INTRODUCTION INTO COLLOID AND INTERFACE SCIENCE 400:612

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COURSE DESCRIPTION

Nanoscale Colloid and Interface Science is an important field of research and application in the industry. Many pharmaceutical and food products are formulated as disperse systems such as suspensions, emulsions, microemulsions, gels etc. These systems can vary from colloidal dispersions (covering the size range 1 nm - 1 μm) to more coarse suspensions or emulsions.

The present course deals with the fundamental principles of colloid and interface science involved in these disperse systems. A general introduction will be given to illustrate the importance of interface phenomena at nanoscale and their role in new drug delivery systems development. This is followed by several lectures on the attractive and repulsive forces involved. A lecture will be given on the various classes of surfactants and their solution properties. Three lectures on suspensions, emulsions and foams will be given to illustrate the application of the above principles. Finally, the methods that can be applied to investigate the stability/instability of dispersions will be briefly described.

For formulation of these disperse systems, maintenance of their stability on storage and their subsequent application it is essential to understand the basic principles of colloid and interface science especially at nanoscale. The properties of disperse systems such as suspensions, emulsions and foams can be described in terms of these fundamental principles. The various repulsive and attractive forces involved in these nano-scale disperse systems will be studied. Various stabilization methods (electrostatic, steric, etc.)

and properties of surfactants that are used for the preparation of these systems will be considered in this new course.

The above course will be valuable for science and engineering majors due to it interdisciplinary nature and broad range of applications. The candidates who will attend this course will be able to interpret their results in a fundamental way and they will be able to design the new drug delivery systems in a systematic way.

Learning goals and objectives:

The goal of the course is to give the student a solid framework for applying knowledge in colloid and surface science to the solution of practical problems and the development of new technologies. Additionally, student will learn the skills that will be useful in either industrial or academic careers; such as critical thinking, problem diagnosis, estimation, data-based decision making.

Assesment

Course include hands-on group project and homework assignments. Course project include in-class presentations, lab work and written report.

COURSE SILLABUS/OUTLINE

General introduction - Colloid Science and Interface Science in the Pharmaceutical Iindustry and Healthcare. Nanoscale phenomena and Interface Science.

Surfactants and their solution properties General classification of surfactants. Solution properties of surfactants and their micellization. Adsorption of surfactants and polymers at interfaces.

Attractive and repulsive forces in disperse systems Van der Waals attraction and its interpretation. Charge separation and the electrical double layer repulsion. Repulsive forces arising from the presence of adsorbed surfactant and polymer layers.

Electrostatic stabilization Repulsive forces arising from the interaction of double layers. Role of surface charge and electrolyte concentration and valency.

The concept of zeta potential and methods of its measurement Definition of the various electrokinetic phenomena. The concept of shear plane and zeta potential. Measurement of zeta potential using micro-electrophoresis and laser scattering techniques.

Steric stabilization Interaction between particles containing adsorbed surfactant or polymer layers. Osmotic and entropic repulsion and the total energy-distance curve for sterically stabilized systems.

Solid/Liquid dispersions (Suspensions) Description of the state of suspensions in terms of the energy-distance curves. Electrostatic, steric and electrosteric stabilization and their role in suspension stabilization. Settling of suspensions and its prevention.

Liquid/Liquid dispersions (Emulsions) Preparation of emulsions and the role of the emulsifier. Selection of emulsifiers. Control of the stability of emulsions against creaming/ sedimentation, flocculation, Ostwald ripening, coalescence and phase inversion.

Gas/Liquid dispersions (Foams) Surface active foaming materials. Foam preparation. Foam structure and its instability. Metastable (persistent foam). Drainage and thinning of foams. Theories of foam stability. Foam inhibitors (antifoamers and defoamers).

Assessment of stability/flocculation and settling of suspensions Definition of stability/flocculation of suspensions both of electrostatically and sterically stabilized systems. Measurement of the rate of flocculation and stability ratio. Measurement of incipient flocculation of sterically stabilized suspensions. Measurement of settling of suspensions.

Assessment of emulsion stability Measurement of creaming/flocculation of emulsions. Measurement of flocculation, Ostwald ripening, coalescence and phase inversion