



#### RENEWABLE ENERGY TECHNOLOGIES

DBF Academy for Applied Engineering

"Where Engineering Meets Real-World Application"

#### **Course Format**

Type: Block Lecture

Duration: 5 Lecture Days + 1 Exam Day

Daily Schedule: 6 hours per day Delivery Mode: In-person or online

Assessment: Final exam (written or oral, to be discussed with host university)

Suggested Credit: approx. 2 ECTS (based on student workload; final decision to be

coordinated with the university)

#### **Target Audience**

Bachelor students in: Energy Engineering, Electrical Engineering, Mechatronics, Industrial Engineering and Mechanical Engineering

#### **Course Outcome**

Students will gain an applied understanding of renewable energy systems including solar, wind, hydro, bioenergy and geothermal. The course covers grid integration, energy storage, sustainability and policy frameworks, preparing students to analyze and contribute to real-world energy transition challenges.



## Day 1: Introduction to Renewable Energy

#### **Global Energy Demand and Sustainability**

Understand current global energy consumption trends and the environmental impacts of fossil fuels. Explore the urgency of transitioning to sustainable energy systems in light of climate change and resource depletion.

#### **Overview of Renewable Energy Sources**

Learn about the main types of renewables — solar, wind, hydro, geothermal and bioenergy. Understand their principles, availability and how they differ in terms of scalability, intermittency and regional suitability.

### **Energy Transition and Decarbonization Strategies**

Study national and international decarbonization pathways (e.g., Net-Zero goals, Green Deal). Analyze how renewable energy, electrification and efficiency improvements play a role in reducing greenhouse gas emissions.



By the end of this session, students will be able to:

Understand global energy challenges and sustainability goals Identify key types of renewable energy Describe strategies for energy transition and decarbonization

# Day 2: Solar Energy

## **Photovoltaic (PV) Systems and Technologies**

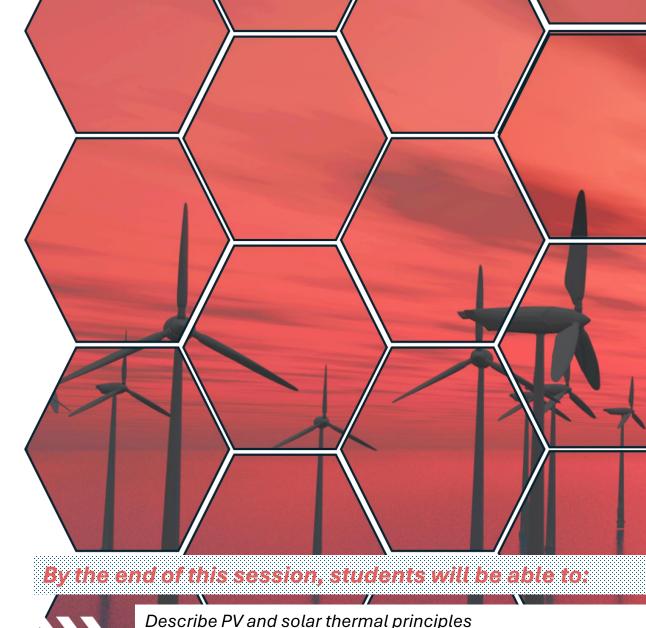
Examine the working principle of PV cells, the difference between monocrystalline, polycrystalline, thin-film technologies and factors affecting solar panel efficiency and performance.

#### **Solar Thermal Energy**

Understand how solar collectors convert sunlight into heat for residential, commercial or industrial use. Learn the differences between flat plate collectors, evacuated tubes and concentrating systems.

#### **Design and Installation of Solar Energy Systems**

Learn the key components of solar PV systems (panels, inverters, batteries, wiring, mounting). Explore sizing calculations, site assessment, orientation and real-world installation challenges.



**>>>** 

Describe PV and solar thermal principles Evaluate solar energy system components Understand design and practical installation issues

## Day 3: Wind and Hydro Energy

#### **Wind Turbine Technologies and Site Assessment**

Understand the design and working principles of horizontal- and vertical-axis wind turbines. Learn how wind resource assessment (speed, turbulence, direction) affects energy yield and site viability.

#### **Hydroelectric Power Generation**

Explore the basics of hydro energy production using dams, run-of-river and pumped-storage systems. Understand how flow rate, head and turbine selection influence output.

#### **Environmental Impacts and Mitigation Strategies**

Analyze ecological and social impacts of wind farms and hydro plants, including land use, wildlife disruption and water management. Learn how environmental assessments and mitigation plans are implemented.



By the end of this session, students will be able to:



Understand wind turbine technologies and siting factors Explain hydroelectric generation principles Assess environmental impacts and mitigation strategies

# Day 4: Bioenergy and Geothermal Energy

#### **Biomass Conversion Technologies**

Learn about bioenergy sources (wood, agricultural waste, biogas) and the technologies for combustion, anaerobic digestion, gasification and fermentation for energy production.

#### **Geothermal Energy Systems**

Understand how heat from the Earth is harnessed through shallow and deep systems. Examine technologies like dry steam plants, binary cycle power stations and direct-use heating systems.

## **Integration of Bioenergy and Geothermal into the Energy Mix**

Explore how these stable, dispatchable energy sources can complement intermittent renewables. Review grid compatibility, regional deployment and their role in decarbonizing heating and electricity.



Describe biomass and geothermal conversion systems Evaluate integration into energy mix Understand operational challenges and advantages

Day 5: Energy Storage and Grid Integration

# **Energy Storage Technologies (Batteries, Pumped Hydro, etc.)**

Compare various storage options: lithium-ion, flow batteries, pumped hydro, compressed air and hydrogen. Understand how energy storage improves reliability and balances renewable supply-demand.

#### **Smart Grids and Demand Response**

Learn how digital technologies enhance grid flexibility through realtime monitoring, demand forecasting and load balancing. Explore how prosumers and IoT devices contribute to smart energy systems.

#### **Policy Frameworks and Economic Considerations**

Review global and local policy instruments supporting renewable deployment (feed-in tariffs, auctions, tax credits). Study market dynamics, levelized cost of electricity (LCDE) and investment risks in renewable projects.



**>>>** 

Compare various energy storage systems
Understand smart grid operation and demand response
Analyze policy and economic considerations

# Day 6: Examination

The final exam format (written or oral) will be discussed with the host university. The evaluation will cover:



Knowledge of renewable energy technologies



System-level thinking and integration



Environmental and policy awareness

