Thermodynamic Chemistry

Calendar: 2nd semester

Contact Hours: T:30,0; PL:22,5; OT:7,5

Scientific Area: Química

Learning outcomes of the curricular unit
The curricular unit has the main goal that student acquires knowledge and competences in the areas of applied thermodynamic to chemistry and chemical engineering.
It is essential that the students understand and predict physical properties of ideal and real gases, knowing how to apply the three laws of thermodynamics to reactions, allowing them to predict and calculate heat and/or work exchanges, entropy variations and spontaneity of the processes.
The student must be able to interpret phase diagram of pure substance, understanding the meaning of triple and critic points, and also to interpret different phase diagrams for mixtures, establishing the basis for several industrial separation process.
It is also necessary that student understand the differences between ideal and real liquid mixtures and the importance of the activity coefficients concept, allowing them to control the variables that affect the equilibrium

Syllabus
1. Introduction: Fundamental concepts
2. Properties of gases: Perfect gases. Kinetic theory of gases. Real gases – state equations.
3. 1st thermodynamics law: Definitions. Work and heat. Internal energy and enthalpy.
4. Thermochemistry: Transitions enthalpies. Types of enthalpy. Temperature effect.
5. 2nd thermodynamics law: Entropy and the 2nd law. Absolute entropy and the 3rd law. Gibbs energy and spontaneity – properties.
6. Phase equilibrium: Transitions thermodynamics. Variation of the Gibbs energy with pressure and temperature. Phase diagrams – interpretations and examples. Liquids molecular structure.
7. Mixtures: Introduction. Ideal solutions. Real solutions and activities. Colligative properties. Mixture phase diagrams – volatile and non-volatile liquids and solid-liquid.
8. Chemical equilibrium: Thermodynamics basis. Standard Gibbs energy. Equilibrium constant and composition. Le Chatelier's principle. Van't Hoff equation.

Demonstration of the syllabus coherence with the curricular unit's objectives
The main goal of this UC is to allow the student to acquire thermodynamic basic knowledge applied to chemistry and chemical engineering.
The 2nd chapter refers to the gases properties and is essential for homogeneous and heterogeneous system control, either in ideal or real conditions, involving gas phase.
Chapters 3, 4 and 5 are referent to thermodynamic laws and thermochemistry, are fundamentals for energy flow studies, especially heat exchanges, which are essential to study heat exchangers, furnaces, cooling towers, etc.
In chapters 6 and 7 are referent to the study of phase diagrams and ideal and real solutions. These are very important subjects to processes control that include phase change, such as distillation towers, vaporizers, etc., and for general processes which usually involve formation of precipitates and solutions.
Finally, chapter 8 refers to equilibrium which is essential for reactors processes, in which such phenomenon can be used as system control.

Teaching methodologies
In theoretical classes fundamental concepts are exposed, using audio-visual techniques. Illustrative applications of these concepts are solved, stimulating rational thinking and fostering a more critical spirit amongst students. In theoretical/practical classes students solves individually and independently application exercises proposed by the teacher.
In the same semester there is a laboratory curricular unit associated (Laboratory III) in which the students performs several experimental works that exemplifies the thermodynamics principles applications.

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 thermodynamic basic knowledge that is essential to understand and control chemical phenomenon and industrial processes.
For these basic contents to be correctly acquired by the students, it must be teach in a solid and consistent approach. For that purpose it is necessary that basic concepts and mathematical developments be properly explained. Consequently, it is essential that in theoretical classes' the fundamental concepts are lectured.
The acquired knowledge can be consolidate by solving relevant amount of exercises and practical problems, either by the teacher or by the student, which is a very important reason for the presence of significant number of practical classes. Finally, the concepts consolidation can be made through laboratorial experiments, results analyses and reports. This fundamental part is achieved in the laboratory curricular unit occurring in the same semester (Laboratory III).