



Curriculum: Energy Systems and Renewable Energies

Bachelor of Engineering, 7 semesters, Technische Hochschule Ingolstadt

7. Semester	Elective	Bachelor's Thesis and Seminar			Energy from Biomass and Biogenic Residues	Mobility within the Energy System
6. Semester	Project	Elective	Elective	Solar Buildings and Energy Consulting	Energy Markets and Coupling Sectors	Smart Grids and Wind Energy
5. Semester	Practical Seminar	Internship				Project and Quality Management
4. Semester	Project: Design and Development	Control Engineering	Energy Distribution and CHP Plants	Building Technology and Smart Homes	Solar Energy Technologies	Cost and Investment Management
3. Semester	Product Development and CAD	Measurement Engineering	Machine Elements	Thermodynamics 2	Fluid Mechanics	Thermal Energy Technology and Power Plants
2. Semester	Engineering Mathematics 2	Material Science	Mechanics of Materials	Thermodynamics 1	Energy Storage	Entrepreneurship and Sustainability
1. Semester	Engineering Mathematics 1	Computer Science in Engineering	Basics of Mechanical Design	Statics	Electrical Engineering	Energy Systems and Energy Economics

Legend:

Management	3 Modules	General Basics	3 Modules	Electives	3 Modules
General Engineering	13 Modules	Specialization Energy	11 Modules	Personal and Practical Skills	4 Modules

Short description of the module contents



<p>Entrepreneurship and Sustainability [5 ECTS] - en -</p>	<ul style="list-style-type: none"> - Sustainability and sustainable development - Implementing Sustainability in companies - Entrepreneurship - Innovation management - Practical Exercise in teamwork: Design Thinking (incl. Business Model) 	<p>Engineering Mathematics 2 [5 ECTS] - en -</p>	<ul style="list-style-type: none"> - Series and Power Series - Matrices - System of Equations - Linear Transformations - Differential and Integral Calculus with several variables - Vector Analysis 	<p>Mechanics of Materials [5 ECTS] - en -</p>	<ul style="list-style-type: none"> - Stress analysis and integrity of mechanical structures - Stress Tensor, Mohr's Circle - Area moments of Inertia - Analysis of stress, strains and deformation under Tension, Bending, Torsion and Shear loads - Strength of materials
<p>Cost and Investment Management [5 ECTS] - en -</p>	<ul style="list-style-type: none"> - Buyer and sales motivation - External Accounting - Internal Accounting - Calculation methods of product costs 	<p>Computer Science in Engineering [5 ECTS] - en -</p>	<ul style="list-style-type: none"> - Fundamentals of Computer Science in Engineering and Digitalization - Data Processing principles - Computer Technology - Algorithms and Programming - Classes and Object Oriented Programming 	<p>Electrical Engineering [5 ECTS] - en -</p>	<ul style="list-style-type: none"> - Direct current circuits - Electric Field - Magnetic Field - Alternating current circuits - Three-phase system - Electric machines - Electronics
<p>Project and Quality Management [5 ECTS] - en -</p>	<ul style="list-style-type: none"> - Project Definition and Organization of Projects - Project structure planning - Risk management in projects, FMEA - Quality management systems - Process management 	<p>Basics of Mechanical Design [5 ECTS] - en -</p>	<ul style="list-style-type: none"> - Fundamentals of Technical Drawings and Mechanical Design - Projection methods - Sectional representations, views - Dimensioning, Dimensioning rules - Deviations in shape and tolerance specifications 	<p>Material Science [5 ECTS] - en -</p>	<ul style="list-style-type: none"> - Fundamentals of Material Science - Structure of materials - Reaction to temperature and mechanical influences - Iron-based alloys - Material testing methods - Practical exercises in the laboratory
<p>Engineering Mathematics 1 [5 ECTS] - en -</p>	<ul style="list-style-type: none"> - Complex Numbers - Sequences and Series - Functions - Differential and Integral Calculus with one variable - Ordinary Differential Equations 	<p>Statics [5 ECTS] - en -</p>	<ul style="list-style-type: none"> - Analysis of mechanical structures, including trusses - Forces, Moments, Resultants - Support Reactions - Internal forces and moments - Spatial mechanical systems - Center of gravity - Friction 	<p>Thermodynamics 1 [5 ECTS] - en -</p>	<ul style="list-style-type: none"> - Fundamentals of Thermodynamics - Exchange and Conservation of Energy - Exchange and Conservation of Entropy - Changes in the state of fluids



Short description of the module contents

Thermodynamics 2 [5 ECTS] - en -	<ul style="list-style-type: none">- Heat Transfer through conduction, convection and radiation- Practical analysis of heat transfer problems- Practical exercises in the laboratory	Machine Elements [5 ECTS] - en -	<ul style="list-style-type: none">- Analysis and Design of typical machine components- Screws, pins and bolts; springs- Axles and Shafts- Shaft-hub connection- Rolling bearings, gears, clutches- Further machine elements	Energy Storage [5 ECTS] - en -	<ul style="list-style-type: none">- Basic concepts of Energy Storage Technologies- Storage of thermal, electrical and chemical energy (including batteries, hydrogen and “green fuels”)- Storage of mechanical energy
Product Development and CAD [5 ECTS] - en -	<ul style="list-style-type: none">- Product Development Process- Solution and creativity techniques- Concepts and concept selection- Practical Mechanical Design- Training on a 3D-CAD program	Fluid Mechanics [5 ECTS] - en -	<ul style="list-style-type: none">- Basic concepts; Fluid properties- Hydrostatics and Aerostatics- Conservation laws- Internal and external flow- Compressible flow, high Mach numbers- Computational Fluid Dynamics- Practical exercises in the laboratory	Thermal Energy Technology and Power Plants [5 ECTS] - en -	<ul style="list-style-type: none">- Basic concepts of Thermal Energy Technology- Heat Generation- Fundamentals of Turbomachinery- Steam Power process, gas turbine- Internal combustion engine- Fuel Cell- Practical exercises in the laboratory
Measurement Engineering [5 ECTS] - en -	<ul style="list-style-type: none">- Basic concepts- Measurement errors- Measurement of mechanical and electrical quantities- Measurement of temperature and fluid-flow- Special sensors- Practical training in the laboratory	Project: Design and Development [5 ECTS] - en -	<ul style="list-style-type: none">- Team Project: students work together on a practical engineering problem- Practical solving of a mechanical design and development problem- Acquisition of practical and social skills; Project management;	Energy Distribution and CHP Plants [5 ECTS] - en -	<ul style="list-style-type: none">- Combined Heat and Power Plants- Use of new fuels in CHP plants- Supply and distribution of electricity, heat and gas- Operation of heat, gas and electricity networks
Control Engineering [5 ECTS] - en -	<ul style="list-style-type: none">- Control Loops- Practical exercises with Matlab on the simulation of control loops- Laplace Transformation- Frequency response- Closed-loop control analysis- Control unit design- Nonlinear control loops- Stability	Energy Systems and Energy Economics [5 ECTS] - en -	<ul style="list-style-type: none">- Energy consumption and energy supply today (including impact on climate change)- Economy, politics, law- Practical exercises	Building Technology and Smart Homes [5 ECTS] - en -	<ul style="list-style-type: none">- Building Technology (incl. heat demand calculation)- Supply of thermal energy- Heat Exchange Systems- Air conditioning and ventilation technology- Smart Home; Building control technology

Short description of the module contents



<p>Solar Energy Technologies [5 ECTS] - en -</p>	<ul style="list-style-type: none"> - Photovoltaic systems (planning, installation, economic efficiency) - Solar heating of drinking water - Thermal Solar Systems (components, design, costs) - Simulation of solar systems - Seminar: design of a solar system - Practical exercises in the laboratory 	<p>Energy from Biomass and Biogenic Residues [5 ECTS] - en -</p>	<ul style="list-style-type: none"> - Greenhouse effect, climate change - Renewable raw materials; Biogenic Residues - Heat generation - Power generation (combustion, thermal gasification, biogas) - Fuels from renewable biomass - Practical Seminar: Planning a bioenergy generation plant 	<p>Internship [24 ECTS] - en/de -</p>	<ul style="list-style-type: none"> - Internship in a company (in Germany or abroad) - Independent, practical work on projects and problems whose topics are related to the degree - Application and deepening of knowledge, methods and procedures that are taught and conveyed in the theoretical studies - Acquisition of practical and social skills - Insight into the structure and the way of working in companies
<p>Solar Buildings and Energy Consulting [5 ECTS] - en -</p>	<ul style="list-style-type: none"> - Building Energy Act; practice - Thermal bridges and calculation - Recommendations for modernization - Ventilation concepts - Energy management in the building 	<p>Mobility within the Energy System [5 ECTS] - en -</p>	<ul style="list-style-type: none"> - Future Mobility - electricity demand for mobility (synthetic fuels, e-mobility, e-gas production) - Legal framework - Gas-Mobility (incl. hydrogen) - Interaction with electricity grids 	<p>Project [5 ECTS] - en/de -</p>	<ul style="list-style-type: none"> - Team Project: students work together on a practical engineering problem from definition of the task to the presentation of the final results - Acquisition of practical and social skills; - Project and time management - Presentation and documentation
<p>Energy Markets and Coupling Sectors [5 ECTS] - en -</p>	<ul style="list-style-type: none"> - Energy Markets (heat, electricity, mobility, system security) and their price regulations - Renewable gas in the natural gas network - System security of power grids - Sector coupling technologies - Technical and economical evaluation, smart markets 	<p>Electives [15 ECTS] - en/de -</p>	<ul style="list-style-type: none"> - The electives serve for the individual profiling of the course according to your preferences - You may select your electives from a module catalogue 	<p>Bachelor's Thesis and Seminar [15 ECTS] - en/de -</p>	<ul style="list-style-type: none"> - Graduation thesis in the field of Engineering - Independent processing of a task according to scientific and engineering standards - Scientific research and documentation techniques - Scientific work
<p>Smart Grids and Wind Energy [5 ECTS] - en -</p>	<ul style="list-style-type: none"> - Network equipment, producers and consumers (incl. Smart Metering) - Network stability strategies - Future Energy Systems; Smart Grids - Wind Energy; evaluation of wind data; wind turbine technology; 	<p>Practical Seminar [2 ECTS] - en/de -</p>	<ul style="list-style-type: none"> - Block course on competencies that are related to the job profile of an engineer in „Energy systems and Renewable Energies“ 		

Curriculum: Energy Systems and Renewable Energies

Bachelor of Engineering, 7 semesters



7. Semester	Elective [5 ECTS]	Bachelor's Thesis and Seminar [15 ECTS]			Energy from Biomass and Biogenic Residues [5 ECTS]	Mobility within the Energy System [5 ECTS]
6. Semester	Project [5 ECTS]	Elective [5 ECTS]	Elective [5 ECTS]	Solar Buildings and Energy Consulting [5 ECTS]	Energy Markets and Coupling Sectors [5 ECTS]	Smart Grids and Wind Energy [5 ECTS]
5. Semester	Practical Seminar [2 ECTS]	Internship [24 ECTS]				Project and Quality Management [4 ECTS]
4. Semester	Project: Design and Development [5 ECTS]	Control Engineering [5 ECTS]	Energy Distribution and CHP Plants [5 ECTS]	Building Technology and Smart Homes [5 ECTS]	Solar Energy Technologies [5 ECTS]	Cost and Investment Management [5 ECTS]
3. Semester	Product Development and CAD [5 ECTS]	Measurement Engineering [5 ECTS]	Machine Elements [5 ECTS]	Thermodynamics 2 [5 ECTS]	Fluid Mechanics [5 ECTS]	Thermal Energy Technology and Power Plants [5 ECTS]
2. Semester	Engineering Mathematics 2 [5 ECTS]	Material Science [5 ECTS]	Mechanics of Materials [5 ECTS]	Thermodynamics 1 [5 ECTS]	Energy Storage [5 ECTS]	Entrepreneurship and Sustainability [5 ECTS]
1. Semester	Engineering Mathematics 1 [5 ECTS]	Computer Science in Engineering [5 ECTS]	Basics of Mechanical Design [5 ECTS]	Statics [5 ECTS]	Electrical Engineering [5 ECTS]	Energy Systems and Energy Economics [5 ECTS]

Legend:

Management	3 Modules	General Basics	3 Modules	Electives	3 Modules
General Engineering	13 Modules	Specialization Energy	11 Modules	Personal and Practical Skills	4 Modules