DIPLOMA SUPPLEMENT ATTACHMENT

POLITECNICO MILANO 1863

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1 INFORMATION IDENTIFYING THE HOLDER OF THE QUALIFICATION

1.1 Last name(s)

RANERI

1.2 First name(s)

ALESSANDRO

1.3 Date of birth (dd/mm/yyyy)

17/11/2001

1.4 Student identification number or code (if available)

220925

2 INFORMATION IDENTIFYING THE QUALIFICATION

2.1 Name of the qualification and title conferred (in the original language)

Laurea magistrale in ENERGY ENGINEERING
Dottore magistrale

2.2 Main field(s) of study for the qualification

Energy and nuclear engineering (LM-30)
ISCED code: 0713

2.3 Name (in original language) and status of the awarding institution

Politecnico di Milano (Istituzione statale), Piazza Leonardo da Vinci 32, 20133 Milano

Description of curriculum

ENERGY CONVERSION A

Code: 054065
Credits: 10.00
Grade: 21
Date: 07/02/2023

Subject groups

ING-IND/09 ENERGY SYSTEMS AND POWER GENERATION

The programme

The course deals with all aspects related to the electricity generation in modern, advanced power plants. Thermodynamic, as well as economical, control, environmental, strategic aspects are addressed. The course treats large scale, centralized power stations fed by fossil fuels or nuclear reactors as well as other applications, including small-scale distributed generation and electricity generation from renewable energy sources. The course addresses a variety of general topics fundamental for understanding the modern energy technologies: second-law analysis of open and closed power plants, thermodynamic properties of working fluids of power cycles, main components such as turbomachines and heat transfer equipment. Eventually, the optimization techniques of single and multiple power stations, as well as economic analyses are described. (Course held in English)

ENERGY AND CLIMATE CHANGE MODELING AND SCENARIOS

Code: 055635
Credits: 8.00
Grade: 25
Date: 07/06/2023

Subject groups

ING-IND/35 BUSINESS AND MANAGEMENT ENGINEERING

The programme

The main objective of the course is to study climate change challenge using quantitative tools. Specifically, the aim is to learn the basic elements of the global energy and climate problems, evaluate the solutions with a focus on the energy sector, and use optimization and simulation models to evaluate the emission reduction and adaptation strategies. To do so, a discussion of the fundamentals of the global economy, energy, land and climate systems will be complemented by development and applications of mathematical models which integrate these key components. The course will also teach programming languages used in energy-climate planning, such as GAMS, R and Python. The course uses innovative teaching methods, in particular it is a flipped classroom course: students will form groups of 4/5 students and work on projects to improve one or more numerical integrated models to deal with climate change solutions, either on mitigation or adaptation.

GREEN BUILDING ENERGY SYSTEMS

Code: 052395
Credits: 8.00
Grade: 18
Date: 20/06/2023

Subject groups

ING-IND/11 BUILDING PHYSICS AND BUILDING ENERGY SYSTEMS

The programme

Unavailable

THERMOECONOMICS AND ENERGY MODELING

Code: 056956
Credits: 8.00
Grade: 18
Date: 05/09/2023

Subject groups

ING-IND/10 THERMAL ENGINEERING AND INDUSTRIAL ENERGY SYSTEMS

The programme

The course is developed along 4 main topics. The introductory part presents current energy scenarios, challenges and policies at a global level. Then exergy analysis for energy conversion systems and components is introduced; these concepts are applied to thermoeconomics theory (exergy efficiency definition, cost allocation criteria in multi-product systems, thermoeconomic analysis for diagnosis and optimization of energy systems). Finally, the topic of energy modelling and its governing principles is introduced. Available modeling approaches are presented, with a focus on linear programming models. A simple Reference Energy System including multiple carriers is developed.

WIND, HYDRO AND GEOTHERMAL POWER GENERATION

Code: 055915
Credits: 8.00
Grade: 25
Date: 08/01/2024

Subject groups

ING-IND/09 ENERGY SYSTEMS AND POWER GENERATION

The programme

The course deals with technical and economic issues related to the design and operation of a renewable power plant based on 3 renewable sources: wind, hydro and geothermal energy. Wind energy (i): working principles, design criteria of a turbine, drive-train configurations, generator technologies and power electronics, control strategies, anemological characterization of a site, design criteria of a wind farm. Off-shore wind technology, electrical connection to the national grid. Small and micro wind turbines. Environmental impact of wind farms. Geothermal energy (ii): classification of geothermal sources, investigation techniques, drilling technologies. Power plant based on direct, binary (ORC) or hybrid cycles. Cogenerative and thermal applications, geothermal heat pumps. Environmental impact. Hydroelectric power (iii): classification based on hydraulic machines and plant layout. Estimation of the hydraulic resource. Design criteria, operating mode and economic assessment of a hydro plant. Pumped-Storage Hydroelectricity (PSH). Small-hydro, design criteria of a run-of-river plant. Environmental impact.

SOLAR AND BIOMASS POWER GENERATION

Code: 055639
Credits: 8.00
Grade: 25
Date: 19/01/2024

Subject groups

ING-IND/09 ENERGY SYSTEMS AND POWER GENERATION

The programme

The course provides knowledge, applying knowledge, understanding and making judgements of solar and biomass energy for power production. Starting from the characterization of solar and biomass as primary energy sources, the conversion principle with the corresponding theoretical limits are discussed setting the base for the selection. For solar energy, the components and design criteria of Photovoltaic (PV) and Concentrated Solar Power plants (CSP) are provided. About biomass resource, the biochemical and thermochemical conversion processes will be described in more detail giving a particular attention to the biogas technology for electricity generation. Finally, a methodology for the economic and environmental assessment of the different technology is provided.

ZERO EMISSION AND POSITIVE ENERGY DISTRICTS

Code: 057902
Credits: 8.00
Grade: 22
Date: 26/01/2024

Subject groups

ING-IND/11 BUILDING PHYSICS AND BUILDING ENERGY SYSTEMS

The programme

The course aims to provide the base knowledge and tools for the development of buildings efficiency renovation and new plans at district and urban scale. This course will introduce to the methodology of energy demand and efficiency assessment to reduce energy loads cost-effectively and set appropriate energy and emission targets. Thermal energy district system design principle will be analysed including heat transformation, thermal storage and coupling with other energy carriers technologies. The course will also deliver competence in renewable energy analysis, planning and mapping, necessary for their exploitation in a district energy system, and to achieve both the zero emissions and the positive energy goal following Energy Community models. Competence will also include basic knowledge on Environmental Life Cycle Assessment (process base modelling).

ELECTRIC CONVERSION FROM GREEN SOURCES OF ENERGY

Code: 052389
Credits: 8.00
Grade: 18
Date: 15/02/2024

Subject groups

ING-IND/31 ELECTRICAL ENGINEERING, ING-IND/32 POWER ELECTRONIC CONVERTERS, ELECTRICAL MACHINES AND DRIVES

The programme

The goal of the course is to provide students with the knowledge of fundamental elements of the energy conversion produced by renewable sources and their connection to the electric grid. The course includes the analysis, modelling and sizing methods of electronic power converters and electric machines suitable to photovoltaic and wind applications. The first part of the course teaches the principles of the static conversion of electric energy, and the working principles of the AC/DC, DC/DC and DC/AC power electronic converters. The control of power converters and the design of power semiconductor cooling systems are introduced. The second part of the course teaches the working principles of both static and rotating electrical machines. Asynchronous machine, synchronous machine and permanent magnet synchronous machine are analyzed from the point of view of their use as generators in wind power generation systems. The course introduces the layouts of power plants for the electricity generation from renewable sources, as well as the limits and constraints for their connection to the grid.

DEVELOPMENT ECONOMICS

Code: 097386
Credits: 8.00
Grade: 24
Date: 10/06/2024

Subject groups

ING-IND/35 BUSINESS AND MANAGEMENT ENGINEERING, SECS-P/01 ECONOMICS

The programme

The main objective of the course is to study (under)development challenges using economic theory and quantitative tools. Specifically, the aim is to learn the basic principles of development economics, and develop analytic skills to evaluate development policy and programs, and to draw independent conclusions when confronting development problems, their sometimes ambiguous evidence, and real-life development policy choice. To do so, a discussion of the fundamental economic models will be complemented by applications of modeling and empirical analyses to conduct detailed diagnostics and establish rigorous causal analyses of development outcomes. The course uses also innovative teaching methods; in particular, it includes a flipped classroom section (in collaboration with UNCTAD): students will form groups of 4/5 students and work on projects to develop new business models for achieving sustainable development.

FUNDAMENTALS OF CHEMICAL PROCESSES

Code: 095910
Credits: 8.00
Grade: 29
Date: 25/06/2024

Subject groups

ING-IND/27 CHEMICAL TECHNOLOGIES

The programme

This course will provide the fundamental bases of chemical and physical equilibria and on chemical kinetics, which are necessary for a rational understanding of unit operations and chemical processes relevant to applications in the energy field. Specifically the following subjects will be addressed both from a theoretical point of view and exemplifications derived from industrial applications: mass and energy balances of reacting systems governed either by stoichioimetric control or by chemical equilibria; phase equilibria in multicomponent systems; chemical kinetics and ideal reactors; thermodynamic and kinetic principles of fuel cell operations.

MATERIALS FOR DIRECT ENERGY CONVERSION

Code: 055640
Credits: 8.00
Grade: 24
Date: 24/07/2024

Subject groups

ING-IND/23 APPLIED PHYSICAL CHEMISTRY

The programme

The goal of this course is to enable students without previous specific knowledge to perform independent critical reasoning and further self-study on state-of-the-art and advanced materials-science topics, underlying the devices implementing the two key Direct Energy Conversion routes: (i) interconversion of electrical and chemical energies (rechargeable batteries), (ii) conversion of solar to electrical energy (photovoltaics). The vision of this course, within the framework of an Engineering School is twofold: (i) to integrate these contents in a wider, system-oriented engineer's approach and (ii) to provide quantitative tools for making appropriate design and control decisions.

HEAT AND MASS TRANSFER

Code: 095902
Credits: 10.00
Grade: 20
Date: 10/01/2025

Subject groups

ING-IND/10 THERMAL ENGINEERING AND INDUSTRIAL ENERGY SYSTEMS

The programme

Balance equations and constitutive equations. Steady-state and transient heat conduction and mass diffusion. Thermo physical properties. Analytical and numerical solution methods. Introduction to convection. The convection boundary layers. Boundary layer equations for laminar and turbulent flow. External flow convection. Internal flow convection. External free convection flows. Free convention in channels and enclosures. Pool boiling: the boiling curve. Forced convection boiling. Film condensation and dropwise condensation. Condensation in vertical and horizontal tubes. Heat exchangers: heat exchanger design and performance calculations. Radiation processes and properties. Radiation exchange between surfaces. Radiation exchange in participating media.

GRADUATION THESIS AND FINAL EXAM (ENG)

Code:	097440
Credits:	20.00
Grade:	--
Date:	30/06/2025

Subject groups

Unavailable

The programme

Graduation thesis and final exam - Master of Science in Energy Engineering