Transport Phenomena I

Calendar: 3rd semester

Contact Hours: T: 30,0; TP:30,0; OT:7,5

Intended learning outcomes of the curricular unit:
This curricular unit aims that students should: Acquire basic knowledge about transport of momentum and heat; Apply the knowledge acquired in solving problems involving fluid flow and heat transfer; Know how to establishing balance sheets of thermal energy and boundary conditions.
After approval students should have the ability to: Design transport systems of a fluid. Understand the fundamentals of energy transfer, being able to apply it for solving practical problems. Identify the processes involved in heat transfer to calculate the amount of heat transferred in one-dimensional systems, using a second Fourier's law, determine the temperature profile and the amount of heat transferred in one-dimensional systems involving heat generation; Analysis of heat transfer equipment, being able to apply knowledge acquired to the selection and design of heat exchangers. Select and design isolation.

Syllabus:
Chapter I: 1. Introduction; 2. Dimensional Analysis; 3. Momentum Transfer and General Balance: Molecular Transport Equation, Velocity Profiles in Laminar Flow; 4. Mass Transfer: Molecular Transport Equation; 5. Energy transfer: Molecular Transport Equation. Bernoulli's equation; 6. Viscosity; Classification of Fluids, Rheology of fluids. Reynolds number, fluid flow under laminar and turbulent regime; 7. Pressure loss. Friction factor; pressure loss in pipes and in pipe fittings, flow meters. Pumps: centrifugal pump sizing
Chapter II: 1. Mechanisms of heat transfer; 2. Fourier's law, Newton's Law of cooling, the Stefan-Boltzmann; 3. Thermal Conduction: Conduction at steady state, one-dimensional conduction in plans and radial systems; with convection and with energy production. Thermal resistances in series, overall coefficient of heat transfer. Thermal insulation; 4. Heat transfer in transient state: finite thickness plate, cylinder and sphere. Analytical method and graphical method

Demonstration of the syllabus coherence with the curricular unit's intended learning outcomes.
This curricular unit is structural for this course and aims to give the students solid competences in the subjects of heat and moment transport. That knowledge is essential to other more advanced curricular units. It is also intended that student gain critical attitude during the learning process for acquisition of knowledge and skills.
Thus, this curricular unit is structured in two main larger chapters, in which the subjects for the first one correspond to the study of movement transport. The themes are subdivided in 7 modules with the aim of lecturing the subjects with adequate insightful. Thus, in 1st and 2nd modules it is lectured basic concepts, while in 3rd, 4th and 5th modules the subjects are the study of moment, mass and energy transfer equations, respectively. 6th module refers to the themes of turbulent and laminar flux conjugated with the viscosity study.
Finally, this chapter ends with the subject of pressure loss in pipes and pumps dimensioning.
The 2nd chapter subjects correspond to heat transport, being this broad theme divided in 4 modules. The 1^{st} one corresponds to the study of heat transport mechanisms, while analyze and study of some laws that interfere with this phenomenon is given in 2nd module. In the 3rd one it is lectured the thermal conduction phenomenon in a very broadening way, in which the thermal isolation has an important role. Final y, 4^{th} module subjects correspond to the study of heat transfer in a transient state.

Teaching methodologies (including evaluation):
Theoretical material will be presented to promote the involvement and participation of all students, by developing their reasoning skills and stimulating their critical thinking. Materials about the subjects lectured will be available for consultations on Moodle. Online mini-tests will be weekly proposed to evaluate the subjects taught in the previous week. At any time students can contact the teacher using the Moodle platform.
The assessment consists of 20% for the practical component (Minitest) and 80% of the theoretical component (final exam).

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The teaching methods are consistent with the objectives of the course because: 1 - exposure of contents by the teacher will allow the acquisition of solid knowledge; 2 - the achievement of individual and weekly mini-tests by the students will give to the students necessary autonomy and capability to solve problems involving fluid flow and heat transfer. The assessment scheme is designed to measure the extent to which skills were developed.