

Course No. 1525

HVAC Systems Design & Engineering Training Course

**HVAC, REFRIGERATION & BUILDING SERVICES
INDUSTRIAL ENGINEERING, MAINTENANCE & OPERATIONS**

DURATION

5 Days

DELIVERY

Classroom



Course Overview

The HVAC Systems Design & Engineering Training Course provides a comprehensive professional framework for designing, engineering, evaluating, and optimizing heating, ventilation, and air-conditioning systems across commercial, industrial, institutional, and large-scale facilities. The course integrates engineering principles, building requirements, equipment selection, system configuration, energy considerations, and practical design methodologies to support reliable and efficient HVAC performance.

Effective HVAC design is essential to maintaining thermal comfort, indoor air quality, equipment reliability, energy efficiency, and operational continuity. Poorly designed systems can lead to excessive energy consumption, inadequate ventilation, unstable temperatures, maintenance difficulties, and reduced building performance. This course equips participants with the technical knowledge required to approach HVAC engineering decisions systematically and align system design with project requirements.

The program covers the complete HVAC design process, from understanding heating and cooling loads through equipment selection, ductwork and piping design, ventilation requirements, air distribution, control strategies, and system commissioning. Participants will examine how engineering calculations and design criteria influence system capacity, operating performance, lifecycle considerations, and maintainability.

Particular attention is given to practical engineering judgment and the integration of HVAC systems within wider building and industrial environments. Participants will explore design challenges associated with large facilities, industrial applications, critical environments, energy-conscious buildings, and projects where reliability and operational performance are key priorities.

By completing this HVAC Systems Design & Engineering Training Course, professionals will be better prepared to review design requirements, evaluate engineering alternatives, identify design deficiencies, communicate technical decisions, and contribute effectively to HVAC projects from concept and detailed design through installation, testing, commissioning, and operational improvement.

Objectives

- Analyze HVAC design requirements and project parameters during the course to establish appropriate engineering criteria for different building and industrial applications.
- Develop preliminary HVAC system concepts based on space requirements, occupancy characteristics, environmental conditions, and operational objectives.
- Calculate and evaluate heating and cooling loads using appropriate engineering principles and relevant project data.
- Assess ventilation and indoor air quality requirements and determine suitable outdoor air and air distribution strategies.
- Apply engineering principles to select appropriate HVAC equipment according to capacity, efficiency, operating conditions, reliability, and maintenance requirements.
- Design and evaluate air distribution systems, including ductwork, airflow requirements, pressure considerations, and terminal devices.
- Design and assess chilled-water, hot-water, refrigerant, and other applicable HVAC piping arrangements based on system requirements.
- Evaluate HVAC control and automation strategies to support stable operation, energy management, monitoring, and equipment protection.
- Assess HVAC design alternatives using performance, energy efficiency, lifecycle, maintainability, and operational considerations.
- Improve HVAC project coordination by identifying interfaces between mechanical systems, electrical systems, controls, architectural requirements, and other building services.
- Apply systematic design review techniques to identify technical deficiencies, inconsistencies, and potential operational risks before implementation.
- Develop a practical HVAC design and engineering action plan incorporating calculations, equipment selection, system coordination, testing, and commissioning considerations.

Who Should Attend

This course is designed for mechanical engineers, HVAC engineers, building services engineers, MEP engineers, project engineers, design engineers, maintenance engineers, facilities engineers, energy engineers, and technical specialists responsible for the design, operation, maintenance, evaluation, or improvement of HVAC systems. It is also suitable for professionals involved in engineering consultancy, construction, commissioning, facilities management, and industrial plant operations.

The program is particularly relevant to engineering managers, maintenance managers, facilities managers, project managers, technical managers, operations managers, energy management professionals, and engineering supervisors who need to evaluate HVAC designs and make informed technical decisions. It can also benefit professionals working in oil and gas facilities, manufacturing plants, commercial buildings, hospitals, hotels, government facilities, data centers, infrastructure projects, and other environments where HVAC reliability and performance are critical.

The course is also valuable for senior professionals and decision makers responsible for reviewing HVAC project proposals, approving technical solutions, managing contractors, controlling project costs, improving energy performance, and ensuring that HVAC systems support organizational operational requirements. Participants from multidisciplinary project teams will benefit from understanding the engineering relationships between HVAC systems and wider building services.

Learning Outcomes

- Explain the fundamental engineering principles governing modern HVAC systems and their application across different facility types.
- Identify key design inputs required to develop reliable and technically appropriate HVAC solutions.
- Perform and interpret heating and cooling load calculations using relevant engineering parameters.
- Evaluate building heat gains and heat losses and determine their influence on system capacity.
- Determine appropriate ventilation requirements and assess indoor air quality considerations.
- Select HVAC equipment based on capacity, efficiency, operating conditions, reliability, and maintenance requirements.
- Develop and evaluate basic ductwork and air distribution arrangements for different applications.
- Assess chilled-water, hot-water, refrigerant, and associated piping system configurations.
- Evaluate HVAC controls, instrumentation, and automation requirements for efficient and stable operation.
- Review HVAC drawings, specifications, equipment schedules, and engineering documentation to identify inconsistencies and potential design issues.
- Assess HVAC systems from energy efficiency, lifecycle cost, maintainability, and operational performance perspectives.

- Apply commissioning, testing, balancing, and performance verification principles to support effective HVAC system handover and operation.

Course Outline

DAY 01

HVAC Engineering Fundamentals and Design Requirements

- Fundamentals of heating, ventilation, and air-conditioning systems
- HVAC system classifications and applications
- Psychrometrics and properties of moist air
- Indoor environmental conditions, thermal comfort, and air quality
- Design conditions, climate data, occupancy, building characteristics, and operational requirements

PRACTICAL APPLICATION

Review of an HVAC project brief and identification of key design inputs

DAY 02

HVAC Load Calculations and System Design

- Principles of heating and cooling load calculations
- Building heat gains and heat losses
- Solar gains, transmission loads, occupancy, lighting, and equipment loads
- Sensible and latent cooling requirements
- Peak load considerations and equipment capacity determination
- Diversity factors and practical load assessment considerations

PRACTICAL APPLICATION

Development and evaluation of representative heating and cooling load calculations

DAY 03

Equipment Selection, Air Distribution, and Piping Systems

- HVAC equipment types and selection criteria
- Air handling units, fan coil units, rooftop systems, package units, and central systems
- Chillers, cooling towers, boilers, and heat-transfer equipment
- Ductwork design, airflow distribution, pressure losses, and fan selection
- Diffusers, grilles, registers, and terminal air distribution devices
- Chilled-water, hot-water, and refrigerant piping fundamentals

PRACTICAL APPLICATION

Equipment selection and preliminary HVAC system configuration for a representative facility

DAY 04

HVAC Controls, Energy Efficiency, and System Integration

- Fundamentals of HVAC control systems and instrumentation
- Sensors, actuators, controllers, valves, dampers, and control sequences
- Building automation and HVAC monitoring
- Variable air volume and variable water flow strategies
- Energy efficiency principles for HVAC systems
- Equipment efficiency, heat recovery, free cooling, and demand-based control
- Integration of HVAC systems with electrical, architectural, fire protection, and other building services

PRACTICAL APPLICATION

Evaluation of an HVAC control strategy and identification of energy optimization opportunities

DAY 05

Design Review, Commissioning, and Operational Performance

- HVAC drawings, specifications, schedules, and design documentation
- Design review and identification of engineering deficiencies

DAY 05 — CONTINUED

- Testing, adjusting, and balancing of HVAC systems
- HVAC commissioning principles and functional performance testing
- Equipment performance verification and acceptance criteria
- HVAC maintenance, reliability, and lifecycle performance considerations
- Common HVAC design and installation problems and corrective approaches

FINAL WORKSHOP

Complete HVAC system design review, identify technical improvement opportunities, and develop an implementation action plan

Register or Request More Information

Course page: <https://quest-training.com/courses/hvac-systems-design-engineering-training-course>

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