



Course Syllabus: Colloids, Interfaces, and Surfaces - EnSE 310

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| Division | Biological and Environmental Sciences & Engineering Division |
| Course Number | EnSE 310 |
| Course Title | Colloids, Interfaces, and Surfaces |
| Academic Semester | Spring |
| Academic Year | 2018/2019 |
| Semester Start Date | 01/27/2019 |
| Semester End Date | 05/23/2019 |
| Class Schedule (Days & Time) | 02:30 PM - 04:00 PM Mon Wed |

| Instructor(s) | | | | |
|----------------------|---------------------------|---------------|--------------------------------|--------------|
| Name | Email | Phone | Office Location | Office Hours |
| Suzana Pereira Nunes | Suzana.Nunes@kaust.edu.sa | +966128082771 | 3274, 4, Al-Jazri (bldg. 4) | |

| Teaching Assistant(s) | |
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| Name | Email |
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| Course Information | |
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| Comprehensive Course Description | The course introduces fundamental aspects of surface science and discuss their implications on material properties and current technologies. The following topics will be covered: Surface tension and surface free energy (theory and measurement methods); Capillarity; Contact angle (theory and measurement methods), wetting, Lotus effect; Surface forces; Detergency, surfactants, self-assembly, micelles and vesicles; Surface films on liquid substrates (surface potential, monomolecular films, Langmuir-Blodgett layers); Emulsions, foams and aerosols; Electrical aspects of surface chemistry (electrical double layer, zeta potential, DLVO theory); Surface of solids; Solid-liquid interface, stability of dispersions, stabilization of suspensions; Flotation, aggregation and flocculation; Friction, lubrication and adhesion; Adsorption; Characterization of colloidal particles; Applications of colloid and surface science in petroleum recovery, coating and painting, food, pharmaceutical and cosmetic industry; Surface characterization methods. |
| Course Description from Program Guide | The course covers a variety of topics in surface science, including surface tension and surface free energy (theory and measurement methods), surface films on liquid substrates (surface potential, monomolecular films, Langmuir-Blodgett layers), capillarity, gecko effect, electrical aspects of surface chemistry (electrical double layer, zeta potential, DLVO theory), surface of solids, solid-liquid interface, stability of dispersions, stabilization of suspensions, contact angle (theory and measurement methods), emulsions, foams and aerosols, wetting of surfaces by liquids, lotus effect, flotation, aggregation and flocculation, detergency, surfactants, self-assembly, micelles and vesicles, friction, lubrication and adhesion, adsorption, characterization of colloidal particles, etc. Applications of colloid and surface science in petroleum recovery, coating and painting, food, pharmaceutical and cosmetic industry will also be covered. Surface characterization methods will be introduced. |
| Goals and Objectives | The objective of the course is to provide basic knowledge on surface science and prepare the student to understand a series of phenomena relevant for the environment, chemical and petrochemical technologies. The course supports material development for different applications, calling attention for important considerations, additional to more classical understanding of physical properties. |
| Required Knowledge | There are no pre-requisites. Basic knowledge of physical chemistry is helpful. |

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| Reference Texts | <p>Main reference text: A. W. Adamson and A. Gast, Physical Chemistry of Surfaces.</p> <p>Additional textbooks:</p> <p>J. Israelachvili, Intermolecular and Surface Forces.</p> <p>T. Cosgrove, Colloid Science.</p> <p>P. Hiemenz, Principles of Colloid and Surface Chemistry.</p> <p>J. C. Berg, An Introduction to Interfaces and Colloids, The Bridge to Nanoscience.</p> <p>J. Goodwin, Colloids and Interfaces with Surfactants and Polymers.</p> |
| Method of evaluation | <p>35.00% - Final exam</p> <p>35.00% - Midterm exam</p> <p>30.00% - Scientific review article presentation</p> |
| Nature of the assignments | <p>The students will write a review on selected topics related to surface science and nanotechnology (or surface characterization methods), which shall be written in the format of a paper and presented (oral presentation) to the class.</p> |
| Course Policies | <p>Attendance is required. The course is interactive, examples of different literature sources are discussed and absence might lead to poor performance in the midterm and final examinations.</p> <p>Part of the course consists of student presentation. The presence particularly this case is mandatory and any absence should be strongly justified.</p> <p>Plagiarism will be a reason for failure.</p> |
| Additional Information | |

Tentative Course Schedule

(Time, topic/emphasis & resources)

| Week | Lectures | Topic |
|-------------|----------------------------------|---|
| 1 | Mon 01/28/2019 Wed 01/30/2019 | General Introduction Surface Tension, Capillarity |
| 2 | Mon 02/04/2019 Wed 02/06/2019 | Methods of surface tension and contact angle measurements Young Laplace, Kelvin Equation and implications Wetting |
| 3 | Mon 02/11/2019 Wed 02/13/2019 | Eid Break |
| 4 | Mon 02/18/2019 Wed 02/20/2019 | Nanostructure influence on wetting Lotus effect, rose petals and birds Marangoni effect |
| 5 | Mon 02/25/2019 Wed 02/27/2019 | Surfactants, detergency and foams |
| 6 | Mon 03/04/2019 Wed 03/06/2019 | (Mon) Practical demonstration (Wed) Midterm |
| 7 | Mon 03/11/2019 Wed 03/13/2019 | Micellization, self-assembly, liquid crystals |
| 8 | Mon 03/18/2019 Wed 03/20/2019 | Emulsion, microemulsion, flotation |
| 9 | Mon 03/25/2019 Wed 03/27/2019 | Spring Break |
| 10 | Mon 04/01/2019 Wed 04/03/2019 | Adhesion, biofouling, adhesives, gecko effect, self-cleaning |
| 11 | Mon 04/08/2019 Wed 04/10/2019 | Electric double layer, zeta potential, electrophoresis and electroosmosis Scientific articles and reviews (discussion and preparation) |
| 12 | Mon 04/15/2019 Wed 04/17/2019 | DLVO, colloids and nanoparticles stabilization |
| 13 | Mon 04/22/2019 Wed 04/24/2019 | Adsorption isotherms |
| 14 | Mon 04/29/2019 Wed 05/01/2019 | Presentations |
| 15 | Mon 05/06/2019 Wed 05/08/2019 | Presentations |
| 16 | Mon 05/13/2019 Wed 05/15/2019 | Presentations |
| 17 | Mon 05/20/2019 Wed 05/22/2019 | Final Exam Week |

Note

The instructor reserves the right to make changes to this syllabus as necessary.