HEATING, VENTILATION, AIR CONDITIONING SYSTEMS (HVAC)

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Persons in charge of the course:

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What is an HVAC:

- **Heating**
  - Residential, tertiary, industrial
  - Houses, offices, shops, hotels, restaurants, educational, warehouse, hospitals, farms, food industries, …

- **Cooling**
  - Residential, tertiary, industrial, servers and data centers

- **Hot water**
  - Houses, sporthalls, swimming pools, hotels, restaurants, hospitals, farms, food industries, …

- **Ventilation**
  - Offices, shops, hotels, restaurants, educational, sporthalls, hospitals, pharmaceutical, …

**Source:** herzitalia.it

**Source:** climaexpert.it

**Source:** ahoraarchitectura.it
HVAC (1/2)

- Problems related to IEQ (Indoor Environmental Quality)
- Climate, peak power, energy and loads
- Recap on heat transfer, building envelope, energy consumptions
- Sizing of Domestic Hot Water (DHW)
- Types of plants (full air, water, primary air)
- Types of ventilation in rooms, mechanical ventilation for residential buildings and control of humidity.
- Air Handling Units (AHU)
- Aeraulics (air ducts distribution, terminal air diffusers) sizing, choice, balancing

HVAC (2/2)

- Types of terminal units (radiators, fan-coils, chilled/active beams, radiant systems)
- Hydronics (piping, distribution, valves) sizing and balancing
- Generation systems: boilers, air source heat pumps
- Control of hydronic systems
- District heating and cooling networks
- Energy certificates and regulations
Exam rules 1/2:

- Report: 7 points

Report
- Calculation of peak power for heating of your house
- Calculation of peak power for cooling of your house
- DHW consumption (energy) + sizing?
- Sizing of a radiant floor
- Sizing/balancing of a ventilation system
- Sizing/balancing of a hydronic system

To be uploaded in Moodle.

Exam rules 2/2:

- Exam:

  - 1 long written question: 7 points
  - 2 short written questions (2 x 4 =): 8 points
  - 1 oral question: 8 points
  - report: 7 points

\[ \sum = 30 \text{ points} \]

Duration of the written part: 1 hour

At the end of the written part, the oral question will start. First In First Out (the first who delivers the written answers will be the first one in answering the oral question).
Potential dates of the exam:

- Exams:
  - 20/6 morning
  - 14/7 morning

- Reports
  They should be uploaded in Moodle
  - either the 13/6 for the first date of the exam
  - or the 7/7 for the second date of the exam

The report has to include all Excel files and the Word document: all compressed in a .zip file named: NAME_SURNAME_HVAC

Subdivision of the program:

- Thermal comfort, IAQ, climate, heating and cooling peak power and energy demand, domestic hot water (DHW), types of ventilation systems, full-air plants, aeraulics, mechanical ventilation for residential buildings, dehumidification, terminal units, generation systems, air to water heat pumps, energy certificate

  Michele De Carli 7 CFU

- hydronics, control of plants, district heating and cooling networks, tools for sizing and balancing air ducts (Dr. Carnieletto) and water pipelines

  Jacopo Vivian 2 CFU
Which plants do we have in a building?

**Mechanical, electrical and plumbing (MEP)**

- HVAC
- DC
- AC
- Lighting
- Information Technology (communication, control, BEM, security, audio, video)

Potable water, hot water, sewerage, stormwater, natural gas, rainwater collection and storage

HVAC + plumbing: 25-30% of overall costs
Electrical plants: 25-30% of overall costs

MEP 50%-60% of overall costs

**Plumbing**

- Supply potable water
- Aqueduct
- Meter
- Soil & waste pipe
- Public sanitary sewer
- Vent
- Cold water
- DHW generator
- Kitchen
- Bath room
- Hot water

*Source: mestiereimpresa.it*
Electrical

Source: systemimpianti.it

Source: stacbond.com

Source: bricoportale.it
Italian regulations:

- L. 46/90 (design of buildings and HVAC)
- L. Merloni 1994 (Public works: documentation for each design phase)
- DPR 554 21/12/99 (Decree implementing the L. Merloni)
- **D. Lgs. 50/2016**

Design phases in Italy:

- Technical- economic feasibility design (location, size/volume, main pipelines) 1:200
- *Final design (definition of all HVAC components, sizing of secondary lines, emission systems) 1:100*
- *Working plan (thickness and details on various components) 1:50*
- Construction drawings: exact position of each component (e.g. shipyards, prefab constructions)
- “As built”
- Test
- Facility management
Volume needed for the ventilation machine

Volume needed for the main pipelines

Preliminary design

Final design/
Working plan
Standards:

- UNI (CTI)
- CEI
- UNI CIG: Comitato Italiano Gas
- EN (CEN)
- ISO
- ASHRAE

Associations:

- AiCARR (Associazione italiana del Condizionamento dell’Aria, Riscaldamento e Refrigerazione)
  http://www.aicarr.org/  https://www.youtube.com/watch?v=ehWJpn_ZLD8

- ASHRAE
- REHVA
- GBC