Subject:	**Colloidal Systems**
Semester:	**Spring**
Credits ECTS:	**2,5**
Professors:	**Joan Estelrich**
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Department / Faculty:	**JE (Dept. Fisicoquímica, Fac. Farmacia)**
	JI (Dept. Química Física, Facultad de Química)
	UB.

Objectives:

Generals:

A. Introduce the student to colloids and interfaces, their preparation and their properties.

B. Present to the student the principles and physical/chemical models implicit in colloidal science and interfacial systems.

C. Show the importance and applications of colloids and interfaces in the nanobiotechnology field.

Competencies the student should have at the end of the course.

The student should be able to:

a). Define what a colloid is, give examples of colloidal systems.

b). Understand why colloidal dispersions are metastable and how can they be conserved in a metastable state due electrostatic or steric stabilization. Identify in free energy plots as a function of function of particle separationboth attractive and repulsive interactions. Be acquainted with different intermolecular forces: Forces between particles, the electrostatics of solutions and electric double layer models.

c). Explain the kinetics of spreading and the electrokinetic properties of colloids.

d) Distinguish between the different rheological behaviours that colloids can present

e) Analyse the physic/chemical properties of amphiphilic molecules in solution.

Recommendations / Previous requisites

Undergraduate degree in Chemistry, Physics , Pharmaceutics or equivalent studies.

Contents:

Topic-1: Interfacial activity. Liquid interface. Surface tension. Young-Laplace Law. Capillarity, Kelvin equation. Cohesion. Adherence and Adsorption. Gibbs treatment of Interfacial thermodynamic . Protein adsorption. Biopolymer adsorption. Spread and absorbed monolayers. Characterization. **(3 hours). Professor: Jordi Ignes.**

Topic-2: Biological interest, Biomimetic and biotechnological principles of Langmuir/Langmuir-Blodgett films. Langmuir isotherm. Aggregation States of Langmuir monolayers. In-situ characterization. Multilayers: Lagmuir-Blodgett technique. Supported Phospholipid Bilayers (SPB) **(3 hours). Professor: Jordi Ignes.**

Topic-3: Colloidal Dispersions. Definition of colloidal system. Classification and Preparation. Importance of the interstitial phenomena in colloidal systems. Importance of colloids in biological structures. **(2 hours). Professor: Joan Estelrich.**

Topic-4: Properties of colloidal systems. Optical properties: light scattering techniques. Kinetic properties: Brownian movement and diffusion. Sedimentation, osmotic pressure and viscosity. Electrical properties of interfaces. Poissson-Boltzmann equation. Debye-Huckel Aproximation. Solution of the Poisson-Boltzmann equation. Zeta potential. Electrokinetic and Electroacoustic determination. **(3 hours). Professor: Joan Estelrich.**

Topic-5: Colloidal stability. Different charges between particles. DLVO theory. Electrostatic Stabilization. Stability of hydrophobic colloids: Schulzer-Hardy Rule. Stability of Lipophilic colloids: Hofmeister series. Protein Precipitation. Kinetic of Coagulation. Polymer Stabilization :steric and evacuation. **(3 hours). Professor: Joan Estelrich.**

Topic-6: Association of colloids. Micelles: thermodynamic and kinetic association of micelles. Study of some micellar systems of biotechnological interest. Inverted Micelles. Bilayers: Molecules that form bilayers. Bilayer based structures (single component, multi-component). Closed bilayers: Liposomes. Experimental techniques used to determine association of colloids. (Radiation scattering, Optical/Electronical microscopy, NMR, Calorimetry, forces between surfaces...) **(3 hours). Professor: Joan Estelrich.**

Topic-7: Biopolymers. Behaviour of polymers in solution: Conformations, thermodynamical aspects (phase behaviour). Macroscopic and mesoscopic properties. Polymeric structures in solution. Self-aggregation phenomena **(2 hours). Professor: Jordi Ignes.**

Topic-8. Lyophobic Colloids. Emulsions. Formation of Emulsions. Gibbs-Marangoni Effect. Rheology of emulsions. Destabilization process of emulsions. Microemulsions. Preparation and properties. Introduction to the microfluidic

techniques (lab-on-a-chip). Foams. Foam formation. Foam stability. Foams of alimentary and biological interests. Defoamers. **(3 hours). Professor: Joan Estelrich.**

Plan:

Lectures:	23 hours.
Independent work:	14 hours
Study:	32 hours.

Bibliography

J. Estelrich: Dispersions col·loïdals (e-book) Publicacions UB, Barcelona (2002)
P.C.Hiemenz, R.Rajagopalan: Principles of Colloid and Surface Chemistry. 3ª edició. Marcel Dekker. Nova York (1997).
G. T. Barnes, I. R. Gentle: Interfacial Science. An introduction. Oxford University Press. Oxford (2005).
D.F. Evans, H. Wennerström: The Colloidal Domain. Where Physics, Chemistry, Biology, and Technology meet. VCH: Nova York (1994).
R.J. Hunter: Introduction to Modern Colloid Science. Oxford Science Publications: Oxford (1993).
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A.W.Adamson, A.P.Gast: Physical Chemistry of Surfaces, 6a edició. John Wiley and Sons: New York (1997).
G. Attard, C. Barnes: Surfaces, Oxford University Press: Oxford (1998).
D. Lasic: Liposomes: from Physics to Applications. Elsevier, Amsterdam (1993).
B.P. Binks (director): Modern Aspects of Emulsion Science. Royal Society of Chemistry, Cambridge (1998).
C.W. Macosko: Rheology. Principles, measurements and applications. VCH, Nova York (1994).
D. Weaire, S. Hutzler: The Physics of Foams. Oxford University Press: Oxford (2001).