Chemical Reactors

Calendar: 4th semester

Contact Hours: T - 30,0; TP - 22,5; OT – 7.5

Scientific Area: Processos em Engenharia Química e Biológica

Learning outcomes of the curricular unit
The aim of this curricular unit is to present topics of intermediate and advanced level for the selection and sizing of different types of reactors ideal and real.
After completed this curricular unit, students should have able to identify important parameters in the selection criteria of chemical reactors and measure different types of reactors, calculate time and spatial distribution of residence time in chemical reactors and determining the causes for deviation to the ideal behavior of the reactors.

Syllabus
1. Introduction to chemical reactors.
2. Energy balance of a chemical transformation. Kinetics. Half-life time. temperature influence.
3. Selection criteria of reactors. Main features of a reactor. Homogeneous, discrete and continuous reactors. Different types of reactors comparison. Material and energy balance formulation. Residence time and space time. Stirring design and classification.
4. Material and energy balances, characteristic equation, scaling under isothermal, adiabatic and industrial applications:
a) single-phase batch reactors in the transient regime.
b) continuous tubular reactors.
c) continuous stirred tank reactors (CSTR). Association in series of continuous reactors.
5. Distribution of residence times. Deviations causes from the ideal behavior of the reactor RTD function for PFR and CSTR reactors in series. Reactors with the RTD function design, segregation model, maximum mixing model.

Demonstration of the syllabus coherence with the curricular unit's objectives
This UC aims to approach some concepts required for the design of reactors with the ability to identify important parameters in the selection of reactors and scaling of different types of reactors, as well as calculate spatial times, DTR and determination/modeling of causes for deviation from the ideal behavior. In 1st and 2nd chapters a small introduction to chemical reactors is made as well as a resume of some concepts of the chemistry kinetics needed for sizing of this type of equipment. In the 3rd chapter it will be lectured the concepts regarding the selection of reactors, as well as specific concepts for their sizing. In the 4th chapter several types of chemical reactors are lectured, in detail,as well as the equations necessary for the implementation of mass and energy balances in different types of reactors when they present an ideal behavior. Finally, it is mentioned some deviations to the ideal behavior of reactors, emphasizing the use of RTD and modeling using the RTD.

Teaching methodologies
Theoretical-practical classes uses the expository technique to transmit the concepts proposed, stimulating the reasoning and critical thinking of students. Furthermore it is also proposed in an autonomous way the resolution of examples and exercises for the application of the concepts outlined above

Demonstration of the coherence between the teaching methodologies and the learning outcomes.
The main goal of this curricular unit is to allow the student to acquire knowledge of reactors design that is essential in a chemical engineering course.
For these basic contents to be correctly acquired by the students, they must be taught in a solid and consistent approach. For that purpose it is necessary that basic concepts, be properly explained. Consequently, it is essential that in theoretical classes' the fundamental concepts are exposed.
The acquired knowledge can be consolidate by solving relevant amount of practical problems, either by the theoretical teacher or by the student, which is a very important reason for the presence of significant number of practical classes.