UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Organic and Polymeric Formulations

2627-1-F5402Q011

Aims

General objectives

To present the basic concepts of formulation chemistry (with references to the physical chemistry of interfaces and interphases), the classes of organic and polymeric compounds used in the field and the main industrial and scientific and technological research applications.

Knowledge and understanding

At the end of the course the student:

1. Can distinguish the type of formulation under examination on the basis of its components (micellar solution, emulsion, dispersion, microemulsion, foam, solid formulation)
2. Can clearly identify active components and compatibilizing additives in a formulation
3. Knows the main descriptive tools of complex interfaces and interfaces constituting the formulations
4. Knows the methods of main characterization of colloidal dispersions

Applying Knowledge and understanding.

1. Can propose methods of preparation of a given formulation according to its nature
2. Can propose further lines of development of existing formulations, checking in particular: stability, rheological properties, appearance, availability of the active ingredient
3. Knows the main areas of application of the chemistry of formulations

4. Is able to develop original formulations, mainly based on water as the dispersing medium

Making judgments.

The student can contextualise classic problems of the chemistry of formulations such as dispersion in a lyophobic environment, selective delivery and the dosage over time of an active ingredient. Can propose original formulations to handle the aforementioned problems in areas such as: detergency, drug delivery, paints, adhesives, agro-food formulations, cosmetics and special reactive formulations

Communication skills.

The student knows the specific terminology of the chemistry of the formulations and is able to use it both in written form and in oral form, in order to summarize in a complete and concise way the characteristics and the possible solutions of formulation problems.

Learning skills.

The Student is able to extend what has been learned in classes to case studies not covered during the course. He is in particular able to autonomously manage the wide technical literature dedicated to the Formulations. He knows the research tools of the dedicated literature, including patents.
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Contents

Definition of formulation and general introduction to the role of formulations in industrial and reaserch applications. Recalls of Physical Chemistry of interfaces and interphases (interphase processes, surface tension). Introduction of the concept of surfactant, its characteristics and description of behavior in complex mixtures. General description of the application of formulations in the agri-food, adhesive, cosmetic, pharmaceutical and dye industry fields. Advanced application of the chemistry of organic formulations: micellar synthesis, advanced systems for biological imaging and drug delivery, colloidal organic nanostructures.

Detailed program

Relevance of the chemistry of formulations, with examples related to commercially available products and new technological applications. Definition of surfactant and structure property relationships. Recalls on the self-assembly processes in solution. Main classes of organic and polymeric surfactants: preparation, properties, scopes of application. Thermodynamic aspects of the formation of colloidal structures. Micellar critical concentration: definition, methods of measurement and dependence on the characteristics of the formulation. Phase diagrams of amphiphilic systems. Liposomes: preparation, features and applications. Dispersions and the DLVO theory. Emulsions and microemulsions. Features of a microemulsion. Qualitative and quantitative descriptors of the chemical-physical characteristics of the components an emulsion. The HLB system, principles and applications. Foams. Solid formulations. Basic principles, components and examples of formulations for: detergency, adhesives, drug delivery, paints, formulations of agri-food interest, formulations for dyeing. Reactive formulations. Rheological properties of non-Newtonian fluids.
Relevant equipment for the production and characterization of formulations.

Prerequisites

Sound basic knowledge of organic, inorganic and physical chemistry. Capability to handle the topics of general chemistry.

Teaching form

23 two-hour lectures, in person. Delivered didactics.
2 two-hour classes, in person, in delivered mode in the initial part aimed at involving students interactively in the subsequent part. Mixed teaching.
2 two-hour classes, in person, on group activities regarding topics covered during lectures. Interactive teaching.
Standard lessons supplemented by supporting multimedia tools functional to a better understanding of the practical aspects. All classroom lessons will still be videotaped and made available immediately after class.

Textbook and teaching resource

Textbooks

- Introduction to applied colloid and surface chemistry. G. M. Kontogeorgis, M. Georgios 2016 John Wiley & Sons
- Formulation Science and Technology (vol.1-2). T. F. Tadros, 2018 Walter de Gruyter GmbH
- Formulation Technology: Emulsions, Suspensions, Solid Forms. H. Mollet, A. Grubenmann 2001 WILEY?VCH Verlag GmbH
- Jonathan W. Steed, David R. Turner, Karl J. Wallace, Core Concepts in Supramolecular Chemistry and Nanochemistry, John Wiley&Son

Slides
Videorecording of classes

Semester

second semester

Assessment method

Oral interview aimed at verifying the capability to recognise the specific function performed by each element introduced in a complex formulation. Knowing how to distinguish the nature of a formulation based on its components. Knowing how to select, at least for general classes, the components of a formulation based on the nature of the active principle and the final application.
Understanding the main fields of application of the chemistry of formulations. Knowing how to correctly classify surfactants both from the point of view of their applications and their structural characteristics.
Knowing how to propose strategies to develop innovative formulations, once the constraints related to the particular target application are known.

Evaluation Scale:

Grade < 18
Insufficient grade; minimum level of preparation not reached.

Score 18-21
Preparation on a limited number of topics from the course syllabus, with poor ability to discuss and analyze independently which only emerge in the oral exam as a result of the Lecturer's help and questions; presentation skills occasionally uncertain, vocabulary not always clear and accurate, sometimes incorrect, with very limited critical elaboration.

Score 22-24
Preparation on a good number of topics from the course syllabus, although not homogeneous, with sufficient ability to discuss and analyze independently, sometimes prompted by the Lecturer's questions; presentation skills sufficiently clear, generally correct vocabulary, although sometimes not accurate or clear, limited critical elaboration capabilities.

Score 25-27
Preparation on a wide range of topics covering the course syllabus, ability to conduct discussions and critical analysis with good autonomy and ability to apply knowledge to real cases, use of correct vocabulary and competence in the use of disciplinary language.

Score 28-30L
Complete and exhaustive preparation on the subjects of the course syllabus, ability to independently discuss and critically analyse the principal topics, ability to connect themes to real cases and to different contexts and disciplines, excellent capacity for critical and independent thinking, full mastery of disciplinary vocabulary, rigorous and articulate presentation skills, argumentation skills.

Office hours

upon request

Sustainable Development Goals

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