Introduction

Heat exchangers are crucial components in many industries, playing a key role in optimizing energy use, reducing operational costs, and ensuring efficient operations. This **Heat Exchanger Design and Maintenance** course provides a comprehensive understanding of industrial heat exchangers, their functions, and applications. Participants will gain insights into the principles of heat transfer, design standards, and operational efficiency that contribute to the effectiveness and longevity of heat exchangers in various industries.

The course covers essential topics such as **material selection**, the thermodynamics of heat exchangers, heat exchange efficiency, and the relevant **design codes and standards** such as **API**, **TEMA**, and **ASME**.

Understand Heat Exchanger Design and Maintenance

This course offers a deep dive into heat exchanger design and maintenance, providing participants with the knowledge to optimize heat exchange processes. Key focus areas include understanding heat transfer, exploring different heat exchanger types, and applying relevant design principles to improve efficiency and reduce operational costs. By the end of the course, participants will be equipped to enhance heat exchanger performance and address common operational issues.

Targeted Groups

This course is designed for:

- **Maintenance Professionals**
- **Inspection Personnel**
- **Process Supervisors**
- **Plant Operators**
- **Plant/Technical Managers**

Course Objectives

Upon completing the course, participants will be able to:

- Understand the role of heat exchangers in optimizing plant operations.
- Master heat transfer and fluid dynamics as they relate to the thermal design of heat exchangers.
- Apply mechanical design methodologies for heat exchangers, following industry codes and best practices.
- Implement cost-effective strategies to improve heat exchanger performance.
- Gain knowledge of hydraulic, thermal, and mechanical aspects of heat exchanger design and operation.
- Identify and address performance issues, extend service life, and conserve energy.

Targeted Competencies

By the end of the course, participants will be able to:

- Develop a deep understanding of heat exchanger designs and characteristics.
- Grasp heat transfer principles and their applications.
- Navigate international codes and standards for fabrication, operation, and maintenance.
- Troubleshoot operational issues such as fouling.
- Inspect heat exchangers for corrosion, erosion, and structural integrity.

Course Content

Unit 1: Types and Application of Heat Exchangers

- **Fundamentals** of heat exchangers.
- The significance of heat exchange in industries like petroleum, petrochemical, and process industries.
- **Heat transfer fundamentals** and **heat transfer coefficients**.
- Overview of **heat exchanger types**:
  - **Shell and tube heat exchangers (STHE)**
  - **Compact heat exchangers**
  - **Plate heat exchangers**
  - **Print circuit heat exchangers**
  - **Heat pipes**
  - **Air-cooled heat exchangers**
  - **Regenerative heat exchangers**
- Understanding **TEMA nomenclature** and selection guidelines for different types of heat exchangers.

Unit 2: Thermal and Hydraulic Design of Heat Exchangers

- Specifying and sizing **heat exchangers**.
- Temperature differences in **shell and tube heat exchangers (STHE)**.
- Understanding **flow arrangements**: countercurrent, co-current, and cross-current.
- Learn how to calculate **velocity triangles** and derive performance from first principles.
- Understanding **pump performance curves**: head-capacity, power, and efficiency.
- Learn about **fluid flow** and **pressure drop** in heat exchangers.
- Design considerations for **condensers** and **reboilers**.

Unit 3: Mechanical Design of Heat Exchangers

- Overview of **design codes** and best practices (ASME BPVC, API 660, 661, 662, TEMA).
- Basic design principles for **STHE**, **PHE**, and **ACHE** heat exchangers.
- Special design considerations, including **piping loads** and the impact of **service conditions** on material selection.

- Materials for **heat exchanger construction**.
- Fabrication methods for **heat exchangers**.

Unit 4: Operation and Maintenance of Heat Exchangers

- Understanding **fouling** in heat exchangers: types, mechanisms, and economic impact.
- Strategies for **fouling mitigation** through design and operation.
- **Corrosion** and **erosion** in heat exchangers: causes, effects, and prevention.
- Inspection techniques for heat exchangers.
- **Troubleshooting and performance monitoring**.
- Preventing **flow-induced vibration** and selecting the right design to avoid damage.
- Cleaning methods for **STHE**, **PHE**, and **ACHE**.
- Cost-effective **maintenance and repair** strategies.

Unit 5: Performance Enhancement and Optimization of Heat Exchangers

- **Heat transfer augmentation** techniques, such as **finned tubes** and **tube inserts**.
- Exploring **tube bundle replacement** and alternative designs to enhance heat transfer.
- **Rod baffle**, **Heli baffle**, and **twisted tube** designs for improved efficiency.
- Implementing **Pinch technology** for process optimization.
- Optimizing **heat exchanger train** and basics of **heat integration**.

This course equips professionals with the skills to design, operate, and maintain heat exchangers efficiently, ensuring optimal performance, longevity, and cost-effectiveness in industrial applications.