APPLIED PHYSICAL AND PHYSICAL CHEMISTRY

SUBJECT: CORE
LINKING AREAS: APPLIED PHYSICAL, PHYSICAL CHEMISTRY
CORE AREA: PHYSICAL CHEMISTRY
DEPARTMENT: PHYSICAL CHEMISTRY
CREDITS: 6 theoretical, 2 practical, 1 of supervised work
TEACHING SCHEDULE: 1st year, annual

THEORETICAL PROGRAM

Chapter I: FUNDAMENTALS OF THERMODYNAMICS
Unit 1. Energy of systems. Thermodynamic method: basic concepts. State equations. First Law of thermodynamics. Changes of state. Enthalpy. Thermochemistry.
Unit 2. Spontaneity and equilibrium. Second Law of thermodynamics; entropy. Calculation of entropy variations. Third Law of thermodynamics. Gibbs free energy. Partial properties. Chemical potential. General equilibrium conditions. The phase rule.

Chapter II: THERMODYNAMICS OF SOLUTIONS
Unit 3. Solutions with ideal and non-ideal behaviour. Liquid solutions: phase diagrams. Ideal liquid solution. Raoult's Law. Raoult's Law deviations. Ideal diluted solution: Henry's law. Activity and activity coefficient.
Unit 4. Non-electrolyte solutions. Colligative properties. The lowering of vapour pressure, freezing point depression, boiling point elevation, osmotic pressure. Solubility and partition.
Unit 5. Electrolyte solutions. Activity and mean activity coefficient of ions. The Debye-Huckel theory. Colligative properties of electrolyte solutions. Osmolarity.

Chapter III: CHEMICAL EQUILIBRIUM
Unit 6. General treatment of chemical equilibrium. Chemical equilibrium conditions for a reversible reaction. Thermodynamic equilibrium constant. Chemical equilibrium in gases. Equilibrium in solutions. Biochemical reference system. Influence of temperature and pressure on the chemical equilibrium.
Unit 7. Complex equilibrium. Simultaneous equilibrium. Coupled equilibrium. Multiple equilibrium: binding of ligands to macromolecules.
Unit 8. Ionic equilibrium. Dissociation constant in acids and gases. Saline effect. Solubility product. Electrochemical equilibrium.

Chapter IV: CHEMICAL KINETICS
Unit 9. Reaction rate and rate equations. Reaction rate, reaction order and molecularity. Reaction mechanisms. Establishment of the rate equation. Influence of temperature on the reaction rate. Theories about the reaction rate.
Unit 10. Treatment of complex kinetic systems. Reversible reactions. Parallel or competitive reactions. Consecutive reactions or reactions in series. Approximation to the stationary state.
Unit 11. Catalysis and enzymatic kinetics. General mechanism of catalysis. Acid-base catalysis. General characteristics of enzymatic catalysis. The Michaelis-Menten model.

Chapter V: SURFACE PHENOMENA
Unit 12. Adsorption on solid surfaces. Physisorption and chemisorption. Langmuir and Freundlinch Isotherms.
Unit 13. Surface tension. Surface tension of pure liquids and solutions. Surfactants. Gibbs adsorption isotherm. Monomolecular layers. Micelles and critical micelle concentration. Biological membranes. Classification and properties of surfactants.
Unit 14. Disperse systems. Classification. Lyophilic and lyophobic colloids. Properties of colloidal systems: electric double layer. Emulsions.

Chapter VI: TRANSPORT PHENOMENA
Unit 15: Diffusion, sedimentation and conductivity. Fick diffusion laws. Sedimentation. Viscosity. Electrolytic conductivity.

PRACTICALS PROGRAM

Basic laboratory techniques
Reaction enthalpy and enthalpy by calorimetric measurements.
Determination of a weak acid dissociation constant by potentiometric and conductimetric measurements.
Kinetic study of the iodine oxidation reaction using persulphate.
Surface tension and viscosity of surfactants and polymers.
Computer simulations of physicochemical processes

BIBLIOGRAPHY

Fisicoquímica para Farmacia y Biología. P. Sanz Pedrero. Ed. Masson-Salvat Medicina.
Química Física para estudiantes de Farmacia y Biología. S. C. Wallwork and D. J. W. Grant. Ed. Alhambra.
Physical Chemistry with applications to the Biological Sciences. R. Chang. Ed. Mac Millan Publishing Co.
Physical Chemistry. Principles and Applications in Biological Sciences.
Tinoco, Sauer and Wang. Ed. Prentice Hall.
Physical Chemistry with applications to the biological sciences. D. Freifelder. Ed. Jones and Barlett Publishers.
Fisicoquímica. I. N. Levine. Ed. Mc Graw Hill. 1996.
Fisicoquímica. Atkins. Ed. Addison-Wesley Iberoamericana.
Principios y problemas de Química Física para bioquímicos. N. C. Price and R. A. Dwek. Ed Acribia