2021-2022	Mechanical Engineering	Year 4 - Sem. 8
MECA422	**Heating, Ventilation, and Air Conditioning**	Mandatory
ECTS: 4	*Coordinator:* Dr Oussama Ibrahim	*Language:* English/French
Total hours: **54 h**	*Lectures:* Dr Oussama Ibrahim, Dr Wael Zmerly, Ing. Andre Kanaan	

Description:

This course aims to introduce the student to the fundamentals of heating, ventilation, and air conditioning (HVAC) systems. It mainly deals with the determination of heating and cooling loads in order to properly design and size the HVAC systems of a building. It also introduces the Psychrometric properties of air and Psychrometric processes, thermal Comfort, and estimation of the overall heat transmission coefficients of building constructions. The determination of the intensity of solar irradiation striking a surface is also presented. Furthermore, it presents the principal methods for sizing of pipes and ducts as well as the general types of fans and air supply devices. Students will also have the opportunity to familiarize themselves with a computer tool for calculating thermal loads.

Learning outcomes:

- Introduce students to the scope, operation and uses of Air Conditioning systems,
- Develop understanding of the principles and practice of thermal comfort,
- Develop clear understanding of Psychrometrics of moist air and its application to HVAC processes,
- Demonstrate an understanding of heat transmission in building structures,
- Calculate building heating loads and heating-plants capacities,
- Calculate building cooling loads and cooling-plants capacities,
- Estimate the intensity of solar irradiation striking a surface,
- Size pipes and ducts,
- Develop understanding of fans and air supply devices,
- Calculate building thermal loads using available corresponding software (HAP, DesignBuilder, TRNSYS, EnergyPlus…).

Content:

- Basis of Air Conditioning (AC). Main components of AC unit. Types of Ac units.
- Thermal comfort conditions with respect to temperature and humidity and human clothing and activities and its impact on human comfort, productivity, and health.
- Read values of properties from the Psychrometric chart. Determine sensible and latent heat changes in AC equipment. Determine mixed air conditions. Determine required supply air conditions. Determine cooling coil performance specifications.
- Basic heat transfer modes (conduction, convection radiation). Thermal properties of building materials (overall heat transfer coefficient, thermal conductivity, thermal capacity). Heat transmission through building structures (walls, doors, windows, floors, ceilings).
- Select appropriate indoor and outdoor cold-weather design conditions. Calculate the heat losses from a space Calculate infiltration and ventilation losses. Determine space heating loads. Estimate heating plant/equipment capacity or size.
- Select appropriate indoor and outdoor warm-weather design conditions. Calculate the heat gains (external & internal) to a space. Determine cooling loads in residential as well as non-residential buildings. Find building peak cooling Load. Estimate heat gains to ducts & heat gains from fans. Calculate cooling coil capacity. Find required ventilation rates.
- Earth’s motion about the sun, solar time, basic solar angles, estimation of intensity of solar radiation striking a surface, shading of surfaces from direct solar radiation.
- The continuity equation. The flow energy equation. Pressure loss in closed and open systems. Total, static, and velocity pressure. Static regain. Pressure loss from friction in piping and ducts. Pressure Loss in pipe and duct fittings. System pressure drop. Sizing of pipes and ducts.
- Types and selection of air supply devices (Grilles & Diffusers). Types and selection of fans.
- Calculate building thermal loads using available corresponding software (DesignBuilder, TRNSYS, EnergyPlus…).

References:

- F.C. McQuiston, J.D. Parker, and J.D. Spitler, Heating, Ventilating, and Air Conditioning Analysis and Design, John Wiley & Sons, Inc. 6th Edition, 2005.
- E.G. Pita, Air Conditioning Principles and Systems, Pearson Education, Inc. 4th Edition, 2002.
- ASHRAE Fundamentals Handbook, SI / IP Editions, 1997.
- ASHRAE Fundamentals Handbook, SI / IP Editions, 2009.

Evaluation Method:

Assessment in the following areas will be converted to points, to compute your final grade in this course:

- Mid-Term
- Final Exam
- Attendance, Homework, and Participation

Description :

Ce cours vise à initier l'étudiant aux principes fondamentaux des systèmes de chauffage, de ventilation et de climatisation (CVC). Il traite principalement de la détermination des charges de chauffage et de refroidissement afin de bien concevoir et dimensionner les systèmes CVC d'un bâtiment. Il introduit également les propriétés psychrométriques de l'air et les processus psychrométriques, le confort thermique et l'estimation des coefficients de transmission thermique globaux des constructions. La détermination de l'intensité du rayonnement solaire frappant une surface est également présentée. De plus, il présente les principales méthodes de dimensionnement des tuyaux et conduits ainsi que les types généraux de ventilateurs et de dispositifs d'alimentation en air. Les étudiants auront également l'occasion de se familiariser avec un outil informatique de calcul des charges thermiques.