Degree course	Five years Master's degree in "Architecture" – Class LM4
Course code	
Lecturer	Marina Mistretta
Course name	Engineering Physics
Disciplinary area	Engineering Physics and thermal plants for architecture
Disciplinary field of science	ING-IND/11
University credits - ECTS	12
Teaching hours	120
Course year	II
Semester	Annual

Synthetic description and specific course objectives

The applied physics class is a formative class, aiming to the learning of the physics fundamentals regarding indoor environments applications. The main learning objectives of the class are connected to: 1) fundamental laws of thermodynamics, regarding mass and energy balances for open and closed systems, aiming to describe significant applications regarding the behavior of the building-thermal plant system; 2) applied physics laws critical understanding, in order for the students to develop the ability to solve conceptual problems, 3) typical applications of the thermo-physics of the building focused on the thermal behavior of the building envelope layers through the study of the steady-state heat transfer laws, 4) indoor environment control in terms of visual and thermo-hygrometric comfort, according to the regulations in force.

Course entry requirements

Elements of Mathematical Analysis

Course programme

Thermodynamics

Recurring unit of measurement conversion. Relevant and universal physical constants. Common values of the thermo-physical properties of matter. Unit of measurement of the derived physical matter properties. Thermodynamics systems: open and closed systems. Thermodynamics properties and measurements methods: temperature, pressure and volume. Energy, energy transfer and general energy analysis. Energy typologies, energy transfer as heat and work, internal energy, kinetic and potential energy. First law of Thermodynamics. Enthalpy. Energy and environment: climatic change and greenhouse gases. Pure substance properties. Phase changes. Pure substances properties tables. Ideal gas law. Energy analysis of closed systems: mass and energy balances, First law of thermodynamics applied to closed systems, specific heat, internal energy, ideal gases, solid and liquids enthalpy and specific heat. Energy analysis of open systems: energy and mass balances, First law of Thermodynamics applied to open systems, pressure-volume work. Steady state flow systems. Psychometrics: absolute humidity and relative humidity, dew temperature and dry bulb temperature. Psychometric chart. Psychometric processes in air handling procedures.

Heat transfer

Thermal conduction in steady state conditions. Conduction heat flow in a plane wall. Thermal conductivity. Steady state general conduction law for a plain wall. Thermal resistances. Thermal conductance. Thermal conduction in series and parallel layers. Convection. Thermal convection law. Convection thermal resistance. Convection coefficients. Natural convection. Heat transfer between walls and air. Forced convection. Heat transfer: radiation. Monochromatic emission. Global emission. Monochromatic emission intensity. Global emission intensity. Hemispheric emission. The black body and the Planck law. Specific emissivity. Gray body. Kirchoff law. Shape factor. Greenhouse effect in buildings. Calculation of the thermal heat flux transferred through a multi-layer wall.
Illuminating engineering. Main definitions. Elements of colorimetry. Chromatic effect and color rendering index. Photometric parameters. Luminous emittance or radiance. Absorption factor. Reflection factor. Artificial light sources.

Daylighting. Thermo-hygrometric verifications in buildings, internal and superficial condensation. Partial vapor pressure and dew pressure. Vapor resistance. Glaser method. Thermal-hygrometric comfort. Energy balance of the human body. Microclimate. Thermal-hygrometric comfort indicators. Local discomfort conditions.

Expected results

The formative objectives of the Engineering Physics class are:

1) Allow the student to :
   - Analyze the energy conversion into different forms. The main focus lies within thermal energy,
   - Describe thermo-dynamics systems and the most significant transformations used in the already described processes,
   - Analyze the main heat transfer mechanics in order to solve simple heat transfer problems,
   - Document the main aspects of acoustic, visual and thermo-hygrometric comfort.
2) Allow the student to acquire the first considerations on the design of high comfort indoor environments,
3) Allow the student to develop the ability to apply the physical laws to real cases and to choose the most suitable techniques to construct high thermo-physical quality buildings.

Course structure and teaching

Lessons (Hours/year in class): 80
Exercise (Hours/year in class):40
Practice (Hours/year in class):

Student's independent work

Study of the suggested books and of the materials provided during the course (180h)

Testing and exams

Intermediate test – Final exam

Suggested reading materials

Yunus Çengel "Termodinamica e Trasmissione del Calore" McGraw-Hill. Quarta edizione
Paola Ricciardi "Elementi di acustica e illuminotecnica". McGraw-Hill.
Lezioni del docente