Study Plan

School: School of Sciences and Technology
Degree: Bachelor
Course: Renewable Energies Engineering (cód. 486)

1st Year - 1st Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
MAT0905L	Mathematical Analysis I	Mathematics	6	Semester	162
MAT0900L	Linear Algebra and Geometry I	Mathematics	6	Semester	156
FIS0703L	General Physics I	Physics	6	Semester	158
QUI1090L	General Chemistry	Chemistry	6	Semester	156
INF0878L	Programming	Informatics	6	Semester	156

1st Year - 2nd Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
MAT0906L	Mathematical Analysis II	Mathematics	6	Semester	162
MAT0925L	Introduction to Probability and Statistics	Mathematics	6	Semester	154
FIS0704L	General Physics II	Physics	6	Semester	158
FIS0528L	Applied Thermodynamics	Mechanical Engineering	6	Semester	156
FIS0522L	Mechatronics System Design	Mechanical Engineering	6	Semester	156

2nd Year - 3rd Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
MAT0907L	Mathematical Analysis III	Mathematics	6	Semester	162
FIS1803L	Applied Electronics	Electrotechnical Engineering	6	Semester	156
FIS0510L	General Electrotechnics	Electrotechnical Engineering	6	Semester	156
FIS0524L	Applied Mechanics	Mechanical Engineering	6	Semester	156
FIS10927L	Fluid Mechanics	Mechanical Engineering	6	Semester	156

2nd Year - 4th Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
FIS0525L	Mechanics of Materials	Mechanical Engineering	6	Semester	156
FIS0512L	Electrical Machines	Electrotechnical Engineering	6	Semester	156
FIS0506L	Control and Automation	Electrotechnical Engineering	6	Semester	156
FIS1811L	Environment Energy and Sustainability	Energy and Environment	6	Semester	156
FIS10987L	Energy and Mass Transfer	Mechanical Engineering	6	Semester	156

3rd Year - 5th Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
FIS1805L	Solar Thermal Energy	Mechanical Engineering and Electrotechnical Engineering	6	Semester	156
FIS1808L	Wind Energy	Mechanical Engineering and Electrotechnical Engineering	6	Semester	156
FIS1809L	Ocean Energy	Mechanical Engineering and Electrotechnical Engineering	6	Semester	156
FIS10989L	Photovoltaic Solar Energy	Mechanical Engineering and Electrotechnical Engineering	6	Semester	156
FIS10990L	Biomass and Fuels Energy	Mechanical Engineering and Electrotechnical Engineering	6	Semester	156

3rd Year - 6th Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
FIS10928L	Project of Energy Systems	Mechanical Engineering and Electrotechnical Engineering	12	Semester	312
FIS1812L	Energy Storage	Mechanical Engineering and Electrotechnical Engineering	6	Semester	156
FIS1813L	Electric Energy Systems	Electrotechnical Engineering	6	Semester	156

Group of Options

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
FIS1814L	Energy in the Building Sector	Mechanical Engineering and Electrotechnical Engineering	6	Semester	156
FIS1815L	New Energetic Vectors	Mechanical Engineering	6	Semester	156
FIS1816L	Geothermics	Mechanical Engineering	6	Semester	156
GES0027L	Organizational Behaviour and Human Resources Management	Management	6	Semester	157
GES10929L	Principles of Management	Management	4	Semester	112
PED0418L	Communication in Professional Context	Education Sciences	2	Semester	52

Conditions for obtaining the Degree:

*** TRANSLATE ME: Engenharia de Energias Renováveis

Para obtenção do grau de licenciado em Engenharia de Energias Renováveis é necessário obter aprovação a 174 ECTS em unidades de curriculares obrigatórias e 6 ECTS em unidades curriculares optativas distribuídas da seguinte forma:

1º Ano

1º Semestre:

5 UC Obrigatórias num total de 30 ECTS

2º Semestre

5 UC Obrigatórias num total de 30 ECTS

2º Ano

3º Semestre

5 UC Obrigatórias num total de 30 ECTS

4º Semestre

5 UC Obrigatórias num total de 30 ECTS

3º Ano

5º Semestre

5 UC Obrigatórias num total de 30 ECTS

6º Semestre

3 UC Obrigatórias num total de 24 ECTS

1 UC Optativa num total de 6 ECTS ***

Program Contents

Back

Mathematical Analysis I (MAT0905L)

Sequences and series.
Real functions of one variable.
Differential calculus.
Sequences and series of functions.
Integral calculus and applications

Back

Linear Algebra and Geometry I (MAT0900L)

Systems of linear equations.
Matrices.
Determinants.
Vector spaces.
Linear applications.
Eigenvalues and eigenvectors. Jordan canonical form.
Geometry of plane and space.
Quadratic forms.

Back

General Physics I (FIS0703L)

1. Introduction to Modern and Contemporary Physics
- Physics as Science: fundamental forces, physical laws and constants, models and orders of magnitude; main subjects of present Physics.
- Relativity: main concepts, speed of light.
- Quantum Physics: wave-particle nature of matter, quantization and Planck's constant; the photoelectric and Compton effects; the spectral lines.
- Present research on Physics: references to microscopic Physics, superconductivity and nanotechnology e applications; graphene.

2. Ondulatory Phenomena and Optics
- Harmonic oscillator; electromagnetic waves and waves in matter; the Doppler effect. Lasers.
- Geometrical optics: reflection and refraction; lenses and mirrors; optical devices. Interference and polarization.

3. Introduction to Thermodynamics
- Temperature scales.
- Kinetical Theory of Gases.
- Calorimetry and Zero Principle of Thermodynamics;
- 1st and 2nd Principles of Thermodynamics; entropy.

Back

General Chemistry (QUI1090L)

1. Constitution of matter
2. Periodic table
3. Chemical bonding
4. States of aggregation of matter
5. Solutions
6. Chemical thermodynamics
7. Chemical equilibrium
8. Equilibrium in heterogeneous systems
9. Ionic equilibria in homogeneous systems: acid-base
10. Electrochemistry
11. (Optional Chapter)

Chemistry of life
Chemical corrosion
Chemical kinetics

Back

Programming (INF0878L)

I – THE Python LANGUAGE
- Introduction to programming
- Using the interpreter
- Variables, expression and statements
- Defining and using functions
- Control structures
- Native data structures
- Vectors e matrices
- Basic input/output concepts (I/O)
- File handling
- Using libraries
- Handling errors and exceptions
- Program development

II – BRIEF NOTIONS ON NUMERICAL METHODS
- What are numerical methods?
- Nonlinear Equations
- Matrices and Vectors
- Linear Systems
- Optimization
- Nonlinear Systems
- Fitting / adjustment

Back

Mathematical Analysis II (MAT0906L)

Topology and Sequences in R$\hat{\{\}}$n.
Limits and continuity of functions in R$\hat{\{\}}$n.
Differential Calculus of functions in R$\hat{\{\}}$n.
Taylor Formula.
Inverse function and Implicit function.
Free extrema and Conditioned extrema.
Line integrals.
Multiple integrals.
Surface integrals.

Back

Introduction to Probability and Statistics (MAT0925L)

1. Descriptive Statistics - Brief Review
2. Basic Probability Notions - Brief Review
3. Conditional Probability and Independence
4. Discrete and Continuous Random Variables
5. Discrete Random Vectors
6. The Most Important Families of Discrete and Continuous Probabilities Distributions
7. An Introduction to Sampling Theory
8. Statistical Inference (parametric and non-parametric)
9. Introduction to Simple Linear Regression
10. Some Non-Parametric Tests (Kolmogorov-Smirnov, Chi-Square, etc.)

Back

General Physics II (FIS0704L)

1. Mechanics:
- Review of da Kinematics;
- Dynamics or the material point and of a system od points;
- Conservation principles (Kepler's laws);
- Movement in non inertial referentials;
- Elementary dynamics of a rigid body.

2. Electromagnetism:
- Electrostatics;
- Gauss' law; Capacitors;
- Electric current;
- Study of DC circuits; RC Circuits;
- Magnetic Field;
- Electromagnetic induction; Maxwell equations.

Applied Thermodynamics (FIS0528L)

Theory and practice

1. Basics
1.1 Extensive and intensive properties
1.2 States of equilibrium
1.3 Processes and cycles. Graphic reprtesentation.
1.3 Forms of Energy

2. Equations of state of pure substances
2.1 Phase diagram
2.2 Ideal Gas
2.3 Specific Heats
2.3 Phase changes. Enthalpy

3. Energy Transfer
3.1 Heat Transfer
3.2 Work
3.3 Chemical Energy
3.4 Energy of flows

4. First Law of Thermodynamics
4.1 Energy balance in closed systems
4.2 Balance of energy flows "stationary"
4.3 Energy balance in transient flow

5. Second Law of Thermodynamics
5.1 Introduction to the Second Law
5.2 Reversible and Irreversible Processes
5.3 Carnot cycle
5.4 Heat Engines, income.
5.5 Heat pumps efficiency ratios

6.Entropy
6.1 Changes of isentropic processes and entropy
6.2 Compressor isentropic efficiency
6.3 Isentropic efficiencies of turbulent "stationary"
6.4 Balance of entropy

Back

Mechatronics System Design (FIS0522L)

» Technical Drawing as a language{\}newline
The importance of Technical Drawing and standardization. Types of technical drawings and representations. Main associated standards: paper formats, scales, line types, line thicknesses, text and layouts.{\}newline
{\}newline
» Elaborating technical drawings{\}newline
The concept of projection, orthogonal projections, views and multiple views representations. Freehand drafting. Perspective drawing in general and based on orthogonal projections. Reading of multiple views drawings. Partial and auxiliary views. Computer aided drafting of orthogonal views and 3D models.{\}newline
{\}newline
» Section views{\}newline
Using sections as a mean to simplify the drawing reading. General rules for section drawings and conventional representations. Assembly drawings.{\}newline
{\}newline
» Introductory concepts of design{\}newline
The several stages present in the design process and the associated documentation. Material properties and manufacturing processes. Some insights and details in the design of structures and mechatronic equipments. The use of standard components in design and its drawing representations, bolts, washers, rivets, springs, bearings, couplings, valves, actuators, etc.{\}newline
{\}newline
» Dimensioning{\}newline
Writing dimensions and other information in drawings. Different dimensioning criteria according to the drawing purpose.{\}newline
{\}newline
» Tolerances{\}newline
Dimensional tolerancing, linear tolerances, angular tolerances and fits. Surface and edge finishes. Geometrical tolerancing, application and interpretation. Verification processes and methods.{\}newline
{\}newline
» Drawing of connections{\}newline
Brief description of welding processes. Welded, bolted and riveted connections. Types of welding, associated symbols and annotation rules. Associated standards and the elaboration of complete parts lists.{\}newline
{\}newline
» Introduction to the drawing of technical diagrams{\}newline
Symbolic representation of mechanical components, electrical wiring diagrams, piping, pneumatic and hydraulic network diagrams, thermal systems and manufacturing processes layouts.

Back

Mathematical Analysis III (MAT0907L)

-Introduction to Complex Analysis. Complex functions and analytic functions. Cauchy-Riemann equations. Laplace equation. Harmonic functions. Geometry of analytic functions. Elementary complex functions. Complex integration. Fundamental Theorem of Calculus. Cauchy's theorem and its evolution. Cauchy integral formula and applications.
NCE/13/00836 - Apresentação do pedido - Novo ciclo de estudos http://www.a3es.pt/si/iportal.php/process_form/print?processId=f1edd
77 de 120 30/10/2013 15:10
-Ordinary Differential Equations. Exact equations and integrating factors. Elementary equations of 1st order. 2nd order linear equations.
-Systems of ordinary differential equations. Introduction and notations. Linear systems. Systems with constant coefficients. Stability of solutions. Planar autonomous systems.
-Fourier series. Convergence and the sum of the Fourier series. Expansion in series of sines and cosines. Periodic extensions. Complex Fourier series. Fourier integrals.

Applied Electronics (FIS1803L)

1. Introduction
Objectives and application examples.

2. Power Electronic Devices
Diode, Tiristor, GTO, BJT, MOSFET, IGBT
Devices characteristics comparison

3. AC/DC Converters - Rectifiers
Analysis of different topologies
Power Flow. Power Factor

4. AC/AC Converters
Cicloconverters: Topology and functioning principles
Static Converters: Functioning as switch and with phase control

5. DC/DC Converters - "Chopper"
Analysis of different topologies

6. DC/AC Converters - Inverters
Voltage Inverters: one and three phases topologies; Power Flow
Current Inverters

7. Regulation and Command of Power Converters
P;PI;PID Controllers. Regulation Circuits.
PWM Command. Tiristors, Transistors and IGBT's Command Circuits.

Back

General Electrotechnics (FIS0510L)

1. Introduction

2. Fundamental notions of electrostatics
Application of Maxwell?s equations to electrostatics.
Capacitors and dielectrics.

3. Stationary Electric Current
Electric resistance; Ohm?s law.
Electrical energy sources. Joule?s law.
Direct current circuit analysis. Kirchhoff?s laws. Circuit analysis theorems.

4. Magnetostatics
Application of Maxwell?s equations to electrostatics.
Magnetic circuits analysis. Inductors.

5. Varying Electromagnetic Field
Faraday?s law.
Ideal transformer. Electrical generator and motor.

6. Quasi Steady State Circuits
Sinusoidal voltages and currents; complex representation.
Analysis of alternating current circuits. Kirchhoff?s law. Circuit analysis theorems.
Active, Reactive and Apparent Power.
Dynamic behavior of electric circuits.

7.Three-Phase Systems
Star and Triangle connections. Transformations. Circuit analysis with different loads. Unbalanced loads.

Back

Applied Mechanics (FIS0524L)

The fundamental laws and concepts in Mechanics.
Static equilibrium of particles in 2D and 3D, free body diagram and corresponding equilibrium equations.
Definition of moment of a force about a point, the concept of couple. Reduction of a system of forces, point wise or distributed, to one equivalent resultant force and resultant couple.
Equations governing the static equilibrium of rigid bodies in 2D and 3D, free body diagrams equilibrium equations, constraints, statically determinacy or indeterminacy.
Centers of mass and centroids, Distributed loads.
Analysis of rigid body structures in 2D and 3D, trusses, structures having members acted by two or more actions, machines and mechanisms. Static determinacy.
Internal forces in bars, beams and cables.
Analysis of rigid body structures in the presence of friction.
Second moments and moments of inertia
Introduction to dynamics and to the vibration study of one degree of freedom systems.

Back

Fluid Mechanics (FIS10927L)

Introductory concepts: fluid properties, stresses, viscosity, surface tension, Newtonian and non-Newtonian fluids, flow classification. Fluid statics: hydrostatic equation, hydrostatic pressure distribution, hydrostatic force, hydrostatic moment, buoyancy and Archimedes principle, equilibrium and stability of immersed bodies. Volume control analysis, conservation of mass, momentum and energy, momentum equation, angular momentum equation. Differential forms: continuity, Navier-Stokes and energy equations. Euler's equation, Bernoulli's equation: static and stagnation pressures. Viscous flow. Transport in porous media and other complex flow structures. Pipe and ducts flow: head loss, turbulence, flow in multiple path pipe and duct systems, Moody diagram. Similitude and Modelling. Introduction to the Constructal Theory.

Back

Mechanics of Materials (FIS0525L)

THEORY OF ELASTICITY

Stress. Strain. Plane stress and plane strain. Pure cut. Stress concentration. Allowable stresses and safety factors. Generalized Hooke's Law. Safety of structures. Yielding criteria and rupture. Types of failure. Perfect elastic-plastic behavior. Shear stresses. Screws and rivets. Design.

Bending.

Shear and bending moment. Classical theories of bending. Stresses. Strains. Differential equation of the elastic line. Universal equations.

Torsion

Bars of circular cross section. Circular shafts . Stresses and strains; Power transmition. Terms of mechanical strength and rigidity.

Combined efforts.

Principal stresses. Equivalent stress. Gage. Mohr's circle. Membrane theory. Laplace equations. Pressure vessels. Spheres and cylinders. ASME Code VIII Div I and BS 5500.

Introduction to Buckling of columns

Critical loads and critical stress, Euler's formulas. Off-center loads. Eurocodes.

Back

Electrical Machines (FIS0512L)

Introduction to the study of Electrical Machines

Fundamental electromagnetic concepts and circuit analysis revisited. Principles of electromechanical energy conversion.

Transformer

Introduction ? constructive aspects. The one-phase transformer. The three-phase transformer. Special transformers. The self-transformer. Measurement transformers. Dynamic behavior analysis.

DC Machines

Introduction and functioning principles. Generator functioning. Main characteristics. Application fields. Motor functioning. Main characteristics. Application fields. Dynamic behavior analysis.

AC Machines

Asynchronous Machine. Constructive aspects and functioning principles. Three-phase induction machine. Application fields.

Synchronous Machine. Constructive aspects and functioning principles. Generator study. Synchronous motor.

Special Electrical Machines

PM Synchronous machine. Switched Reluctance Machine. Step Motor.

Back

Control and Automation (FIS0506L)

PART I: Control Systems:
1) Mathematical models for Control: Electrical, Mechanical, Fluidic, Thermal.
2) Analysis of systems - Transfer Function representation:
i) Time-domain analysis -1st order, 2nd order and multiple order systems -. Stationary response. Stability criteria. P-Controller design using the Root Locus method.
ii) Frequency-domain analysis. Bode diagram. Stability. Gain and phase margins. P-Controller design using the Bode method.
iii) PID controller. Usual design methods.
3) Analysis of systems represented by State-space formulation: Linear systems stability.
PART II: Industrial Automation:
1) Industrial logic components: pneumatic, electric and electronic technology.
2) Programmable automation. Basic components: Processing Unit, sensors and actuators.
3) Automatic Systems: Combinatory and sequential. Design of sequential systems using GRAFCET.
4) Implementation of automatic systems using Siemens LOGO PLC. (Programmable Logic Controller). LADprogramming.

Back

Environment Energy and Sustainability (FIS1811L)

1. The Earth: subsystems and their interaction. The resources: content, availability and strategic importance. Duration of resources and their distribution.
2. Sustainability and use of resources: Biocapacity and ecological footprint, the ecological balance, the water footprint and the carbon footprint. Energy and sustainability: "life-cycle assessment"in the scope of sustainability. Diagnosis for the sustainability in Portugal.
3. Energy, entropy and exergy. Thermodynamic cycles.
4. Energy sources: fossil fuels, nuclear energy and alternative sources (renewable energy). Energy and exergetics analysis.
5. Energy markets. Energy efficiency.
6. Energy and environment: pollution, greenhouse effect and climate change.

Back

Energy and Mass Transfer (FIS10987L)

1. CONCEPTUAL FRAMEWORK
2. CONDUCTION: Steady-state Conduction (in slabs, cylinders and spheres). Critical radius. Conduction-convection coupling. Biot number. Transient regime. Fourier Number. Analytical solutions of the diffusion equation and numerical methods.
3. CONVECTION: Boundary layer flow. Thermal boundary layer. Laminar and turbulent regimes. Forced convection. Reynolds number, Prandtl, and Schmidt. Calculation of the coefficients of convective heat transfer (Nusselt number) and mass transfer (Sherwood Number).Natural convection. Mathematical formulation of the problem. Grashoff and Rayleigh Numbers.
4. RADIATION: Electromagnetic spectrum. Distribution of Planck and Stefan-Boltzmann equation. Electromagnetic radiation in transparent media and absorbent media. Properties of surfaces. Emissivity, reflectivity, transmissivity and absorptivity. Kirchhoff's Law. Exchanges between radiative surfaces. Form factors. Calculation methods.

Back

Solar Thermal Energy (FIS1805L)

1. Introduction
- Solar energy resource
- Thermal applications of solar energy.
- Types of solar thermal collectors and materials used in the manufacture.
- Optical performance and thermal efficiency.
- Collectors tests: quasi-stationary and dynamic. Stagnation temperature.

2. Thermal applications at temperatures up to 80 ° C
- Hot water. Heating. Process heat.
- Flat collector. CPC. Vacuum tubes. Heat pipes.
- Systems: Common designs; Systems with and without storage.

3. Applications at medium temperatures
- Hot water. Air-conditioning. Heat for industry.
- Types of collectors used and common system designs.

4. Applications to high temperatures
- Solar thermal electricity generation.
- Systems: Parabolic-cylinder; Central Tower; Fresnel; Parabolic dish with Stirling engine

5. Other applications
- Thermolysis of water.
- High temperatures and materials processing.
- Storage of thermochemistry energy

Back

Wind Energy (FIS1808L)

1. INTRODUCTION
Evolution of wind energy and environmental impacts

2. WIND ENERGY RESOURCE
Wind energy and the energy balance at the earth surface and atmosphere. Analysis of wind: Variation in time and the spectral representation; Local effects; Weibull distribution and Prandtl law; Turbulence. Wind measurements and assessment of wind energy resource.

3. WIND ENERGY CONVERSION
Available wind energy and Betz limit. Power coefficient of a wind generator. Energy analysis of wind power conversion.

4. TECHNOLOGY
Components of wind generator. Aerodynamics. Power control - stall and pitch systems. Electric generators and power grid connection - Synchronous, Induction and Doubly-Fed Induction Generators. Vertical axis turbines and micro-generators.

5. WIND ENERGY PLANTS
Onshore wind farms. Offshore wind energy. Micro-generation.

6. INTRODUCTION TO ECONOMIC ASSESSMENT OF WIND ENERGY SYSTEMS.

Back

Ocean Energy (FIS1809L)

The ocean as a physical system. Main mechanisms that force the ocean movements. Thermodynamic properties of the seawater. Ocean dynamics. Ocean hydrokinetic energy conversion. Ocean hydropotential energy conversion. Ocean thermal gradient energy conversion. Ocean salinity gradient energy conversion. Near and offshore wind energy conversion. Hydropower energy and hydropower plants.

Back

Photovoltaic Solar Energy (FIS10989L)

1. Introduction
- The Physics of photovoltaic conversion.
- Conversion Technologies (1st, 2nd and 3rd generations).

2. Photovoltaic Systems.
- stationary systems and tracking systems.
- Photovoltaics with Concentration (CPV).
- photovoltaic systems with cogeneration of heat. Systems PV / T.

3. Applications and Projects.
- Types of applications: autonomous, connected to the network, integration into buildings (BIPV) and other (water purification, telecommunications systems, electric vehicles).
- Design of Photovoltaic systems.
- Standards for Testing and Monitoring Photovoltaic systems.
- Photovoltaic systems modeling.

4. New Trends.
- Photovoltaic Systems and Intelligent Networks (Smart Grid)
- New technologies for direct conversion of solar energy into electricity.

Back

Biomass and Fuels Energy (FIS10990L)

1. Status of the Portuguese, European and World bioenergy: Energy statistics. Portuguese and European strategy for bioenergy.
2. Biomass as a fuel source: the carbon cycle (geological and biological cycles). Bioenergy concept. Global biomass carbon distribution. Biomass energy potential (virgin and residues).
3. Handling and treatment of farming and agri-industry effluents: Effluents types. Characterisation and production quantities. Handling systems. Storage facilities. Valorisation and treatment systems (compost, separation, etc.).
4. Legislation for the biomass sector.
5. Biofuels: biogas production through anaerobic digestion. Biofuels production.
6. Forest biomass thermochemical processing: combustion, gasification and Pyrolysis.
7. Electricity production from biomass: solid biomass and biogas power plants.
8. Thermal energy production from biomass: project of biomass heating systems.

Back

Project of Energy Systems (FIS10928L)

The workplan for each student will be defined by the supervisor in coordination with the course committee, respecting and fulfilling the general objectives and competences to develop in the curricular unit. The activities may, in general, be divided into the following topics:

1. participation in research or enterprise activities;
2. attendance to seminars, workshops or courses;
3. developing a study or project;
4. writing the report.

The study or project will be framed in at least one of the following topics:

I. renewable energy resource assessment and utilization;
II. selection and sizing of equipment and technologies;
III. design of renewable energy equipment or process optimization;
IV. calculating the energy production from a renewable source;
V. economic and financial analysis of investments in renewable energy systems.

Back

Energy Storage (FIS1812L)

Electricity:

1. Electrochemical storage: lead-acid and Ni-Cd batteries; metal hydrides and lithium ion; redox batteries; characteristics (energy density, power density) and sizing battery system
2. Hydrogen and fuel cells
3. Supercapacitors: state of development, types and characteristics
4. Electromechanical storage: flywheels of high rotation. State of development, types and characteristics. Systems (wheel/motor/generator)
5. Synthetic fuels: state of development, types and specific application. Advantages and problems
6. Storage debit network. Measurement systems. Problems associated.
7. Storing in compressed air systems. Description of the systems and related income.
8. Storage potential energy by pumping hydraulic. Description of the systems and related income.

Thermal energy:

9. Thermal storage for use at low and high temperatures
10. Capture and store solar heat in lakes
11. Storage systems of phase transition (PCMs)
12. Storage in natural reservoirs. Coupling with heat pumps

Back

Electric Energy Systems (FIS1813L)

Fundamental concepts: Per-unit system; Charge diagrams.

Transformer: electrical parameters; Scheme equivalent; numerical applications.

Power transmission line: Electric Line Parameters: Resistance and inductance, transverse conductance and capacity.

Equations of the long line; exact model; Scheme equivalent; Line lossless; Power carry capacity; numerical applications.

Transmission and distribution of electricity; Function; Configuration; voltage levels; constituent elements; one-line diagrams.

Short circuits: neutral systems; Calculation of short-circuit currents symmetrical and asymmetrical; Applications using numerical informatics platform; Techniques limitation of short circuit currents.

Standards, regulations and technical orders applicable to these systems, indicators of quality of service.

Back

Energy in the Building Sector (FIS1814L)

- The situation of Energy in Buildings in Portugal.
- Energy Efficiency in Buildings.
- The integration of Renewable Energies in Buildings.
- Bioclimatic Buildings and Net Zero Energy Buildings (NZEB).
- The Portuguese Code of Thermal Behavior of Buildings (RCCTE)
- The Portuguese Code on Heating and Cooling Systems for Buildings (RSECE).
- The Portuguese System of Energy Certification of Buildings (SCE).

Back

New Energetic Vectors (FIS1815L)

1. Introduction
2. Hydrogen as energy carrier
3. Hydrogen production - electrolysis, thermolysis, photocatalytic production, thermochemical processes, gasification, steam reforming, biological processes. Integration of renewable energy sources. Centralized and decentralized production
4. Storage and transportation of hydrogen
5. Fuel cells - types and operation, energy analysis and efficiency. Applications
6. Safety and environmental impacts
7. Hydrogen economy
8. Synthetic fuels - Carbon neutral fuels and carbon negative fuels, production methods, carbon sources. Integration of renewable energy sources

Back

Geothermics (FIS1816L)

Introduction. The Earth as a heat source. Heat transfer.
Heat flow through ocean regions. Cooling of the Oceanic Lithosphere. Heat loss through the oceanic bottom.
Heat flow through continental regions and mean heat flow value. Estimates of Moho heat flow values. Recently active regions. Continental margins. Heat flow from the Mantle.
Heat sources. Radioactive elements. Heat flow from the Core. Other sources.
Secular cooling. The present-day Mantle Geotherm. Temperature versus age of the Earth. Magma Ocean evolution. Average secular cooling rate.

Utilization of the Internal heat of the Earth. Electricity production. Direct utilization of geothermal fluids. Geothermal heat pumps. Geothermal energy use in Portugal.

Back

Organizational Behaviour and Human Resources Management (GES0027L)

Module 1. Organizational Behaviour and Human Resources Management: delimitation and areas of fork of the two areas
Module 2. Leadership and Power
Module 3. Motivation and satisfaction in the work
Module 4. Organizational Communication
Module 5. Participation and negotiation
Module 6. Culture and ethical organizational
Module 7. Tendencies of the organisational models
Module 8. The development of the work face to the legislation in vigour
Module 9. The human resources management (GRH) as sub-system of management system: Of the stages of the evolution of GRH to the main dimensions and politics of GRH
Module 10. Strategic Plan of human resources
Module 11. Recruitment, Selection and Integration
Module 12. Management systems and evaluation of the performance
Module 13. Reward Systems
Module 14. Systems of Health and Safety in the Work
Module 15. Formation Systems and Development of the human resources
Module 16. Information Management Systems of human resources (SIGRH)

Back

Principles of Management (GES10929L)

Module 1: Basic concepts and challenges
1.1 Concept definitions of organization, company and management
1.2 Business and individual cycle
1.3 Business stages and legal forms
1.4 Organizational structures

Module 2: Organizational areas
2. Strategy and Marketing
3. Operation and production management
4. Human capital and behavioural organizational dimensions
5. Operational planning and economic and financial management

Module 3: Cross sectional issues of management
6.1 Informational systems management
6.2 Quality management
6.3 Entrepreneurship and innovation management

Back

Communication in Professional Context (PED0418L)

1. Being and communicating
1.1. Who I am and the way I am together with the other
2. Human communication
2.1. Verbal aspect
2.1.1. Communication models
2.2. Non-verbal aspect
2.2.1. Functions of non-verbal communication
2.2.2.The body
2.2.3. Non-verbal communication in professional context.
2.2.4. The importance of active listening in the communicating process.
2.2.4.1. Difficulties and obstacles to the listening process
3. Barriers to communication.
3.1. Among people, among people and groups and among groups.
3.2. In professional situations.
4. Production of materials for electronic presentation and its practical use.