Renewable Energies

DBF

ACADEMY FOR APPLYIED ENGINEERING

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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.

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

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.

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

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 real-time 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 (LCOE) and investment risks in renewable projects.

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

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