasses, wood chip. etc.

7. RES modelling

Overview of approaches to RES modelling, modelling principles, sample data sets (e.g. JRC solar irradiance), example modelling tools: PVGIS, RET Screen, etc

Teaching methods

The theoretical part of the course is presented in the classroom with power point presentation

The practical work of the course is represented with exercises and demonstrations.

Assessment

The course grade consists of these components:

40% – Intermediate exam

50% – Final exam

10% - Duty course

Recommended reading

1. Ahmad Azar, Nashwa Kamal (2021): Renewable Energy Systems

Modelling, Optimization and Control, 1st Edition, eBook ISBN: 9780128203989

2. John Twidell (2021): Renewable Energy Resources, 4th Edition, Published by Routledge,

ISBN 9780415633581

3. Pankaj Pathak , Rajiv Ranjan Srivastava (2021): Alternative Energy Resources: The Way to a Sustainable Modern Society, 1st edition, Published by Springer, ISBN-10 : 3030579220, ISBN-13 : 978-3030579227

4. Edward S. Cassedy, Peter Z. Grossman (2017): Introduction to Energy: Resources, Technology, and Society, 3rd edition ,Published by Cambridge University Press, ISBN-10 : 1107605040, ISBN-13 : 978-1107605046.

Syllabus

4. "Basics of Energy Efficiency"

Course topic

Energy efficiency of building conditioning systems

Duration:

90 learning hours

Participants of the course:

Conditioning systems specialist students (2-year professional program)

Educational background:

High school

Course responsible

Aleksander Moisiu University, Durres

Professional Studies Faculty,

Department of Marine and Engineering Sciences,

Dr. Alma Golgota

Course lecturer / tutor

Msc. Stela Sefa

Educational Prerequisites

General knowledge in the energy field

Learning outcomes

Upon successful completion of this course students should be able to:

Knowledge:

- to understand the performance and energy efficiency in systems installed in buildings, greater usage of energy efficient technologies
- to understand basic areas of energy efficiency and conservation methods.

- to explain the proper usage of the equipment necessary to gather energy efficiency data.
- to explain the energy conservation measures pertaining to HVAC systems, building
o equipment, building envelope, sustainable building design and electrical systems.
- to explain the math and science principles used to design, develop, test, and supervise
- production/construction energy efficiency and conservation methods.
- to classify the various types of energy suppliers and methods of fuel acquisition.
- to understand basic engineering principles and physical laws that they will use in their education and/or profession.
- to understand various energy resources, technologies and management fundamentals, and capable in addressing the present and potential future energy problems.

Skills:

- to test the reduced energy consumed in the case of insulated buildings or from the use of other energy efficient methods
- to test conservation methods used to reduce energy consumption in the built environment.
- to work with residential and commercial facilities for opportunities to employ these energy saving measures.
- to work with of energy monitoring and measuring equipment used for energy auditing.
- to solve problems with energy savings and determining environmental impacts of these energy saving methods
- to work with different devices and applying basic methodology for evaluating the use of different energy sources

Competence:

- to manage the energy efficient systems
- to demonstrate the energy efficiency /conservation methods available for energy use
- reduction in residential and commercial settings.
- to demonstrate energy savings and environmental impacts for most energy efficiency
- methods in order to identify and assess energy conservation opportunities.
- to demonstrate the appropriate usage of energy monitoring and measuring equipment commonly used by energy specialists and energy auditors
- use, maintain and serve the energy efficient systems
- to manage the use of renewable technologies for electricity generation in buildings

Abstract

The material focuses on technical aspects related to the overall topic of energy efficiency in building systems. It aims at increasing trainees' knowledge, skills and capacities regarding technical aspects related to EE in buildings, with the specific focus on integration of different solutions, choosing most optimal scenarios, ensuring efficient monitoring and involving building users in the processes.

Content

1. Introduction to energy efficiency in buildings
2. How to use energy more efficiency
3. Basic characteristics of energy Saving
4. Energy audit and energy performance

4.1 Walk-through audit

4.2 Utility cost analysis

4.3 Standard energy audit

4.4 Detailed energy audit

5. Energy using products

6. Energy retrofitting of the buildings.

6.1 Building envelope

6.2 Heating and cooling

6.3 System airflow

6.4 System use of controlling - central control system

6.5 Boiler plant

6.6 Chilled and hot water circulation

6.7 Plant general

6.8 Domestic hot water

6.9 Lighting

6.10 Appliances

7: Installation of RES

7.1 Solar power

7.1.1 Solar energy

7.1.2 Photovoltaic systems

7.1.3 Solar thermal

7.1.4 Solar energy in public buildings

7.2 Geothermal power

7.2.1 Heat pumps

7.3 Biomass

7.3.1 Biomass potentials

7.4 Wind power

7.5 Hydro power

8: Choosing most optimal EE improvement scenario for a specific building

9: Integration of technical measures with each other and with other types of EE solutions

Teaching methods

The theoretical part of the course is presented in the classroom with power point presentation

The practical work of the course will be carried out with lab equipment demonstrations

Assessment

The course grade consists of these components:

40% – Intermediate exam

50% – Final exam

10% - Duty course

Recommended reading

1. Daniel Martinez, Ben Ebenhack, Travis Vagner (2019): Energy efficiency (Concepts and calculations), first edition, ISBN: 9780128121115;

2. Umberto Desideri, Francesco Asdrubali (2018) : Handbook of Energy Efficiency in Buildings, ISBN: 9780128128183;

3. Mehmet KanoğluYunus A. Çengel (2020): Energy Efficiency and Management for Engineers, 1st Edition, McGraw-Hill Education, ISBN: 9781260459098;

4. Jacob J. Lamb and Bruno G. Pollet (2020): Energy-smart buildings : design, construction and monitoring of buildings for improved energy efficiency, Institute of Physics (Great Britain), publisher.

Syllabus

5. "Alternative energy plants"

Course topic

Renewable energy systems

Duration:

90 learning hours

Participants of the course:

Mechanics of agricultural industrial plants (2-year professional program)

Educational background:

High school

Course responsible

Aleksander Moisiu University, Durres

Professional Studies Faculty,

Department of Marine and Engineering Sciences,

Dr. Alma Golgota

Co-funded by the
Erasmus+ Programme
of the European Union

Course lecturer / tutor

Dr. Ing Eli Vyshka / Msc.Ing Luiza Lluri

Educational Prerequisites

General knowledge in the field of energy

Learning outcomes

Upon successful completion of this course students should be able to:

Knowledge:

- Understand and use for problem solving the main concepts of electric power calculations for one and tree phase systems: complex power, power factor, power triangle, power quality and harmonic distortion.

- Understand the main concepts of heat engine and Carnot efficiency.

Calculate the efficiency of a fossil fuel steam cycle power plant and its pollution parameters.

- Understand different types of steam cycle plants (base load and others) and calculate the optimal mix of combined cycle plants for a given load duration distribution

- Understand the concept of distributed generation and know its main types.

Understand principle of work of micro-combustion turbines and Stirling engines.

- Understand the concept of fuel cells. Calculate efficiency, fuel consumption and electric parameters of a simple fuel cell

- Understand the concept of micro hydro-electric systems. Calculate efficiency, and parameters of a micro hydro system. Design a consumer micro hydro installation for a given site and performance parameters

- Understand major concepts of wind energy. Calculate air parameters at different conditions, impact of installation height, wind power and average wind power

- Know the operation and comparative analysis of different concentrating solar power systems

- Understand concepts of nuclear power systems.

- Understand concepts of geothermal and marine power systems.

Skills:

- Evaluate economic efficiency and compare small scale renewable energy projects using major economic measures of pay-back period, simple rate of return, net present value, internal rate of return.

- Calculate wind turbine performance parameters (efficiency, energy produced, capacity factor) for a turbine with given power curve and for a given location with given wind speed distribution function

- Calculate the major parameters of sun movement, solar radiation, and tracking systems.

- Design the parameters of a consumer scale stand alone and grid connected photovoltaic system for a given site location and performance specification.

Competence:

- demonstrate an ability to use critical thinking and problem-solving skills to evaluate

  business energy use and how and when to apply renewable energy solutions

- demonstrate an understanding of, and assess the obstacles associated with implementation of renewable energy systems

- demonstrate an understanding and familiarity with engineering and financial aspects of projects

- demonstrate an understanding and familiarity with the regulatory aspects of renewable energy projects

Abstract

The training material focuses in the various sources of alternative energy including wind, solar, and biomass as potential sources of energy and investigates the contribution they can make to the energy profile of the nation. The technology used to harness these resources will be presented. Discussions of economic, environment, politics and social policy are integral components of the course.

Content

1. Introduction. Fundamentals of electric power
   - o Electric energy in the world
   - o Power factor, Complex power, power triangle.
   - o Three-phase systems.
   - o Synchronous generators.
   - o Power quality
2. The basic conventional electric power industry
   - Regulatory side of electric power
   - Heat engines. Carnot efficiency
   - Types of conventional power plants (steam-cycle, combustion gas turbines, combined cycle power plants, nuclear power plants)
   - Economically optimal mix of power plants
   - Transmission and distribution. Grid stability. Losses in the transmission line

3. Energy economics
4. Distributed generation. Various renewable energy systems
   - o Intro to distributed generation
   - o Micro-combustion turbine, sterling engine
   - o Fuel cells
   - o Micro-hydro
   - o Wave power
   - o Tidal power
   - o Biomass & biogas
   - o Geothermal power
5. Wind power systems
   - o Power in the wind.
   - o Wind turbine performance
   - o Average power of the wind
   - o Wind turbine energy production
   - o Wind farms, wind economics, environmental impact
6. Solar energy systems
   - o the solar resource
   - o Concentrating solar power technologies
   - o Photovoltaic cells
   - o Photovoltaic systems

7. Smart grid

Teaching methods

The theoretical part of the course is presented in the classroom with power point presentation

The practical work of the course is represented with exercises and demonstrations

Assessment

The course grade consists of these components:

40% – Intermediate exam

50% – Final exam

10% - Duty course

Recommended reading

1. Ramesh C Bansal and Ahmed F Zobaa (2021) : Handbook of Renewable Energy Technology & Systems, ISBN 978-1-78634-904-0;

2. Hoboken, NJ : John Wiley & Sons (2017): Alternative energy systems and applications, Second Edition, 9781119109228 1119109221 9781119109235 111910923X;

3. Bent Sorensen (2017) : Renewable Energy: Physics, Engineering, Environmental Impacts, Economics and Planning 5th Edition, ISBN-10 : 0128045671, ISBN-13 : 978-0128045671;

4. Eduardo Rincón-Mejía, Alejandro de las Heras (2020): Sustainable Energy Technologies, Published to CRC Press, ISBN 9780367572679.

Syllabus

6. "Basics of Energy Efficiency"

Course topic

Energy efficiency in buildings

Co-funded by the
Erasmus+ Programme
of the European Union

Duration:

90 learning hours

Participants of the course:

Construction manager students (2-year professional program)

Educational background:

High school

Course responsible

Aleksander Moisiu University, Durres

Professional Studies Faculty,

Department of Marine and Engineering Sciences,

Dr. Alma Golgota

Course lecturer / tutor

Msc. Stela Sefa

Educational Prerequisites

General knowledge in the energy field

Learning outcomes

Upon successful completion of this course students should be able to:

Knowledge:

- to understand energy efficiency in buildings;
- to understand basic areas of energy efficiency and conservation methods;
- to explain the proper usage of the equipment necessary to gather energy efficiency data.
- to explain the energy conservation measures pertaining to HVAC systems, building equipment, building envelope, sustainable building design and electrical systems.
- to explain the math and science principles used to design, develop, test, and supervise production/construction energy efficiency and conservation methods.
- to classify the various types of energy suppliers and methods of fuel acquisition.
- to understand basic engineering principles and physical laws that they will use in their education and/or profession.
- to understand various energy resources, technologies and management fundamentals, and capable in addressing the present and potential future energy problems.
- to classify the types of air conditioning systems, the methodologies of their placement in the buildings

Skills:

- to test the reduced energy consumed in the case of insulated buildings or from the use of other energy efficient methods
- to test conservation methods used to reduce energy consumption in the built environment.
- to work with residential and commercial facilities for opportunities to employ these energy saving measures.
- to work with of energy monitoring and measuring equipment used for energy auditing.

- to solve problems with energy savings and determining environmental impacts of these energy saving methods
- to work with different devices and applying basic methodology for evaluating the use of different energy sources
- to work with HVAC-related practical exercises

Competence:

- to manage the energy efficient systems
- to demonstrate the energy efficiency /conservation methods available for energy use reduction in residential and commercial settings.
- to demonstrate energy savings and environmental impacts for most energy efficiency methods in order to identify and assess energy conservation opportunities.
- to demonstrate the appropriate usage of energy monitoring and measuring equipment commonly used by energy specialists and energy auditors
- use, maintain and serve the energy efficient systems
- to manage the use of renewable technologies for electricity generation in buildings
- to demonstrate air conditioning and environmental control equipment for multifunctional facilities

Abstract

In this course you get knowledge on energy efficiency in buildings as well as energy analysis of different buildings. Knowledge is also obtained on HVAC plants that are installed in the facility as well as work management.

Co-funded by the
Erasmus+ Programme
of the European Union

Content

7: Installation of RES

7.1 Solar power

7.1.1 Solar energy

7.1.2 Photovoltaic systems

7.1.3 Solar thermal

7.1.4 Solar energy in public buildings

7.2 Geothermal power

7.2.1 Heat pumps

7.3 Biomass

7.3.1 Biomass potentials

7.4 Wind power

7.5 Hydro power

8. The air-conditioning plants

8.1 The different types of systems: all-air, all-water, mixed air-water systems.

8.2 All-air systems with constant flow and variable flow, single-channel, with zone post-heating, multi-zone, dual-channel.

8.3 Autonomous conditioners.

8.4 The choice of the plant about the intended use.

8.5 The heating plant and the refrigeration plant: location and safety conditions.

8.9 The air distribution channels: sizing criteria and integration problems with the structures. The problems related to the diffusion of air in the environment.

Teaching methods

The theoretical part of the course is presented in the classroom with power point presentation

The practical work of the course will be carried out with lab equipment demonstrations.

Assessment

The course grade consists of these components:

40% – Intermediate exam

50% – Final exam

10% - Duty course

Recommended reading

1. Daniel Martinez, Ben Ebenhack, Travis Vagner (2019): Energy efficiency (Concepts and calculations), first edition, ISBN: 9780128121115;

2. Umberto Desideri, Francesco Asdrubali (2018) : Handbook of Energy Efficiency in Buildings, ISBN: 9780128128183;

3. Mehmet KanoğluYunus A. Çengel (2020): Energy Efficiency and Management for Engineers, 1st Edition, McGraw-Hill Education, ISBN: 9781260459098;

4. Jacob J. Lamb and Bruno G. Pollet (2020): Energy-smart buildings : design, construction and monitoring of buildings for improved energy efficiency, Institute of Physics (Great Britain), publisher.

5. Ashrae (2020) : HVAC systems and equipment , ISBN(s):9781947192539

6. Elias Moore (2020): Heating systems: Nova Science Publishers, Inc., 2020.

a. (DLC) 2020006804, ISBN:9781536175578 1536175579

Co-funded by the
Erasmus+ Programme
of the European Union

3.COURSES OF PROFESSIONAL COLLEGE OF TIRANA (KPT)

The Professional College of Tirana - an institute of higher education in Albania, that offers 2 years higher education vocational study programs (120 ECTS), level 5 - is a partner in the Erasmus + CBHE Engine.

The courses part of KPT are:

1. Solar photovoltaic systems
2. Renewable energy sources
3. Automatic Control
4. Electricity Supply in the enterprise
5. Electric and hybrid vehicles
6. Fundamentals of heating and heating systems

Table 1 – Summary of new / updated courses in KPT:

No	Name of the course	Study program	Lecturer	Category	
				Mandatory/ Elective	New/ Updated
1	Solar photovoltaic systems (6 ECTS)	Electrical Installation Technology (2 years professional study program with 120 ECTS)	Msc. Ersi Salaj	Mandatory	New
2	Renewable energy sources (6 ECTC)	Electro-Mechanics (2 years professional study program with 120 ECTS)	Msc. Fadil Likaj	Elective	New
3	Automatic Control (5 ECTS/ 6 ECTS)	Electro-Mechanics (2 years professional study program with 120 ECTS) And Electrical Installation Technology (2 years professional study program with 120 ECTS)	Mp. Ervis Qose	Mandatory	Updated
4	Electricity Supply in the enterprise (6 ECTS)	Electrical Installation Technology (2 years professional study program with 120 ECTS)	Msc. Ersi Salaj	Mandatory	Updated

5	Electric and hybrid vehicles (6 ECTS)	Vehicle technology (2 years professional study program with 120 ECTS)	Msc.Eng. Ilir Palushi /Msc. Eng. Arjan Kullolli	Mandatory	Updated
6	Fundamentals of heating and heating systems (6 ECTS)	Ventilation and air conditioning technology (2 years professional study program with 120 ECTS)	Msc. Marjeta Dhima / Msc. Artur Ruzi (Lab assistant)	Mandatory	Updated

The learning outcomes of the new and updated courses are presented in Table 2 below.

Course	Knowledge	Skills	Competences
Renewable energy sources	This course will introduce students to alternative energy sources, namely the renewable energy sources and their related systems. It is intended to provide students with basic operating concepts on renewable energy alternatives. This course will address the causes and consequences of global warming, gases, and the greenhouse effect. Further, it will deal with the advantages and the increasing trend in the production of energy from renewable sources.	• Introduction to global warming, causes, consequences, measures; • Renewable energy sources • Solar Energy: water heating potential	At the end of the course, the students will: understand, use and apply safety rules when working with solar panels etc. understand and apply operating concepts with regard to renewable energy alternatives;

		• Wind Energy, its constrains, wind turbines • Water energy, water turbines, hydro powers, • Geothermal Energy, sources, way and opportunities to use; • Biomass energy • Energy efficiency	classify types and nature of renewable energy sources; assess and evaluate their advantages and drawbacks; understand operation of alternative energy production systems, their energy efficiency and maintenance;
Automatic Control Systems	The program aims to prepare students with the necessary knowledge on the basics of automatic control. The course focuses on technologies that include renewable energy and also energy efficiency using the technologies of the IoT family (Internet of Things) such as Smart Homes, Smart Buildings, Smart Grid, and Smart Farming. The aim of this course is for students to understand the way these technologies function, how to integrate the systems that require automatic control and also to be able to install and maintain such systems, also, to get acquainted with new technologies as well as implement them in	· IOT (Smart Home/ Buildings) KNX , Z-Wave. · Smart Grid / Smart City · Renewable energies/Energy efficiency, their automatic control · SCADA	At the end of the course, students will: · Explain how a system that uses automatic control works and also how it integrates with other systems. · Discuss and evaluate which system is valid for a given

	buildings, through the use of communication protocols suitable for those environments.	· Other building security systems (CCTV, Burglary Alarm, Fire Alarm) · Basic principles of cyber security in industry · Industry 4.0 · 3D Printing /Scanning · Augmented reality Digital twin	environment and justify it. · To classify the types of systems used in Smart Home/ Buildings and IOT Grid and also other support systems. · Implement the project and install systems that use automatic control. · Implement the electrical and technical standards of Smart Home / Buildings installations. · Test systems and maintain them as planned.
Automatic Control Systems	The program aims to prepare students with the necessary knowledge of the basics of automatic control. This course focuses on technologies that include renewable energy and also energy efficiency using the technologies of the IoT family (Internet of Things) such as Smart Homes, Smart Buildings, Smart Grid, and Smart Farming. The aim of this course is for students to understand the way these technologies work	· IOT (Smart Home/ Buildings) KNX , Z-Wave. · Smart Grid / Smart City	At the end of the course, students will: · Explain how a system that uses automatic control works and also how it integrates

	/function, how to integrate the systems that require automatic control and also to be able to install and maintain such systems, to also get acquainted with new technologies as well as implement them in buildings, through the use of communication protocols suitable for those environments.	· Renewable energies/Energy efficiency , their automatic control · SCADA · Other building security systems (CCTV, Burglary Alarm, Fire Alarm) · Basic principles of cyber security in industry	with other systems. · Discuss and evaluate which system is valid for a given environment and justify it. · To classify the types of systems used in Smart Home/ Buildings and IOT Grid and also other support systems. · Implement the project and install systems that use automatic control. · Implement the electrical and technical standards of Smart Home / Buildings installations. · Test systems and maintain them as planned.

Course	Knowledge	Skills	Competences
Electricity Supply in the enterprise	This course will introduce the power supply system as a whole of equipment for the production, transmission, and distribution of electricity. Challenges to meet the technical and sustainable requirements, within the future perspectives for each of the resources and systems. Students will learn the basics of power supply to enterprises as well as the major development of renewable sources as part of power supply in international trends in power transmission and distribution.	• The study of new methods of electricity supply. • Rational choice of the number and power of the transformation. • Choice of rational voltage depending on specific electrical schemes. • Compensation with reactive energy. • Security of supply. determination of average loads. • Enterprise network protection.	At the end of the course, students will: • Understand the decentralization of electricity generation and the continuous changes in flow directions and how these interact in larger traditional systems, • Understand the basic principles for the construction of unipolar schemes with the corresponding sizes for the supply of one or more enterprises that function as consumers and producers with the installation of renewable resources.
Solar Photovoltaic Systems	This course will cover theoretical and practical topics about solar energy and its use in electricity production from systems with PV modules, types of PV systems, inverters, batteries, charge controllers, rack mounting and permits. Sizing solar systems puts students in a good position to advance students in evaluating	• At the end of the course, students will be able to: • To implement the design of a photovoltaic plant and perform energy yield simulations. • To build preventive, choose	At the end of the course, students will: Have knowledge of photovoltaic system technology. Understand how photovoltaic energy conversion is used to produce electricity. Design and manufacture of various technologies of

	installed active power, how solar cells and modules are connected. This course offers you advanced knowledge within the field of Converting DC electricity to AC electricity.	materials and equipment for the construction of a photovoltaic plant. • To install, maintain and repair the elements and equipment of a photovoltaic system.	solar cells and modules, various components of the photovoltaic system, Assess and evaluate the role of photovoltaic energy in sustainable energy systems.

Course	Knowledge	Skills	Competences
Electric and hybrid vehicles	This course consists of both theoretic and laboratory components. Global warming, the danger that currently threatens the globe, needs an increase in the production of electric and hybrid vehicles. Through this course, it is intended to provide students with the basic operational concepts, types and realizations of these vehicles. The main topics of this course deal with the advantages and the increasing trend in the use of these vehicles, construction and components, high voltage batteries, their management systems, etc. Priority has been	– The phenomenon of global warming, the greenhouse effect and its consequences. Greenhouse gases and their global warming potential. Consequences and measures against global warming. – Trends of electric and hybrid vehicles. Their priorities, especially in relation to gas emissions, environmental protection and global warming.	At the end of this course, the students are expected to have received the appropriate knowledge on the construction and operation of these vehicles as well as their trend To understand the principle and technical operation of photovoltaic panels and their application

	given to the use of renewable energies (solar panels) for charging the batteries of these vehicles, the growing trend of using solar panels for charging batteries, as well as vehicles with photovoltaic panels integrated into the vehicle. Special topics have addressed the energy efficiency of these vehicles.	– The main systems and aggregates that make up the vehicle. High voltage batteries types and their construction. – Electronic management system. Battery charging methods, inverter, etc. – Electric motors used in electric and hybrid vehicles. – Bidirectional and intelligent charging of electric vehicles – Charging the batteries of electric and hybrid vehicles with photovoltaic panels – Electric vehicles with integrated photovoltaic panels – Construction and operation of photovoltaic plants. – Cooling system of the battery block and other electronic equipment – Braking system, and other vehicle systems, differences from those of traditional vehicles	in electric and hybrid vehicles. To efficiently use and make use of safety at work using instruments and other protective equipment. To perform periodic checks, maintenance and safety measures in electric and hybrid vehicles

		– The vehicle's air conditioning and comfort system, construction, operation, the difference from those of traditional vehicles. – Electronics in all vehicle systems – Hybrid vehicles, the different ways of their construction. Differences between hybrid and purely electric vehicles – Hydrogen vehicles – Periodic checks, maintenance and safety measures in electric and hybrid vehicles. – Energy efficiency in electric and hybrid vehicles	

Course	Knowledge	Skills	Competences
Fundamentals of heating and heating systems	The course contains the main theoretical and practical information about	Heat and its transmission. Laws of Thermodynamics.	At the end of the course, students will be able to use the basic theoretical and practical concepts and laws of

	the basics of heating and heating systems. Specifically, the basic concepts of heat and its transmission methods, the main requirements of thermal comfort, thermal losses and their analysis, heating systems and their components, solar panels, types, assembly, operation and their use for hot water and heating systems.	Heat losses. Thermal balance and thermal insulation of a building. Heating plants and their components. Thermal power plants (boilers). Solar panels.	the subject. They will have the necessary skills to solve the technical problems they will encounter while working in their profession. Specifically, students will know, use and maintain the main heating systems and equipment, such as: • boilers, • radiant and convective heating radiators, • floor and ceiling heaters, • solar panels for hot water and sanitary water, • tanks and their connection to the boiler, • control and security devices, etc.

The syllabi of each course are as follows:

Syllabus

1. **SOLAR PHOTOVOLTAIC SYSTEMS**

Co-funded by the Erasmus+ Programme of the European Union

Course topic

Solar photovoltaic systems

Number of credits

6 ECTS

Course responsible

Professional Collage of Tirana

Department of Information Technology

Prof. Dr. Piro Cipo (Head of Department)

Study program: Electrical Installation Technology

Course lecturer

Msc. Ersi SALAJ

Prerequisites

Previous knowledge of electrical equipment, electrical installations, etc.

Learning outcomes

Upon successful completion of this course students should be able to:

- Explain the use of photovoltaic solar energy in electrical installation.
- Discuss Classification of main photovoltaic materials: photovoltaic, monocrystalline, polycrystalline, and amorphous cells.

- Classify Formation of modules by connecting modules, panels, and a combination of electrical connections.
- Design and describe the installation Converters (DC / DC converters and DC / AC inverters), their quality, and their role as part of the photovoltaic system. Batteries and their types as part of the photovoltaic system.
- Reading of electrical projects, with the necessary elements for the possibility of implementing systems from renewable energy sources.
- Construct power supply system of photovoltaic panels on terraces, vertical walls, on the ground, and on the surfaces of lakes and their dams.
- Test Converters (DC / DC converters and DC / AC inverters), their quality, and their role as part of the photovoltaic system. Batteries and their types as part of the photovoltaic system.
- Manages defects in photovoltaic systems and ways to repair them
- Lead a team in installation safety, maintenance, and troubleshooting.

Abstract

At the end of this cycle of lectures, the student is introduced to the ways of calculating electrical loads for Hydropower, solar, wind, geothermal, and biomass renewable energy. Classification of main photovoltaic materials: photovoltaic, monocrystalline, polycrystalline, and amorphous cells. Formation of modules by connecting modules, panels, and a combination of electrical connections. Installation of photovoltaic panels on terraces, vertical walls, on the ground, and on the surfaces of lakes and their dams. Converters (DC / DC converters and DC / AC inverters), their quality, and their role as part of the photovoltaic system. Batteries and their types as part of the photovoltaic system. Protection against atmospheric shocks, earthing, and protection against tactile and step voltage. Realization in practice. The course aims to give students general knowledge about the development of solar photovoltaic systems. Legislation. Technical norms and national and international standards. Their value. CEI modules and brands. The course aims to provide practical knowledge in these areas., hydropower, solar, wind. The course aims to give students a general knowledge of Electricity Supply from Renewable Energy Sources using techniques for reducing energy losses. The course illustrates the techniques followed in building a renewable energy supply for

power plant which consists in design, supplies of building materials installation, inspection and testing for a "turnkey" product.

Content

1. Introduction. Renewable energies. Hydropower, Solar thermal and Photovoltaic Solar; Wind energy and Geothermal energy. Biomass energy.

2. The situation in Albania. Areas with large and small radiation, according to the indicator kWh / m2 annually, monthly, and daily. Areas with sunnier days.

3. Classification of the main materials with which photovoltaic cells are built: monocrystalline, polycrystalline, and amorphous materials.

4. Volt-ampere characteristic of a photovoltaic cell, the influence of the degree of radiation, the power curve, and the influence of the ambient temperature (in W/ m2 or in kWh / m2).

5. Installation of photovoltaic panels on terraces, roofs of houses, palaces, and their placement on the ground in a certain way. Buffer diodes and reverse polarity diodes. Their role in the protection of photovoltaic panels.

6. Orientation of solar panels and optimal angles in space referring to the South. Sunlight movements and panel position. Efficiency and the problems that arise.

7. Converters (DC / DC Converters). Why they are needed, and what is their role as part of the solar photovoltaic system. Types of DC / DC converters: Boost converters that increase the output voltage.

8. Inverter (DC / AC). Why they are needed, and what is their role as part of the solar photovoltaic system. Types of DC / AC inverters: Solar panel inverters: centralized inverters, string inverters, and the role of micro inverters located in the photovoltaic solar system modules.

9. Photovoltaic solar system batteries. The main parameters that characterize a battery: voltage (V), battery capacity (Ah), battery power P(W), and electric energy E (Wh). Simple calculations of these capacities for battery type selection.

10. Assessment of battery charge rate, with ampere-meter or voltmeter. Connections in series and parallel, mixed to achieve multiple voltage change and multiple capacitance. Battery safety problems, from explosion, fire, etc.

11. Protective earthing and protection against atmospheric overvoltage, as a function of the way the photovoltaic panels are placed on the terrace, roof, vertical walls of buildings, and on the ground.

12. Types of earthing conductors, ways of placement in the ground, and number of earthing conductors. Simple calculations of earthing resistance. Rails and connecting cables of metal parts where the panels/panel with the group of earthing conductors are placed. Ways and methods of protection from lightning strikes, vertical rods, their length, etc.

13. Concrete projects with calculations for the installed power of some systems, parameters, geographical position, other characteristics such as degree of solar illumination, orientation, etc.

14. Photovoltaic sources in the near future, Examples from the system in the lake of the hydropower plant of Banja, Karavasta, and Spitalla

15. Test.

Teaching methods

Providing the students with the fundamental of the electricity supply professional concepts and to prepare them for advanced study in electrical professional areas. Teaching how to search, classify and analyse technical information about equipment, device or component datasheets and to be able to identify suitable information sources. Providing hands-on and experimental experience, to supplement projects in electricity supply and to promote the application of professional concepts. Using, quite complex project scenarios to provide the students with the ability to find solutions to the problems and to enhance their critical reasoning needed to choose the appropriate solution in accordance with specific criteria. Implementing and test one or more design alternatives to better solve the problem to enhance other competencies within the professional task, such as: the ability to write good technical reports and to make presentations, project management and economics, and team-work.

(face to face class, lab practice, on place visits etc.)

Assessment

10% - Participation and activation in exercises

30% - Laboratory/Practice

60% - Final exam

Recommended reading

1. "Power System Analysis" by John J. Grainger, William D. Stevenson.1995, McGraw-Hill Inc.

2. "Power Systems Protection, Power Quality, Substation Automation" 1994, IDC TechBooks.

3. "Power Systems Modelling and Fault Analysis: Theory and Practice" by N.D. Tleis. 2008, Elsevier Ltd. Batteries in pv systems. Javier Bernabé Mohedano Martínez.

4. Design and construction of works in the field of electricity generation industry with hydropower plants in the coming decades in the world and Albania / Edmond Pinguli; Nasho Pinguli; rec. Emin Musliu;

5. Electricity supply of industrial enterprises / Bardhyl Reso; Bamir Çano; Gjergj Çaçani; Mihal Jorgoni;

Recommended web pages

1. https://books.google.com/googlebooks/about/ Transition to Renewable Energy Systems - Detlef Stolten, Viktor Scherer (Wiley-VCH, 2013)

Syllabus

2. ELECTRICITY SUPPLY IN THE ENTERPRISE

Course topic

Electricity supply to the enterprise

Co-funded by the Erasmus+ Programme of the European Union

Number of credits

6 ECTS

Course responsible

Professional Collage of Tirana

Department of Information Technology

Prof. Dr. Piro Cipo (Head of Department)

Study program: Electrical Installation Technology

Course lecturer

Msc. Ersi SALAJ

Prerequisites

Previous knowledge of electrical equipment, electrical installations, etc.

Learning outcomes

Upon successful completion of this course students should be able to:

- Explain electrical loads for typical schemes in the electricity supply sector.
- Discuss the technical-economic calculation, quality of electricity and security of customer supply.
- Classify the rating systems for Overcurrent protective devices, equipment grounding.
- Design and describe the installation of an electrical power distribution system, including the loads and circuits required for various buildings and operations
- Reading of projects, basics of design and measurement of electrical systems with the necessary elements for the possibility of building supply systems from renewable energy sources.

- Construct power supply system of a basic renewable energy plant with a capacity of up to 500 kW.
- Test current and voltage transformers, metering devices and electrical conductors.
- Manages a project on renewable energy sources installed in the enterprise
- Lead a team in installation safety, maintenance, and troubleshooting.

Abstract

At the end of this cycle of lectures, the student is introduced to the ways of calculating electrical loads, Typical schemes for electricity supply, Technical-economic calculation, quality of electricity and security of customer supply of electricity from renewable energy sources reading of projects, basics of design and measurement of electrical systems with the necessary elements for the possibility of building supply systems from renewable energy sources. Course “Electricity supply in the enterprise. Addresses international trends for energy supply from renewable energy sources” deals with general knowledge on the power system and electricity supply network of urban, industrial, and rural consumers from renewable energy sources, hydropower, solar, wind. The course aims to give students a general knowledge of Electricity Supply from Renewable Energy Sources using techniques for reducing energy losses. The course illustrates the techniques followed in building a renewable energy supply for power plant which consists in design, supplies of building materials installation, inspection and testing for a "turnkey" product.

Content

1. Introduction of electrical network. Warranty of supply and quality of energy, Stability, Effects of renewable energy on the network, Limits of the current network configuration. Demand management.
2. Calculation of various electrical loads and specific equipment for electricity from renewable sources.
3. Typical schemes for the supply of electricity from renewable sources combined with the power grid or on the island.

4. Direct control of the predicted power of the systems connected to the power grids. Disconnection and protection devices in generation and storage networks. Technological aspects of connecting power systems to the grid.

5. Section calculation of conductors and cables according to some criteria, which are the choice according to the heating currents. In hydropower plants and photovoltaic plants.

6. Selection according to protection against short circuit currents and overloads.

7. Optimization and Planning of the Supply Network from renewable hydric and photovoltaic sources.

8. Technical-economic calculation in power supply systems of urban, industrial and rural loads.

9. Integration of Renewable Energy Sources with the Smart Grid.

10. Short circuit current calculations.

11. Improving the power factor through renewable energy sources.

12. Micro-Networks. Assessment of resources and needs. Dimensioning Optimization and Control of integrated systems.

13. Electricity Grid Modelling and Simulation tools consisting of energy production, through renewable hydric and photovoltaic sources.

14. Calculation of their reactive power, where capacitor batteries are most used.

15. Test.

Teaching methods

Providing the students with the fundamental of the electricity supply professional concepts and to prepare them for advanced study in electrical professional areas. Teaching how to search, classify and analyze technical information about equipment, device or component datasheets and to be able to identify suitable information sources. Providing hands-on and experimental experience, to supplement projects in electricity supply and to promote the application of professional concepts. Using, quite

complex project scenarios to provide the students with the ability to find solutions to the problems and to enhance their critical reasoning needed to choose the appropriate solution in accordance with specific criteria. Implementing and test one or more design alternatives to better solve the problem to enhance other competencies within the professional task, such as: the ability to write good technical reports and to make presentations, project management and economics, and team-work.

(Face to face class, lab practice, on place visits etc.)

Assessment

10% - Participation and activation in exercises

30% - Laboratory/Practice

60% - Final exam

Recommended reading

"Power System Analysis" by John J. Grainger, William D. Stevenson.1995, McGraw-Hill Inc.

"Power Systems Protection, Power Quality, Substation Automation" 1994, IDC TechBooks.

"Power Systems Modelling and Fault Analysis: Theory and Practice" by N.D. Tleis. 2008, Elsevier Ltd. Batteries in pv systems. Javier Bernabe Mohedano Martínez.

Design and construction of works in the field of electricity generation industry with hydropower plants in the coming decades in the world and Albania / Edmond Pinguli; Nasho Pinguli; rec. Emin Musliu; rec. Kiço Negovani; rec. Niko Pano.

Electricity supply of industrial enterprises / Bardhyl Reso; Bamir Çano; Gjergj Çaçani; Mihal Jorgoni; red. Jorgjia Haxho

Recommended web pages

https://books.google.com/googlebooks/about/ Transition to Renewable Energy Systems - Detlef Stolten, Viktor Scherer (Wiley-VCH, 2013)

Syllabus

3. AUTOMATIC CONTROL

Course topic

Automatic control systems

Number of credits

5 ECTS

Course responsible

Professional Collage of Tirana

Department of Information Technology

Study program: Electro-Mechanics

Prof. Dr. Piro Cipo (Head of Department)

Course lecturer

MP. Ervis Qose

Prerequisites

Previous knowledge of sensors, input/output, basics on electronics and electrical installation etc.

Learning outcomes

Upon successful completion of this course students should be able to:

- Explain how a system that uses automatic control works and also how it integrates with other systems.
- Discuss and evaluate which system is valid for a given environment and justify it.
- To classify the types of systems used in Smart Home/ Buildings and IOT Grid and also other support systems.
- Implement the project and install systems that use automatic control.
- Implement the electrical and technical standards of Smart Home / Buildings installations.
- Test systems and maintain them as planned.

Abstract

This program is based on contemporary literature combining lectures with exercises and laboratory work. The program aims to prepare students with the necessary knowledge of the basics of automatic control. This course focuses on technologies that include renewable energy and also energy efficiency using the technologies of the IoT family (Internet of Things) such as Smart Homes, Smart Buildings, Smart Grid, and Smart Farming. The aim of this course is for students to understand the way these technologies' function, how to integrate the systems that require automatic control and also to be able to install and maintain such systems, to also get acquainted with new technologies as well as implement them in buildings, through the use of communication protocols suitable for those environments. An integral part of the course is the introduction to other systems which are related to building safety and energy efficiency management by integrating them with photovoltaic panels of buildings or other household appliances. An important element is also the cyber security of IoT systems, types of attacks, and defense mechanisms.

Content

1. Introduction to IoT. Areas of use and different methods of automatic controls. Definition of IoT.

2. IoT concepts and architecture. The four phases of the IoT architecture. The role of artificial intelligence, big data, and machine learning. Communication protocols and standards in the IoT. LORA, MQTT, CoAP. The role of 5G technology.

3. Renewable energies, their need, and their management using automatic control. Process control and monitoring system.

4. Areas of application of IoT and technologies. The role of IoT in increasing energy efficiency and its management.

5. Smart grid. Its integration and role in electricity management. Elements of its architecture such as Smart Metter. Energy peak management. Concrete implementation cases.

6. Smart Buildings and green buildings. The main elements of Smart Buildings such as sensors, actuators, and Gateway. Building automation for automatic control.

7. Integration of Smart Buildings with photovoltaic panels for renewable energy management and efficient energy management using other sources such as solar heating, lighting, etc.

8. SCADA and its implementation in hybrid power plants for efficient management. SCADA architecture and other integrations with GIS and monitoring systems.

9. Smart Buildings and Smart Home. The importance of these technologies, the way of their implementation and operation. Constituent elements of architecture.

10. Communication protocols and technologies in Smart Home and Smart Buildings. Types of sensors and actuators, and ways of installing and configuring them. Importance of local servers and configurations.

11. KNX architecture and components of the KNX family. Mode of operation, electrical connections, addressing, etc.

12. Z-WAVE Architecture. The way of communication of sensors and actuators with the local server. Types of integrations between technologies. Strong and weak points of ZWAVE communication.

13. Other technologies in Smart Home and Smart Buildings. Other Smart Communications and Smart Home communication standards and protocols. Crestron, Leviton, Control4, Sevant, Loxone etc.

14. Implementation of Smart Home and Smart Buildings (Case Studies). Smart Hotels, protection and security systems (Surveillance systems, fire systems, alarm systems, dorbell, etc.)

15. Security in IoT, Smart Buildings, and Smart Home. Types of attacks that affect the security of technologies in the IoT family. Importance of a safe communication protocol and configuration modes. Case studies of cyberattacks.

Teaching methods

During this course are going to be used PowerPoint lectures, video simulations, lecture series, and simulations with various software and real equipment Digital Twin Methods[1].

Seminars with questions and exercises as well as a knowledge check every two other weeks through the Teams platform.

Laboratories are conducted by working with physical installations of local sensors, actuators, and local servers, as well as the implementation of electrical circuits for connecting sensors or actuators, Scenario configurations, and programming to create an example of Smart Home and Smart Buildings. Integrations with voice assistants like Amazon Alexa or Google Assistant and integration with SCADA (Industries 4.0).

Assessment

10% - Participation and activation in exercises

30% - Laboratory/Practice

60% - Final exam

Recommended reading

1. Internet of Things Architectures, Protocols and Standards by Simone Cirani Gianluigi Ferrari Marco Picone Luca Veltri 2018, ISBN 1119359678, 978-1119359678

2. Building Automation: Communication systems with EIB/KNX, LON und BACnet, Hermann Merz, Thomas Hansemann, Christof Hübner,2007,ISBN: 3540888284,9783540888284

3. Z-Wave Essentials , Christian Paetz 2017 , ISBN: 1545394547,9781545394540

4. The IoT Hacker's Handbook A Practical Guide to Hacking the Internet of Things by Aditya Gupta, 2017, ISBN: 1484242998, 978-1484242995

5. Renewable Energy Systems, David Buchla, Thomas Kissell and Thomas Floyd, Pearson, 2015, ISBN: 978-0-13-262251-6.

Recommended web pages

2. LoRa Alliance https://lora-alliance.org/

3. KNX Association https://www.knx.org/knx-en/for-professionals/index.php

4. Z-WAVE Alliance https://z-wavealliance.org/

Syllabus

4. AUTOMATIC CONTROL

Course topic

Automatic control systems

Co-funded by the Erasmus+ Programme of the European Union

Number of credits

6 ECTS

Course responsible

Professional Collage of Tirana

Department of Information Technology

Prof. Dr. Piro Cipo (Head of Department)

Study program: Electrical Installation Technology

Course lecturer

MP. Ervis Qose

Prerequisites

Previous knowledge of sensors, input/output, basics on electronics and electrical installation etc.

Learning outcomes

Upon successful completion of this course students should be able to:

- Explain how a system that uses automatic control works and also how it integrates with other systems.
- Discuss and evaluate which system is valid for a given environment and justify it.
- To classify the types of systems used in Smart Home/ Buildings and IOT Grid and also other support systems.

- Implement the project and install systems that use automatic control.
- Implement the electrical and technical standards of Smart Home / Buildings installations.
- Test systems and maintain them as planned.

Abstract

This program is based on contemporary literature combining lectures with exercises and laboratory work. The program aims to prepare students with the necessary knowledge of the basics of automatic control. This course focuses on technologies that include renewable energy and also energy efficiency using the technologies of the IoT family (Internet of Things) such as Smart Homes, Smart Buildings, Smart Grid, and Smart Farming. The aim of this course is for students to understand the way these technologies' function, how to integrate the systems that require automatic control and also to be able to install and maintain such systems, to also get acquainted with new technologies as well as implement them in buildings, through the use of communication protocols suitable for those environments. An integral part of the course is the introduction to other systems which are related to building safety and energy efficiency management by integrating them with photovoltaic panels of buildings or other household appliances. An important element is also the cyber security of IoT systems, types of attacks, and defense mechanisms.

Content

1. Introduction to IoT. Areas of use and different methods of automatic controls. Definition of IoT.

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Teaching methods

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Laboratories are conducted by working with physical installations of local sensors, actuators, and local servers, as well as the implementation of electrical circuits for connecting sensors or actuators, Scenario configurations, and programming to create an example of Smart Home and Smart Buildings. Integrations with voice assistants like Amazon Alexa or Google Assistant and integration with SCADA (Industries 4.0).

Assessment

10% - Participation and activation in exercises

30% - Laboratory/Practice

60% - Final exam

Recommended reading

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3. Z-Wave Essentials , Christian Paetz 2017 , ISBN: 1545394547,9781545394540

4. The IoT Hacker's Handbook A Practical Guide to Hacking the Internet of Things by Aditya Gupta, 2017, ISBN: 1484242998, 978-1484242995

5. Renewable Energy Systems, David Buchla, Thomas Kissell and Thomas Floyd, Pearson, 2015, ISBN: 978-0-13-262251-6.

Recommended web pages

1. LoRa Alliance https://lora-alliance.org/
2. KNX Association https://www.knx.org/knx-en/for-professionals/index.php
3. Z-WAVE Alliance https://z-wavealliance.org/

Syllabus

5. RENEWABLE ENERGY SOURCES

Course topic

Renewable energy sources

Number of credits

6 ECTS

Course responsible

Professional College of Tirana

Electro-Mechanics and Applied System Department

Prof. Dr. Marenglen Gjonaj (Head of Department)

Course lecturer

Msc. Fadil Likaj

Learning outcomes

This course consists of both theoretical and laboratory components. This course is intended to provide students with basic operating concepts on renewable energy alternatives. This course will address the causes and consequences of global warming, gases, and the greenhouse effect. The advantages and the increasing trend in the production of energy from renewable sources.

At the end of the course, the students will:

understand, use and apply safety rules when working with solar panels etc.

understand and apply operating concepts with regard to renewable energy alternatives;

classify types and nature of renewable energy sources;

assess and evaluate their advantages and drawbacks;

understand operation of alternative energy production systems, their energy efficiency and maintenance;

Abstract

At the end of this course, students are expected to have acquired the necessary knowledge of production alternatives, construction, and operation of alternative energy production systems and their energy efficiency. Students will have the opportunity to practice the knowledge gained using special tools and instruments in the laboratory.

Content

During this course, students will have acquired basic concepts related to:

1. Knowledge of the phenomenon of global warming. What is global warming, its consequences, the greenhouse effect and the gases that affect global warming, the potential for global warming, the

measures needed, and international agreements to curb the phenomenon of global warming. (Lectures prepared by course instructor)

2. Solar energy for water heating. Equipment used for utilizing solar energy for heating water. Construction and components of a solar water heating system. Active and passive systems, thermosyphon, and pump systems. Solar systems combined with additional heating. (Lectures prepared by the course instructor, recommended literature No.1 pp. 27 to 27, recommended No.2. P.9 to 17)

3. Dimensioning of solar systems for heating water. Solar collectors. Collectors without covers and those with glass covers. Vacuum tube collectors. Water reservoir and its capacity. Circulating water pump. Control and monitoring equipment. Solar heating efficiency. Applications in Albania. (Lectures prepared by the course instructor, recommended literature No.1. Pp.33 to 52, recommended No.2. P.18 to 41)

4. Electricity generation through photovoltaic panels. Properties of photovoltaic circuits. Photovoltaic cells and their working principle. Structure, construction, and efficiency of photovoltaic cells. (Lectures prepared by the course instructor, recommended literature No.1. Pp.59 to 90, recommended No.2. P.44 to 54)

5. Photovoltaic group modules, series, and parallel connection of cells. Types of photovoltaic systems. Autonomous, hybrid, and grid-integrated photovoltaic systems, their configuration. (Lectures prepared by the course instructor, recommended literature No. 2. Pp. 57 to 69)

6. The energy efficiency of electricity production through photovoltaic panels and their application in Albania. Energy storage systems. The main trend of studies in the field of solar energy, and the possibility of implementing solar systems in Albania. (Lectures prepared by the course instructor, recommended literature No. 1. p.90 to 105)

7. Wind energy, its constraints. Wind source features. Technologies used to produce wind energy. Wind turbines, the principle of their operation. (Lectures prepared by the course instructor, recommended literature No. 1. p.449 to 450 and p.458 to 460, recommended No. 2. p.74 to 78)

8. Types of wind turbines. Horizontal axis turbines. Vertical axis turbines. Components of wind turbines, propellers, transmissions, generators, transformers, etc. (Lectures prepared by the course instructor, recommended literature No.1. Pp.460 to 463, recommended No.2. P.79 to 84)

9. Installation of wind turbines. Determining the conditions of their location. Integration in the electrical grid, environmental effects. The energy efficiency of wind turbines. Possibilities of their implementation in Albania. (Lectures prepared by the course instructor, recommended literature No.2. P.92 to 96)

10. Water energy. Water turbines, types. Pelton, Kaplan, Francis, Ossberger turbines. Construction and operation of water turbines. (Lectures prepared by the course instructor, recommended literature No.2. P.101 to 108)

11. Systems for the use of hydropower (hydropower plants). The Principle Scheme of energy heights in the construction of hydropower plants. Energy efficiency. (Lectures prepared by the course instructor, recommended literature No.2. P.110 to 120)

12. Geothermal energy. Thermal energy sources. Ways and opportunities for the use of thermal energy. Utilization of geothermal energy for the production of electricity as well as for heating buildings. (Lectures prepared by the course instructor, recommended literature No.1. Pp.330 to 340, recommended No.2. P.156 to 169)

13. Heat pumps, their working principle, construction, and their constituent components. Scope of application of heat pumps. Energy efficiency. The possibility of using them in our country. (Lectures prepared by the course instructor, recommended literature No.2. Pp.173 to 184)

14. Biomass energy. Bioenergy sources, urban and industrial solid waste sources. The technology of benefiting energy through them. Regulatory and institutional legislation on renewable energy. (Lectures prepared by the course instructor, recommended literature No.1. P.507 to 543, recommended No.2. P.128 to 153)

Teaching methods:

Power point presentations, through tables and interactive communications with the audience.

Exercises according to the topics given in lectures, demonstrations, and various simulations, which will serve students to know the sources of renewable energy, construction and operation of renewable energy production systems, trends, and areas of their application in our country.

(Face to face class, lab practice, on place visits etc.)

Laboratory work

LABORATORY No.1: Getting familiar with safety precautions when working on solar panels. Procedures to be performed to disconnect the high voltage current. Tension protective clothing etc.

LABORATORY No.2: Getting familiar with solar panels for water heating. Getting familiar with the construction and components that make up the system. Application in home heating, assembly, dismantling, and possible defects of components.

LABORATORY No.3: Vacuum tube collectors. Water reservoir and its capacity. Circulating water pump. Control and monitoring equipment. Solar heating efficiency. Solar systems combined with additional heating

LABORATORY No.4: Electricity generation through photovoltaic panels. Properties of photovoltaic circuits. Photovoltaic cells and their working principle. Structure, and construction of photovoltaic cells.

LABORATORY No.5: Photovoltaic group modules, series, and parallel connection of cells. Their practical application. Energy storage systems. The possibility of implementing solar systems for energy production.

LABORATORY No.6: Water energy. Water turbines. Construction and operation of water turbines. Their concretization in a hydropower plant in Rrubik or in Ulez, etc.

LABORATORY No.7: Geothermal energy. Heat pumps, their construction, the principle of work, and their constituent components. Assembly, disassembly, and possible defects of components. Circulating system fluid, leaks, testing, and elimination. Cases of application of heat pumps for heating homes, swimming pools, etc.

Assessment

The course grade consists of these components:

10% - Participation and activation in exercises

30% – Laboratory work

60% - Final exam

LITERATURE

Basic literature Lectures prepared by the course lecturer

Recommended reading

1. Alternativa te energjise se riperteritshme (Prof.Pellumb Berberi, Prof. Ilirjan Malollari, Prof. Elmaz Shehu, Prof. Nevton Kodhelaj, Dr. Konalsi Gjoka etj, viti 2020

2. Burimet e riperteritshme te energjise (Naser sahiti, Maliq Pireci, Besim Veselaj)

Syllabus

6. FUNDAMENTALS OF HEATING AND HEATING SYSTEMS

Course topic

Renewable energy sources

Number of credits

6 ECTS

Course responsible

Professional College of Tirana

Electro-Mechanics and Applied System Department

Prof. Dr. Marenglen Gjonaj (Head of Department)

Co-funded by the Erasmus+ Programme of the European Union

Study Programme: Ventilation and air conditioning technology

Course lecturer

Msc. Eng. MSc. Marjeta DHIMA

Prerequisites

Students must already have a general knowledge of Physics, Thermotechnics, and Fundaments of Hydraulics.

Learning outcomes

Upon course completion, students will be able to use the basic theoretical and practical concepts and laws of the subject, as well as have the necessary skills to solve the technical problems they will encounter while working in their profession, in terms of designing, assembling, using and maintaining heating plants and solar panels. Students will be able to use the basic theoretical and practical concepts and laws of the subject. They will have the necessary skills to solve the technical problems they will encounter while working in their profession.

Specifically, students will know, use and maintain the main heating systems and equipment, such as:

- boilers,
- radiant and convective heating radiators,
- floor and ceiling heaters,
- solar panels for hot water and sanitary water,
- tanks and their connection to the boiler,
- control and security devices, etc.

Co-funded by the Erasmus+ Programme of the European Union

Abstract

The course contains basic theoretical and practical information on heating bases and heating systems. Specifically, the basic concepts for heat and its transmission methods, the main requirements of thermal comfort, thermal losses and their analysis, heating systems and their components, solar panels, types, installation, operation and use for hot water and heating systems are treated.

The objective of the course is to enable students to use the basic theoretical and practical concepts and laws of the course and to have the necessary skills to solve technical problems that they will encounter while working in their profession.

For normal course development, students must have prior knowledge of General Physics, Thermotechnics and Basics of Hydraulics.

Course Objectives:

1. Heat and its transmission.
2. Laws of Thermodynamics.
3. Heat losses.
4. Thermal Balance and thermal insulation of the building.
5. Heat plants and their components.
6. Thermal power plants (boilers).
7. Solar panels.

COURSE CONTENT

Week Lectures topic

Methodology: Direct communication, slide demonstration, activation through concrete examples, questions and discussions.

1 Program presentation, purpose, objectives. Basic knowledge of Thermotechnics. Technical thermodynamics, key definitions. The first law and the second law. pp. 1-3

2 Energy and its forms. Heat, basic concepts. pp.1-2

3 Heat transmission and its ways. Transmission by conduction, convection, radiation and composite. pp.3-11

4 Climate and thermal comfort. Comfort requirements and their analysis. Thermal comfort equation. pp.12-16

5 Termophysics of the building and its thermal balance. Thermal charges for heating. p. 17

6 Thermal losses with heat transfer from surrounding structures and their additions. Thermal insulation in the surrounding walls of the building. pp.17-22

7 Thermal losses from infiltrated air. Condensation phenomenon. Glasser Diagram. Energy consumption required for heating. Volumetric coefficient of thermal losses. pp. 22-23

8 Heating methods and their classification. Heat transporters. Water heating plants. Natural and forced circulation circuits. Delivery circuits and monotube circuits. Measurement of pipelines. pp. 24-35.

9 Heat emitting equipment. Basic criteria, design temperatures. Radiant and convective heaters (radiators). Types, their selection, calculation and placement. pp. 36-53

10 Thermal power plants. Boilers and their classification, burners, chimneys, circulating pumps, their selection and installation. Expansion vessels, their types, calculation and assembly. Security, protection and control equipment. pp. 54-68

11 Renewable energies, solar energy, solar radiation and its spread, solarization in Albania. Classification of solar thermal systems. pp. 69-73

12 Solar panels with thermosyphon and those with forced circulation as well as boilers integrated in the scheme. Functional schemes, analysis of components. pp. 64-82

13 Solar panel collector (mirror), water collector (boiler), antifreeze, piping and plumbing pp. 82-92

14 Working order for mounting solar panels, ways of mounting. Technical conditions in installation, technical warranty, service and maintenance of solar panels pp. 92-100

15 Exam

Week Exercises

1-15 The exercises cover the whole range of issues, in line with the Course Program.

Methodology: Demonstration of concrete examples and preparation by the students of the course assignment in accordance with the program.

Java Laboratory/Practice Plan

Methodology: Individual work and group work by topics. Laboratory work and teaching practices are finalized with the relevant report by each student.

2 Rules of technical security. Equipment, work tools, control and service. (Machine-scoop of Air conditioning technology in Professional College of Tirana)

4 Boilers, types, components and commissioning. (Machine-scoop of Air conditioning technology in Professional College of Tirana)

6 Scheme of connection of the boiler to the heat emitting equipment. Radiant and convective heating radiators, floor and ceiling heaters. (Machine-scoop of Air conditioning technology in Professional College of Tirana)

8 Connection of circulating pump, expansion vessel and safety control apparatus. Simulators no. 2. Experiments no. 4. (Machine-scoop of Air conditioning technology in Professional College of Tirana)

10 Installation of solar panel for hot water. Reservoir and its connection to the boiler. (Machine-scoop of Air conditioning technology in Professional College of Tirana).

12 Using the Simulator (stand) Nr. 2 for hot water and sanitary water. Experiments No. 5 and 6. (Machine-scoop of Air conditioning technology in Professional College of Tirana)

14 Practical visit to a private business. Application of a heating system with boilers and solar panel.

Teaching methods:

PowerPoint presentations, interactive communications with the audience.

Exercises according to the topics given in lectures, face to face class, lab practice etc.)

Attendance: of the learning process in lectures / exercises is compulsory at 60% (sixty) and is mandatory for laboratories up to 80% (eighty).

Assessment

Active participation in exercises and Course Assignment	10 %
Laboratory / Practice	30 %
Final exam	60 %

Recommended reading

Basic Written lectures for students. Marjeta DHIMA, Tirana

Recommended "Thermotechnical plants (heating and air conditioning)1". R.ALUSHAJ,Tirana, 2012

Syllabus

7. ELECTRIC AND HYBRID VEHICLES

Course topic

Electric and hybrid vehicles

Number of credits

6 ECTS

Course responsible

Professional Collage of Tirana

Electro-Mechanical and Applied Systems Department

Prof. Dr. Marenglen Gjonaj (Head of Department)

Course lecturer

Msc. Eng. Ilir Palushi

Msc. Eng. Arjan Kullolli

Prerequisites

General education in physics, mathematics, fluid mechanics etc.

Learning outcomes

This course consists of both theoretical and laboratory components. This course intends to provide students with basic operating concepts, types, and realizations of electric and hybrid vehicles. This course will address the advantages and increasing trends of the use of these vehicles, construction, and components of electric and hybrid vehicles, high voltage batteries, management systems of these vehicles, etc. Students will be able to know the latest trends of electric and hybrid vehicles, and their priorities, especially in relation to gas emissions, environmental protection and global warming. Students will be able to explain the main systems and aggregates that make up the vehicle and take care of electronic management system, battery charging methods, inverter, etc. They will perform periodic

checks, maintenance and safety measures in electric and hybrid vehicles and discuss and assess energy efficiency in electric and hybrid vehicles.

Abstract

At the end of this course, it is expected that students have received the necessary knowledge on the construction and operation of electric and hybrid vehicles and the trend of their development. Students will have the opportunity to practice the knowledge gained using special tools and measuring instruments in the course laboratory.

Content

During this course, students will have acquired basic concepts related to:

1. Knowledge of the phenomenon of global warming. What is global warming, its consequences, the greenhouse effect, the gases that affect global warming, the potential for global warming, and the measures that need to be taken to curb the phenomenon of global warming. (Lectures prepared by the course lecturer, recommended literature)

2. Renewable energy sources. Electricity generation through photovoltaic panels. Properties of photovoltaic circuits. Photovoltaic cells and their working principle. Structure, construction, and efficiency of photovoltaic cells. (Lectures prepared by the course lecturer, recommended literature)

3. Application of photovoltaic panels in electric vehicles. The way of their integration in the vehicle. Energy efficiency. International agreements on curbing the phenomenon of global warming. Regulatory and institutional legislation on global warming and renewable energy. (Lectures prepared by the course lecturer, recommended literature)

4. Electric vehicles. History and trend of electric vehicles. Types of electric and hybrid vehicles. Clean electric vehicles (EV), the advantages and disadvantages of electric vehicles compared to traditional vehicles. Construction and components that make up the clean electric vehicle. (Lectures prepared by the course lecturer, recommended literature)

5. High voltage batteries, their development, and types. Construction of high voltage batteries, nickel-metal hydrate batteries, lithium-ion batteries, and other types of batteries, their lifespan. Battery Management Unit (BMS). Battery recharging, charging modes, types, and features. Types of charging plugs and sockets. (Lectures prepared by the course lecturer, recommended literature)

6. Inverter solar photovoltaic panels (with integrated battery charger) for electric vehicles. Charging with a photovoltaic panel with inverter and integrated battery charger, dedicated to electric vehicles.

Electric vehicles with integrated photovoltaic panel.

Construction of the charging plant in a domestic setting. Inductive charging method. Inverter and power control module (PCM - Power Control Module) function, diagnose, their dismantlement and assembling in the vehicle. Electrical voltage in the electrical system of the vehicle (Lectures prepared by the course lecturer, recommended literature).

7. The electric motor in electric and hybrid vehicles. Ways of assembling them in the vehicle, vehicles with four electric motors. Construction and operation of electric motors, types, synchronous and asynchronous motors. (Lectures prepared by the course lecturer, recommended literature)

8. The braking system of an electric vehicle. Servo brake, vacuum pump. Power transmission, modes. Average consumption and cost per kilometer in electric vehicles. (Lectures prepared by the course lecturer, recommended literature)

9. Braking energy regenerative system. Conversion of kinetic energy into electricity. (Lectures prepared by the course lecturer, recommended literature)

10. Cooling, heating and air conditioning system in electric and hybrid vehicles. Construction and different ways of their realization and functioning. Components of the system, their construction and operation. (Lectures prepared by the course lecturer, recommended literature).

11. Hybrid vehicles, advantages and disadvantages compared to traditional vehicles. The main differences of hybrid vehicles from electric ones. Constructive scheme of hybrid vehicles and their classification. The main elements that make up the vehicle. Construction structure, types of hybrid vehicles. Hybrid vehicles with serial propulsion, parallel propulsion, and those with bimodal (mixed) propulsion. (Lectures prepared by the course lecturer, recommended literature.

12. Braking energy recovery. Braking energy recovery. Judgment on the choice of hybrid vehicle type. Hydrogen vehicles, operating scheme, components, hydrogen unit, batteries. Advantages and disadvantages compared to electric and hybrid vehicles. Energy efficiency in hybrid vehicles (Lectures prepared by the course lecturer, recommended literature).

13. Maintenance and repairs, electrical hazards concerning maintenance and repair of electric and hybrid vehicles. Potential risks. Safety rules for those working with electric and hybrid vehicles. Procedures to be performed to disconnect the high voltage current. (Lectures prepared by the course lecturer, recommended literature).

14. Work tools and personal protective equipment used in electric and hybrid vehicles. Energy efficiency and fuel consumption in electric and hybrid vehicles. (Lectures prepared by the course lecturer, recommended literature)

Teaching methods: PowerPoint presentations, through tables and interactive communications with the audience, face to face classes, lab practice.

-Exercises in accordance with the topics covered in lectures, demonstrations and various simulations, which will help students to better understand the construction, operation of systems and defects, controls, and repair of defects of electric and hybrid vehicles.

Laboratory work

LABORATORY No.1: Getting familiar with safety precautions in cases when working on electric and hybrid vehicles. Procedures to be performed to disconnect the high voltage current. Placing warning signs. Work tools and personal protective equipment used in electric and hybrid vehicles. Tension protective clothing etc.

LABORATORY No.2: Getting familiar with an electric vehicle (EV), advantages and disadvantages of electric vehicles. Getting familiar with the construction and components that make up the clean electric vehicle. Getting familiar with high voltage batteries of an electric vehicle. Construction and structure of high voltage battery. Meeting, unplugging the battery, assembling, and disassembling it. Battery Management Unit (BMS).

LABORATORY No.3: Getting familiar with the ways of recharging batteries. The battery charger integrated into the vehicle and the one integrated into the recharging column. Limits for recharging and discharging high voltage batteries. Types of charging sockets and plugs.

LABORATORY No.4: Production of electricity through photovoltaic panels. Properties of photovoltaic circuits. Photovoltaic cells and their working principle. Structure, and construction of photovoltaic cells. Their application in the vehicle.

LABORATORY No.5: Inverter and power control module (PCM - Power Control Module) function, diagnostic methods, assembly, and disassembly. The electric motor in electric and hybrid vehicles. Ways of setting it up in the vehicle. Diagnosis, disassembly-assembly of the engine. Braking system and power transmission.

LABORATORY No.6: Cooling, heating, and air conditioning system in electric and hybrid vehicles. The components that make up the system, their construction, and operation. Dismantling and assembling system elements. Vehicle braking system and power transmission

LABORATORY No.7: Constructive scheme of a hybrid vehicle. The main elements that make up the vehicle. Structure of the hybrid vehicle (with serial propulsion, parallel propulsion, or bimodal (mixed) propulsion. Main differences between hybrid vehicles and electric ones.

Assessment

The course grade consists of these components:

10% - Participation and activation in exercises

30% – Laboratory work

60% - Final exam

Literature

Basic literature Lectures prepared by the course lecturer

Recommended reading Emanuele Biagetti “Veicoli elettrici e ibridi”

Ilirjan Malollari “Alternativa te energjise se riperteritshme”

4.BACHELOR COURSES OF UET

ENGINE - List of Courses - EUT

No.	Name of the course	Study program	Lecturer	Category	
				Mandatory / Elective	New/ Updated
1	Introduction to Energy	BA Industrial Engineering	Prof. Dr.Angjelin Shtjefni/ Hasimin Keci	Mandatory	New
2	Introduction to Turbomachine	BA Industrial Engineering	Prof. Dr. Andonaq Londo/ Hasimin Keci	Mandatory	New
3	Science and Materials Technology in the field of Energy	BA Industrial Engineering	Dr. Eng. Kreshnik Hakrama	Mandatory	Updated
4	Electrical Plants Systems and Energy	BA Industrial Engineering	Msc. Jani Petro	Elective	Updated
5	Mechanical characteristics of Materials in the field of Energy	BA Industrial Engineering	Dr. Eng. Kreshnik Hakrama	Elective	Updated
6	Energy and Environment	BA Industrial Engineering	Dr. Fatri Morina	Elective	New

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Syllabus

1. "Introduction to energy"

Name of the course

Introduction to energy

Course topic

Energy and its resources

Duration:

6 ECTS (15 weeks)

Participants of the course:

BSc students in industrial engineering

Educational background:

General education in physics, mathematics etc.

Course responsible

Department of Engineering and Architecture

Course lecturer / tutor

Prof. Dr. Eng. Angjelin Shtjefni

Msc. Eng. Hasimin Keçi

Educational Prerequisites

Previous knowledge on technical physics, fluid mechanics etc.

Co-funded by the Erasmus+ Programme of the European Union

Learning outcomes

Upon successful completion of this course students should be able to:

Knowledge:

- Knowledge about types of resources of energy.
- Knowledge about systems of energy.

Skills:

- Compare the resources of energy.
- Calculate main coefficients of the system of energy.

Competence:

- Analysis about the possibilities of use of each resource of energy in Albania
- Analysis of the system of production and transmission of energy

Abstract

Today the problem of energy is very important. This course aims to give the students the concepts of the energetical system. During this course the students are going to learn for the main resources of energy that can be used in Albania.

Content

1. Introduction to energy.

In this topic the students are going to know the main concepts that are going to be treated

during the course.

2. Sources of renewable of energy, types of sources of renewable energy.

In this topic the students are going to learn about the sources of renewable energy.

3. Energy of water.

In this topic the students are going to learn about the use of water in the production of energy.

4. Main equipment's that are used to produce energy from water.

In this topic the students are going to learn about the main equipment's that are used to produce energy from water.

5. Wind as a source of energy

In this topic the students are going to learn about the wind as a source of energy.

6. Solar energy

During this topic the students are going to use about the solar energy and its use in Albania.

7. Photovoltaic energy

In this topic the students are going to learn about the multiuse of photovoltaic energy

8. Geothermal energy

In this topic the students are going to learn about the geothermal energy and the application of this type of energy in Albania.

9. Biomass

In this topic the students are going the concept of biomass and how can we produce energy form biomass.

10. Conventional sources of energy

In this topic the students are going to learn the concept of conventional sources of energy and the use of this type of sources in Albania.

11. Main indicators of TEC's

During this topic the students are going to learn the main indicators of TEC's and how can we calculate them.

12. Conventional sources of energy vs. renewable sources of energy

During this topic the students are going to learn how to compare conventional sources with renewable sources of energy.

13. Energy system reliability indicators.

During this topic the students are going to learn which are the energy systems reliability indicators and how to calculate them.

14. The role of legislation in energy developments, electricity developments in Albania and the functioning of the ERE (power regulatory entity).

In this topic the students are going to learn about the role of legislation in energy developments in Albania.

Teaching methods

During this course are going to be used classic teaching methods that aims to develop an interactive lesion.

Assessment

The course grade consists of these components:

10% - Participation during seminars

20% – Final project

30% – Middle term exam

40% - Final exam

Recommended reading

Soft S., Power system economics, IEE Wiley, 2002

Harris Ch., Electricity markets, pricing, structures and economics, Finance Wiley, 2006

Paloka A., Burimet e rinovueshme të energjisë, SHBLU, 2010.

Berisha Xh., Burimet e energjisë, 2011

Syllabus

2. "Introduction to turbomachine"

Name of the course

Introduction to turbomachines

Course topic

Turbomachines

Duration:

6 ECTS (15 weeks)

Participants of the course:

BSc students in industrial engineering

Educational background:

General education in physics, mathematics, fluid mechanics etc.

Course responsible

Department of Engineering and Architecture

Course lecturer / tutor

Prof. Dr. Eng. Andonaq Londo

Msc. Eng. Hasimin Keçi

Co-funded by the
Erasmus+ Programme
of the European Union

Educational Prerequisites

Previous knowledge on technical physics, fluid mechanics etc.

Learning outcomes

Upon successful completion of this course students should be able to:

Knowledge:

- Knowledge about types of turbomachines
- Knowledge about main indicators of turbomachines.

Skills:

- Compare turbomachines among them.
- Calculation of main indicators of these machines

Competence:

- Analysis of main indicators values

Abstract

During this course students are going to learn the importance and the use of turbomachines. Also, they are going to learn the main indicators that we use for the analysis of a turbomachine and how they are calculated.

Content

1. Differential equations for 1 dimensional flow.

In this topic the students are going to know the main differential equations for 1 dimensional flow.

2. Determination of flow velocity.

In this topic the students are going to learn about the flow velocity.

3. Maximum flow.

In this topic the students are going to learn about maximum flow and how can it be calculated.

4. Grid. Grid parameters.

In this topic the students are going to learn about the grid and grid parameters.

5. Axial compressor

In this topic the students are going to learn about the axial compressor and its indicators.

6. Axial turbine

During this topic the students are going to use about the axial turbine and its indicators.

7. Axial asymmetric flow

In this topic the students are going to learn about the axial asymmetric flow and its features

8. Gas turbines

In this topic the students are going to learn about the gas turbines and its features

9. Pumps

In this topic the students are going to learn about pumps and their features

10. Hydraulic turbines

In this topic the students are going to learn the hydraulic turbines and its features

11. Blade construction

During this topic the students are going to learn about blade construction

12. Radial grid

During this topic the students are going to learn about radial grid and its features

13. Axial grid of blades.

During this topic the students are going to learn what is an axial grid and the features of axial grid of blades

14. Hydraulic turbines

In this topic the students are going to learn about hydraulic turbines and its features

Teaching methods

During this course are going to be used classic teaching methods that aims to develop an interactive lesion.

Assessment

The course grade consists of these components:

10% - Participation during seminars

20% – Final project

30% – Middle term exam

40% - Final exam

Recommended reading

Londo A., Turbomakinat, SHBLU, 2014

Cengel Y., Cy,bala J., Fluid mechanics, fundamentals and applications, McGraw Hill, ISBN 0072472367

Wright T., Gerhart P., Fundamentals of turbomachines, Springers, 2016, ISBN 9789402403480

Co-funded by the
Erasmus+ Programme
of the European Union

Syllabus

3. "Science and materials technology in the field of energy"

Name of the course

Science and materials technology in the field of energy

Course topic

Materials that are used in the field of energy

Duration:

6 ECTS (15 weeks)

Participants of the course:

BSc students in industrial engineering

Educational background:

General education in physics, mathematics, chemistry etc.

Course responsible

Department of Engineering and Architecture

Course lecturer / tutor

Dr. Eng. Kreshnik Hakrama

Educational Prerequisites

Previous knowledge on technical physics, fluid mechanics etc.

Co-funded by the
Erasmus+ Programme
of the European Union

Learning outcomes

Upon successful completion of this course students should be able to:

Knowledge:

Knowledge about types of materials that are used in the field of energy

Knowledge about features of materials that are used in the field of energy

Skills:

Compare materials that are used in the field of energy.

Calculation of main indicators of these materials

Competence:

Analysis of materials that are used in the field of energy

Abstract

This program describes the mechanical properties of materials that are used in the field of energy, mechanisms of their reinforcement the destruction of these materials etc.

Content

Classification of materials

In this topic the students are going to know the classification of materials that are used in the field of energy

Defect of materials.

In this topic the students are going to learn about the defects of materials, how to diagnose and fix them.

Diffusion and factors affecting it.

In this topic the students are going to learn about diffusion and factors affecting it

Mechanical properties of materials

In this topic the students are going to learn about the mechanical properties of materials

Dislocations and reinforcements mechanisms

During this topic the students are going to use about the dislocations and reinforcements mechanisms.

Destruction of materials

In this topic the students are going to learn about the destruction of materials.

Fatigue, creep and the factors affecting them.

In this topic the students are going to learn about the fatigue, creep and the factors affecting them.

Metal alloys and applications in the field of energy.

In this topic the students are going to learn about metal alloys and their applications in the field of energy.

Manufacturing of metals used in the field of energy

In this topic the students are going to learn the forming operations, casting, welding etc.

Structures of ceramics used in the field of energy

During this topic the students are going to learn about crystalline and non-crystalline structure, silicate glass etc.

Manufacturing of ceramics used in the field of energy.

During this topic the students are going to learn about processes of manufacturing of ceramics used in the field of energy.

Polymers used in the field of energy.

During this topic the students are going to learn about plastics and polymers used in the field of energy.

Types of polymers

In this topic the students are going to learn about types of polymers that are used in the field of energy.

Composites

In this topic the students are going to learn about types of composites that are used in the field of energy.

Teaching methods

During this course are going to be used classic teaching methods that aims to develop an interactive lesion.

Assessment

The course grade consists of these components:

10% - Participation during seminars

20% – Final project

30% – Middle term exam

40% - Final exam

Recommended reading

William D. Calister Jr, Materials science and engineering an introduction 10th edition, 2018, John Willey & Sons

Spring 2010 MSE 2009 – Section-1, Introduction to the science and engineering of materials

Co-funded by the
Erasmus+ Programme
of the European Union

Syllabus

4."Electrical plant systems and energy"

Name of the course

Electrical plant systems and energy

Course topic

Electrical plant systems and energy, systems, plants.

Duration:

6 ECTS (15 weeks)

Participants of the course:

BA Industrial Engineering

Educational background:

Open to students enrolled in Bachelor program

Course responsible

Department of Engineering and Architecture

Course lecturer / tutor

Msc. Eng. Jani Petro

Educational Prerequisites

Previous understanding of mathematics, energy, physics, electronics etc.

Co-funded by the Erasmus+ Programme of the European Union

Learning outcomes

Upon successful completion of this course students should be able to:

Knowledge:

- Knowledge on plants in general.
- Knowledge in electrical plants.

Skills:

- Analyse advantages and disadvantages of each type of plant.
- Analysis of problems that are related with electrical plants.
- Solve different types of problems related with plants.

Competence:

- Making decision related with electrical plants.

Abstract

This course aims to give the students the basic knowledges about electrical plants. During this course students are going to learn what is a electrical plant, from what its composed, what are the typical problems related with them and how to solve these problems.

Content

1. Introduction to electrical plants.

In this topic the students are going to be presented with electrical plants.

2. Power plants.

In this topic the students are going to learn what is a power plant, its characteristics, its main indicators and how to calculate them.

3. Turbines and engines.

In this topic the students are going to learn about the role that the turbines and engines have in the work of an electrical plant. They are also going to know the main characteristics of engines and turbines used in this type of plants.

4. Electrical system of plants.

In this topic the students are going to learn the characteristics of the electrical system of plants. They are going to learn the main indicators of this system, how to calculate them and how to analyse based on the values of these indicators.

5. Instruments and control.

In this topic the students are going to learn about the process of control in the work of these systems and the instruments used to do this control.

6. Nuclear power systems.

In this topic the students are going to learn what is a nuclear power system, how it functions, what are its main indicators, what do they tell us about, how to calculate them and how to analyse based on their values.

7. Repetition.

In this topic it is going to be done a repetition of all main concepts treated in previous topics.

8. Hydropower.

In this topic the students are going to be introduced with the concept of hydropower, where is it used, its advantages and disadvantages.

9. Alternative sources of energy 1.

In this topic the students are going to learn and discuss about alternative sources of energy and why they are so important nowadays.

10. Alternative sources of energy 2.

In this topic the students are going to learn and discuss about alternative sources of energy and why they are so important nowadays.

11. International security standards.

In this topic the students are going to learn what is a security standard and what are international security standards.

12. Environmental control.

In this topic the students are going to learn about that electrical plants have in the environment and why should this impact be controlled and how can we control it.

13. Security system.

In this topic the students are going to learn what is the security system, why it is important and what are the means we can use to ensure it.

14. Quality control.

In this topic the students are going to learn what is the important of quality of the plants and the procedure that must be followed to ensure it.

Teaching methods

During the course interactive teaching methods are going to be used to make sure that the students will understand all the concepts that are going to be treated.

Assessment

The course grade consists of these components:

10% - Active participation in the seminar hours.

20% - Final project.

30% - Middle term exam.

40% - Final exam.

Recommended reading

Nag. P. K. – Power plant engineering 3rd edition, Tata McGraw Hill Publishing Companies, ISBN 9780070648159.

Syllabus

5 "Mechanical characteristics of materials in the field of energy"

Name of the course

Mechanical characteristics of materials in the field of energy

Course topic

Material used in the field of energy, mechanical characteristics, columns, rotations, displacements etc.

Duration:

6 ECTS (15 weeks)

Participants of the course:

BSc. Students in civil engineering

Educational background:

General education in mathematics, physics, rational mechanics, material resistance etc.

Course responsible

Department of Engineering and Architecture

Co-funded by the
Erasmus+ Programme
of the European Union

Course lecturer / tutor

Dr. Eng. Kreshnik Hakrama

Educational Prerequisites

Previous understanding of mathematics, physics, electronics, rational mechanics etc.

Learning outcomes

Upon successful completion of this course students should be able to:

Knowledge:

- Knowledge on mechanics of materials used in the field of energy;
- Knowledge in mechanical characteristics of materials used in the field of energy;
- Knowledge of main mechanical indicators of materials used in the field of energy

Skills:

- Calculate main mechanical indicators of materials used in the field of energy;
- Analysis of the values of the main mechanical indicators of materials used in the field of energy;

Competence:

- Making decision based on the analysis of the values of main mechanical indicators of the materials used in the field of energy.

Co-funded by the Erasmus+ Programme of the European Union

Abstract

It is very important for engineers to know the mechanical characteristics of materials used in the field of energy. During this course the students are going to learn about the mechanical indicators of these materials, analyze these values and making decision based on these calculations.

Content

1. Introduction to the mechanics of materials.

In this topic the students are going to be presented with the mechanics of materials.

2. Strain and deformation

In this topic the students are going to learn the concepts of strain and deformation, mathematical indicators of strain and deformation, how to calculate them and how to analyze them.

3. Axially loaded rods.

In this topic the students are going to learn the concept of axially loaded rods.

4. Twisting

In this topic the students are going to learn the concept of twisting, it mathematical indicators, how to calculate and analyze them.

5. Shear forces and bending moments.

In this topic the students are going to learn about shear forces and bending moments, their mathematical indicators, how to calculate and analyze them.

6. Bending deformation (basic issue).

In this topic the students are going to learn about basic issues of bending deformation.

7. Bending deformation (advanced issue).

In this topic the students are going to learn about advanced issues of bending deformation.

8. Analysis of rotation and displacement.

In this topic the students are going to learn the process of analysis of rotation and displacement.

9. Applications of rotations and displacements.

In this topic the students are going to be introduced with the applications of rotations and displacement.

10. Beam curvatures.

In this topic the students are going to learn about beam curvatures, their mathematical indicators, how to calculate and analyze them.

11. Statically undefined beams.

In this topic the students are going to learn about statically undefined beams, their mathematical indicators, how to calculate and analyze them.

12. Columns in eccentric printing.

In this topic the students are going to learn about columns in eccentric printing and their calculation.

13. Geometric characteristics of cross sections.

In this topic the students are going to learn about geometric characteristics of cross sections and their calculation.

14. Section of tasks.

In this topic the students are going to learn about section of task.

Teaching methods

During the course interactive teaching methods are going to be used to make sure that the students will understand all the concepts that are going to be treated.

Assessment

The course grade consists of these components:

10% - Active participation in the seminar hours.

20% - Final project.

30% - Middle term exam.

40% - Final exam.

Recommended reading

Fagu M., Rezistenca e materialeve, SHBLU, 1974.

Gere J. M., Barry J. G., Mechanics of materials, 2013, ISBN 9781111577742

Syllabus

6.“Energy and Environment”

Name of the course:

Energy and Environment

Course topic:

Energy, Climate Change and Sustainability

Duration:

6 ECTS (15 weeks)

Participants of the course:

BA Industrial Engineering

Educational background:

Open to students enrolled in Bachelor program

Course responsible:

Co-funded by the Erasmus+ Programme of the European Union

Department of Engineering and Architecture

Course lecturers:

Dr. Fatri Morina

Educational prerequisites

No specific prerequisites. Open to students enrolled in Bachelor program

Learning outcomes

In terms of learning outcomes, after the completion of this course students should be able to:

- Knowledge

o Understand the Environment: Resources, Climate, Energy and Sustainability.

o Understand the Climate System: What is Climate Change, Carbon Cycle and the Relationship between the Land, the Ocean and the Atmosphere?

o Have knowledge on Effects of Climate Change on Ecosystems.

o Have knowledge on Energy and Environmental Policies

- Skills

o uses basic knowledge about different forms of production, transport and use of electricity and heating /cooling to solve simple problems.

o to use the knowledge to explain the relationship between the use of energy resources and environmental impacts

o to analyze the consequences of today's energy consumption

o to evaluate energy and environmental issues and policies

- Competence

o has basic competence regarding environmental impacts arising from different energy carriers and technical solutions

o reflects and evaluate the environmental impact of energy production and the relationship between energy production, consumption and climate change

o to independently analyze problems and be able to critically assess and provide recommendations.

Abstract

This course introduces students to the fundamentals of energy and environment, with a specific focus on Energy, Climate Change and Sustainability. This course covers a wide range of topics from understanding the Environment: Resources, Climate, Energy and Sustainability to energy and environmental policies. The course pays particular attention to the energy-environment nexus, including the challenge of low-carbon development in an era of climate change.

Content

I. Understanding the Environment: Resources, Climate, Energy and Sustainability. Understanding the environment and our role in it. Environmental issues.

II. Energy: Basics, concepts and qualification. What is energy? Form and sources of energy.

III. The climate system. What is Climate Change? The Global System Concept. The Carbon Cycle and the Hydrologic Cycle.

IV. Climate Change. Fossil fuels and Climate Change. Contributors to Climate Change and pollution.

V. Results of Climate Change on ecosystems. Forests, deserts, wildfire, marine environment, sea-level rise.

VI. Energy-Environment nexus I. Energy resources, production, consumption and impacts.

VII. Energy-Environment nexus II. Energy resources, production, consumption and impacts.

VIII. Scenario Analysis I.

IX. Renewable energy resources. Solar, geothermal, wind, hydropower, bioenergy.

X. Environmental policies and actors.

XI. Energy policies and actors.

XII. Political and geopolitical consideration. Energy and environment issues implications.

XIII. Economic dimension of energy and environment.

XIV. Public perception. What the public think about energy and environment threats.

XV. Scenario analysis II.

Teaching methods

A combination of lecture and seminar, in an interactive environment. PowerPoint materials, quizzes, individual and group work, and case studies.

Assessment

The course grade consists of these components:

10% - Active Participation in seminars

20% – Final project/ Essay

30% – Mid-term exam

40% - Final exam

Recommended reading

Kerr, J. (2018) Introduction to energy and climate: developing a sustainable environment. Taylor & Francis

Botkin, D. and Keller, E. (2014) Environmental Science: Earth as a Living Planet. John Wiley and Sons.

Yergin, D. (2011). The Quest: Energy, Security, and the Remaking of the Modern World, Penguin