Applied MATLAB and Simulink for Renewable Electrical Systems Training Course

Ref: #ERE4197

Course Introduction / Overview:

The global energy transition has made proficiency in renewable energy systems a critical skill for engineers and technicians. This training course, offered by BIG BEN Training Center, provides a comprehensive, hands-on experience in using MATLAB and Simulink to model, simulate, and analyze renewable electrical systems. It is designed to equip professionals with the practical tools needed to address real-world challenges in this dynamic field. The curriculum covers everything from fundamental principles of renewable energy technologies, like solar and wind power, to advanced control systems and grid integration. The course draws on the seminal work of academic authors, such as Dr. Saifur Rahman's contributions to power system analysis and control and is grounded in the principles found in texts like "Renewable Energy Systems: A Modeling Approach" by Fouad G. Ghaffour. Through a series of practical exercises and case studies, participants will learn how to build accurate simulations of photovoltaic arrays, wind turbines, and energy storage systems. Our program focuses on the technical skills required for simulation and modeling, including the design of converters and inverters, ensuring participants can confidently analyze system performance and optimize designs for efficiency and reliability.

Target Audience / This training course is suitable for:

- Electrical engineers and power system designers.
- Renewable energy researchers and developers.
- Control systems engineers.
- Technical managers and project leaders.
- Students and academics in electrical engineering.
- Maintenance and operations personnel in energy sectors.

Target Sectors and Industries:

- Renewable energy and clean tech.
- Power generation and utility companies.
- Engineering and design firms.
- Research and development institutions.
- Government agencies and regulatory bodies.
- Manufacturing and automation.

Target Organizations Departments:

- Research and development.
- Electrical engineering.
- Power systems.
- Operations and maintenance.
- Project management.
- Renewable energy.

Course Offerings:

By the end of this course, the participants will have able to:

- Design and simulate renewable energy systems using MATLAB and Simulink.
- Model and analyze photovoltaic (PV) systems and wind turbines.
- Implement power electronic converters for grid integration.
- Simulate energy storage systems and their control.
- Analyze the performance of hybrid renewable energy systems.
- Develop control strategies for maximum power point tracking (MPPT).
- Troubleshoot and optimize system performance using simulation.
- Integrate various renewable sources into a single electrical grid.
- Evaluate the stability and reliability of renewable power systems.

Course Methodology:

This training course is built around a highly interactive and practical methodology. Participants will spend a significant portion of their time engaged in hands-on simulation and modeling exercises using the MATLAB and Simulink environments. Each module includes a series of guided workshops where participants apply theoretical concepts to real-world scenarios, building and testing models of solar panels, wind turbines, and power converters. The course emphasizes collaborative problem-solving through teamwork and group projects, allowing participants to share insights and learn from one another's experiences. Instructors will provide immediate feedback and guidance, ensuring that all participants master the technical skills required for effective simulation and analysis. This approach moves beyond passive learning, encouraging active engagement and critical thinking. By the end of the program, participants will not only understand the principles of renewable energy systems but will have also gained practical expertise in using one of the industry's most powerful simulation tools. BIG BEN Training Center is committed to this hands-on approach to guarantee a comprehensive and lasting educational experience.

Course Agenda (Course Units):

Unit One: MATLAB and Simulink Fundamentals for Power Systems

- Introduction to the MATLAB and Simulink environments.
- Basic programming for electrical engineering applications.
- Building a simple electrical circuit model in Simulink.
- Understanding blocks and libraries for power systems simulation.
- Setting up and running a basic simulation.
- Data analysis and visualization of simulation results.
- Introduction to power electronics components.

Unit Two: Modeling and Simulation of Photovoltaic Systems

- Principles of solar energy and PV cell characteristics.
- Building a realistic PV cell and array model in Simulink.
- Designing a maximum power point tracking (MPPT) controller.
- Simulating the effects of varying irradiance and temperature.
- Modeling power converters for grid-connected PV systems.
- Analysis of PV system performance under different conditions.
- Case study: simulating a residential solar installation.

Unit Three: Modeling and Simulation of Wind Energy Systems

- Introduction to wind turbine aerodynamics and control.
- Modeling a wind turbine and its generator in Simulink.
- Implementing pitch and yaw control mechanisms.
- Simulating variable wind speeds and their impact on power output.
- Design of converters for grid integration of wind farms.
- Analyzing the dynamics of a wind power plant.
- Advanced topics in wind energy system simulation.

Unit Four: Power Electronics and Grid Integration

- Fundamentals of AC-DC and DC-AC converters.
- Detailed modeling of inverters for grid connection.
- Control strategies for injecting power into the grid.
- Simulating grid stability with integrated renewable sources.
- Harmonic analysis and power quality issues.
- Modeling energy storage systems (batteries) in Simulink.
- Design and control of a hybrid renewable energy system.

Unit Five: Advanced Topics and System-Level Simulation

- Simulation of a microgrid with multiple renewable sources.
- Integrating energy storage and its control for grid support.
- Developing a comprehensive system-level model.
- Analyzing the economic and technical aspects of system design.
- Exploring new technologies like hydrogen energy systems.
- Optimization techniques for system efficiency.
- Final project: simulating a complete renewable energy plant.

FAQ:

Qualifications required for registering to this course?

There are no requirements.

How long is each daily session, and what is the total number of training hours for the course?

This training course spans five days, with daily sessions ranging between 4 to 5 hours, including breaks and interactive activities, bringing the total duration to 20 - 25 training hours.

Something to think about:

How can advanced simulation techniques using MATLAB and Simulink predict and mitigate the impacts of climate change and extreme weather events on the stability and reliability of future renewable energy grids?

What unique qualities does this course offer compared to other courses?

This training course distinguishes itself by offering a deep practical and hands-on learning experience focused entirely on the use of MATLAB and Simulink for renewable energy systems. Unlike broader courses that cover only theoretical concepts, our program immediately immerses participants in the process of building and analyzing functional models. We don't just talk about control systems or grid integration; we teach participants how to design, simulate, and optimize them step-by-step. The curriculum is meticulously structured to progress from foundational concepts to complex, system-level simulations, ensuring participants gain a mastery of both individual components and complete hybrid systems. The focus is on real-world applications, giving attendees the skills to confidently tackle challenges in power systems design and analysis. We emphasize the development of practical, transferable skills rather than just theoretical knowledge, which means our graduates are better equipped to contribute to renewable energy projects from day one. This makes the course an invaluable asset for anyone looking to advance in this fast-growing sector.