

FACULTY OF **ENGINEERING**

DEGREE COURSE: **INDUSTRIAL ENGINEERING**

MASTER DEGREE: **INDUSTRIAL ENGINEERING / ENERGY**

**SUBJECT:** HVAC DESIGN

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## **OBJECTIVES**

The course aims at providing the basic knowledge needed for the design of heating ventilation and air-conditioning (HVAC) plants in the service of every type of user. The main objective is the acquisition of knowledge of the equipment of the overall features and methods of designing which are characteristics of each type of plant

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## **CONTENTS**

Introductory concepts

1. Review of applied thermodynamics
2. Fundamentals of heat transfer
3. Thermodynamics of moist air
4. Comfort conditions

Thermophysics of building

1. Heat Transfer in buildings
2. Calculation of heat losses
4. Heat gain and cooling load
5. Greenhouse Effect
6. Insulation materials.

Generalities on heating ventilation and air conditioning plants

1. Classification
2. Water systems
3. Air systems
4. Mixed systems
5. Direct expansion systems

Components of heating and air conditioning plants

1. Boilers, Chillers and Heat Pumps
2. Air Treatment Unit, Free-cooling systems and Cooling towers
3. Pumps, Fans and Compressors
4. Thermophysical characteristics of refrigerants
5. Pipe & Channels
7. valves and dampers, control elements and calibration

8. Heat metering
9. Heat exchangers

#### Energy efficiency in HVAC plants

1. Low temperature Heat generator and condensation technique
2. Biomass heat generator
3. Geothermal heat pumps (low enthalpy geothermal energy)
4. Absorption chiller
5. Cogeneration and trigeneration
6. Recovery of waste heat

#### Ventilation strategies in buildings

1. Natural Ventilation
2. Controlled Mechanical Ventilation
3. Reference Standards
4. Indoor air quality IAQ

#### Hot water production and distribution

1. Calculation of the needs of domestic hot water
2. Designing water distribution networks
3. Strategies for the production of domestic hot water
4. Designing water pressurization group
5. Production of hot water using renewable energy: solar thermal pannel
6. Strategies for disinfection of domestic hot water

#### Standards on energy saving

1. The Italian and European standards on energy saving
3. UNI-TS 11300 standards
4. Energy Audit
5. Energy certification of buildings

#### Distribution networks for natural gas and LPG

1. Gas distribution network
2. Calculation of pressure losses
2. Standard UNI 7129

#### Design Examples

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## **LEARNING OUTCOMES**

At the conclusion of the course, students will have acquired the necessary tools for the selection of the best system solution to ensure the proper functioning of the HVAC-building system and to ensure the comfort conditions inside the building. Also, at the end of the course, students will be able to design and select the main system components aiming at reducing energy consumption.

## **ASSESSMENT**

Written exam: multiple-choice tests and open-ended questions

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## RECOMMENDED TEXTBOOKS

HVAC Design Handbook

Roger W. Haines, P.E., Michael E. Myers, P.E., LEED AP

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