ECH 6726/EMA 6905

Interfacial Phenomena I & II: Fall 2008-Spring 2009

Course Credits: Students requiring 2 credits-register for ECH 6726;
3 credits-register for EMA 6905. Class Schedule; TBD
Instructor: Dr. Brij Moudgil, bmoudgil@perc.ufl.edu (352) 846-1194 ext. 225
T/A: Dr. Georgios Pyrgiotakis, gpyrgiotakis@perc.ufl.edu (352) 846-1194 ext. 240

What is *Interfacial Phenomena*?

An interface is defined as the area where two immiscible faces meet. Such interfaces include solid/liquid (slurries), solid/gas (aerosols), gas/liquid (foams) or liquid/liquid (emulsions) and solid/solid (cell-membrane interactions, nanocomposites, coatings). The phenomena that take place at such interfaces collectively comprise interfacial phenomena, and can include processes such as adsorption and transport. Interfacial phenomena become even more important at nanoscale, since the mix of forces involved changes drastically from micro to nanoscale.

Why *Interfacial Phenomena* is so important, especially in nano & nano-bio technologies?

Interfacial Phenomena is important in a wide variety of practical applications; from the stability of slurries, nanoparticles for bioimaging and therapies, and foams to the formation of deltas in big rivers. Applications such as polishing slurries used for manufacture of computer chips, emulsions and aerosols used in drug formulations, functionalized nanoparticles for drug delivery/diagnostics/ therapies; foams/emulsions for soil remediation, nanocomposites for advanced materials for space and other emerging applications - all are governed by the interfacial phenomena.

Who should take the course?

The course is primarily designed for graduate students who are conducting research in any area impacted by one or more of the interfaces mentioned above. In the past, students from the following departments have enrolled in the course: Materials Science and Engineering, Chemical Engineering, Environmental Engineering, Soil and Water Science, Biomedical Engineering, Chemistry, Pharmacy, and Food Science & Human Nutrition.

What is the objective of the course?

The overall scope of the course is to familiarize the students with the fundamentals and applications of interfacial phenomena in existing and emerging fields including nano and nano-bio systems (e.g., ceramics, electronics, polymers and medical sciences). Highly interactive lectures and discussions are designed to foster synthesis of knowledge leading to critical thinking skills. Integration of fundamental knowledge in cutting edge practical applications is illustrated by case studies.

What should I expect to learn?

Upon completion of the course, students would have learnt the fundamental theories to understand the phenomena at different interfaces, and skills to use this knowledge to develop solutions to real world problems. Students would learn how to achieve synergistic integration of fundamental knowledge to develop critical thinking skills. Scientifically, they would acquire knowledge in areas from material synthesis to drug discovery to photocatalytic degradation of hazardous microbes to development of safe and useful products and devices.

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COURSE OUTLINE

The first part (fall semester) of the course, Interfacial phenomena I, focuses on the liquid/liquid and liquid/gas interfaces. It covers the fundamental of surfactants and their properties, surfactant kinetics, micelles and micellar dynamics, and adsorption at the interfaces (Gibbs adsorption equation). It also covers specific applications of the theories for developing emulsions, microemulsions, foams and aerosols and examines case studies, such is disinfection and detergency.

The second part (spring semester) of the course, Interfacial Phenomena II focuses onto the solid/liquid and solid/gas interfaces. It covers the fundamental intermolecular forces (van der Waals forces), more extended and detailed theory of the electric double layer, hydration and hydrophobic forces, DLVO theory, the properties of surfactants and polymers and the use thereof in colloidal stability. It examines case studies, e.g., Chemical Mechanical Planirization (CMP), froth flotation, adhesion and lubrication, cohesive powder flow and wetting/spreading.

Although the courses are related, they are free standing - allowing students to take Interfacial Phenomena II before I. Although it is not required that students take both courses, it is highly recommended that they do so to gain comprehensive knowledge of the field.

TOPICS COVERED IN THE COURSES

Interfacial Phenomena I Fall semester	**Interfacial Phenomena II Spring semester**
Scientific foundation: • Surfactants/Surfactant Kinetics (detailed description) • Micelles/Micellar kinetics • Equation of state for monolayer • Electrical Double Layer Applications/Case studies: • Foams/Soil Remediation • Emulsions • Microemulsions/Drug Detoxification, Drug Delivery • Aerosols • Detergency • Anti Microbial Agents	Scientific foundation: • Intermolecular forces • Electric Double Layer (EDL) (detailed description) • DLVO theory (detailed description) • Surfactants & Polymers Applications/Case studies: • Dispersion/Chemical Mechanical Planirization (CMP) • Selective Coatings/Froth Flotation • Adhesion & Lubrication • Wetting and Spreading • Cohesive Powder Flow/ Drug Formulation