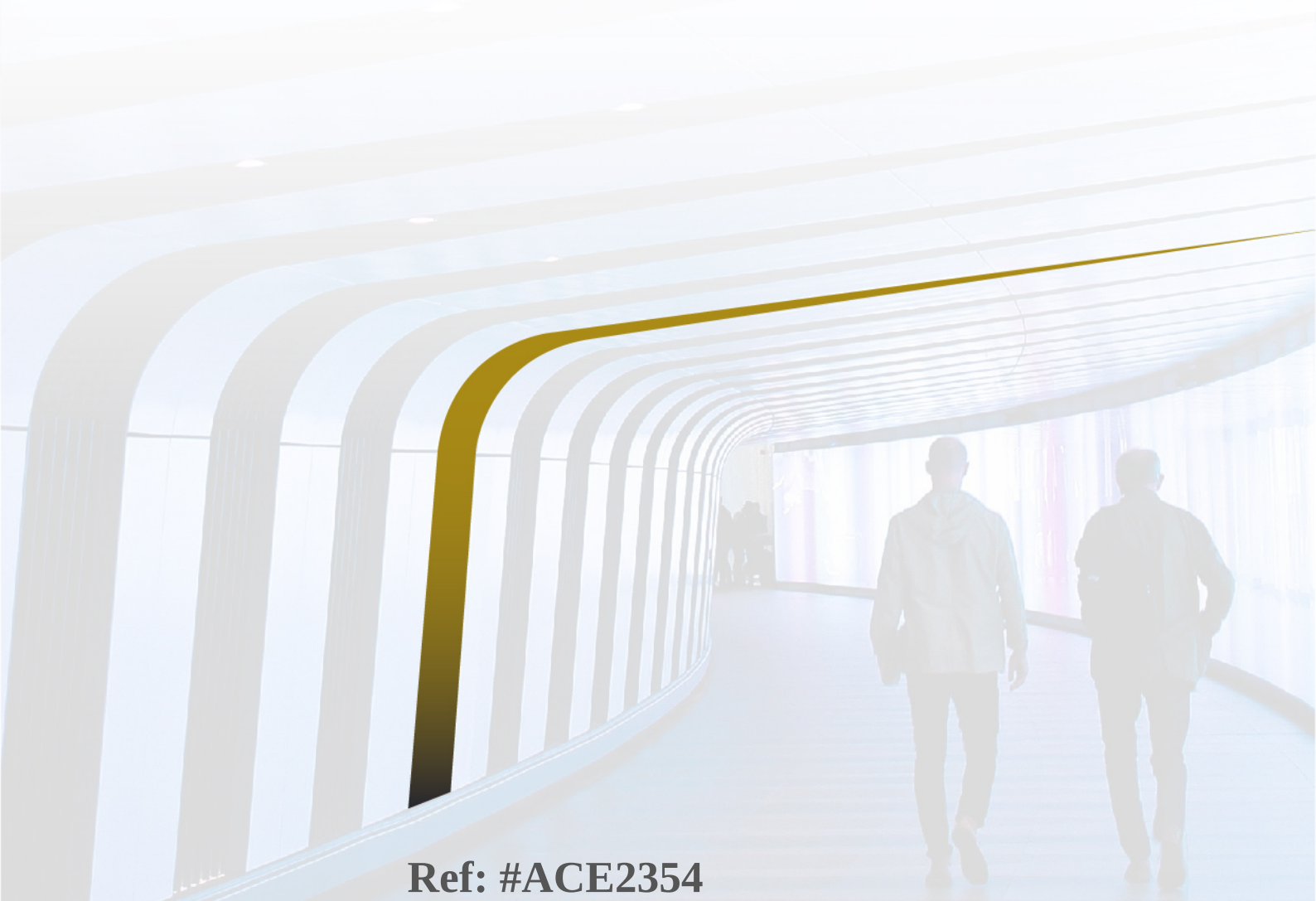
Computational Fluid Dynamics for Process and Chemical Engineers Training Course



Ref: #ACE2354

Course Introduction / Overview:

This training course offers a comprehensive look into computational fluid dynamics (CFD), specifically tailored for chemical and process engineers. In today's complex industrial landscape, using CFD simulations is no longer a luxury, but a necessity for optimizing process design, troubleshooting issues, and innovating new products. This course gives participants a solid foundation in the fundamental principles of fluid dynamics and mass transfer, then shows them how to apply these concepts using modern CFD software. We cover the entire simulation workflow, from pre-processing and meshing to solving and post-processing, with a focus on practical applications in chemical engineering. The course content is informed by leading academic research in the field. For instance, the principles discussed in the book Computational Fluid Dynamics: The Basics with Applications by John D. Anderson, Jr. serve as a core reference. At BIG BEN Training Center, we believe in hands-on learning, so this program is designed to equip engineers with the practical skills needed to analyze and solve real-world fluid flow problems in their specific industry.

Target Audience / This training course is suitable for:

- Chemical and process engineers.
- R&D scientists and researchers.
- Mechanical and production engineers.
- Academics and students in related fields.
- Design engineers and consultants.
- Project managers overseeing process development.
- Professionals in the oil and gas industry.

Target Sectors and Industries:

- Oil and gas.
- Pharmaceuticals.
- Chemical manufacturing.
- Food and beverage processing.
- Energy and power generation.
- Government agencies and research institutes.
- Aerospace and automotive engineering.

Target Organizations Departments:

- Process engineering.
- Research and development.
- Design and simulation.
- Operations and maintenance.
- Product development.
- Quality control.
- Safety and environmental management.

Course Offerings:

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

- Formulate and set up CFD models for chemical processes.
- Apply discretization methods to solve fluid dynamics equations.
- Analyze flow patterns and pressure drop in reactors and pipelines.
- Simulate multiphase flow and mass transfer phenomena.
- Troubleshoot common issues in CFD simulations.
- Interpreting CFD results to optimize process design.
- Validate simulation results using experimental data.
- Integrate CFD into the chemical engineering workflow.

Course Methodology:

This training course uses a blend of theoretical instruction, guided exercises, and hands-on projects to ensure a complete understanding of CFD. The training starts with a clear explanation of the underlying physics and numerical methods before moving on to practical software applications. We use a case study-based approach, where participants will solve real-world problems related to chemical reactors, mixers, and heat exchangers. Each unit includes interactive sessions where participants can ask questions and discuss their simulation results. This approach helps participants understand the entire CFD workflow, from preparing the geometry and meshing to solving the equations and analyzing the data. We also give feedback on each participant's work, which helps them improve their skills. At BIG BEN Training Center, we are dedicated to helping professionals master complex engineering tools, and this course is designed to build confidence and competence in applying CFD to chemical processes.

Course Agenda (Course Units):

Unit One: Introduction to CFD for Chemical Engineering.

- Fundamentals of fluid flow and heat transfer.
- Governing equations of fluid dynamics.
- Introduction to the CFD workflow.
- Meshing and pre-processing techniques.
- Introduction to commercial CFD software.

Unit Two: Discretization and Numerical Methods.

- Finite difference and finite volume methods.
- Discretization of the Navier-Stokes equations.
- Solving systems of linear equations.
- Convergence and solution accuracy.
- Grid independence studies.

Unit Three: Simulating Single-Phase Flow.

- Laminar and turbulent flow models.
- Incompressible and compressible fluid simulations.
- Flow through pipes, valves, and fittings.
- Pressure drops and pump sizing.
- Heat transfer and thermal analysis.

Unit Four: Multiphase Flow and Reaction Engineering.

- Introduction to multiphase models.
- Gas-liquid and liquid-solid flow simulations.
- Mix and mass transfer in stirred tanks.
- Modeling chemical reactors and reaction kinetics.
- Fluidized beds and particle flow.

Unit Five: Advanced Topics and Practical Application.

- Mesh motion and dynamic meshing.
- Coupled heat and mass transfer.
- Best practices for post-processing and visualization.
- Validation and verification of CFD results.
- Case study: A full-scale industrial simulation.

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:

In what ways could the integration of machine learning algorithms with traditional CFD models revolutionize the design and optimization of complex chemical processes?

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

This training course is designed specifically for chemical and process engineers, which is their most important quality. Unlike other courses that give a general overview of CFD, our content is focused on the practical problems and applications most relevant to this field. We don't just teach you how to click buttons in a software program, but rather how to think like a CFD analyst, understanding the underlying physics and numerical methods. This deep-dive approach helps participants troubleshoot complex simulation issues on their own. Our methodology is heavily based on realistic case studies that mirror challenges in the chemical industry, giving a clear bridge between academic knowledge and professional practice. The curriculum is also regularly updated to reflect the latest trends in computational fluid dynamics, ensuring that participants get the most current and relevant information. It’s an advanced program that gives engineers the skills to use CFD as a powerful tool for innovation and problem-solving.