Last update: 23-04-2019

220130 - Industrial Organic Chemistry

Coordinating unit: 205 - ESEIAAT - Terrassa School of Industrial, Aerospace and Audiovisual Engineering

Teaching unit: 713 - EQ - Department of Chemical Engineering

Academic year: 2019

Degree: BACHELOR'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
BACHELOR'S DEGREE IN AEROSPACE VEHICLE ENGINEERING (Syllabus 2010). (Teaching unit Optional)
BACHELOR'S DEGREE IN AEROSPACE TECHNOLOGY ENGINEERING (Syllabus 2010). (Teaching unit Optional)
BACHELOR'S DEGREE IN INDUSTRIAL TECHNOLOGY ENGINEERING (Syllabus 2010). (Teaching unit Optional)

ECTS credits: 3 Teaching languages: English

Teaching staff

Coordinator: Josep Mª. Dagà

Others: Josep Mª. Gibert

Teaching methodology

The course is divided into parts:
Theory classes
Practical classes
Self-study for doing exercises and activities.
In the theory classes, teachers will introduce the theoretical basis of the concepts, methods and results and illustrate them with examples appropriate to facilitate their understanding.
In the practical classes (in the classroom), teachers guide students in applying theoretical concepts to solve problems, always using critical reasoning. We propose that students solve exercises in and outside the classroom, to promote contact and use the basic tools needed to solve problems.
Students, independently, need to work on the materials provided by teachers and the outcomes of the sessions of exercises/problems, in order to fix and assimilate the concepts.
The teachers provide the syllabus and monitoring of activities (by ATENEA).

Learning objectives of the subject

The technological revolution of the XX century second half is linked, in a great measure, to the industrial development of organic chemistry. Fuels, polymers, pharmaceuticals, materials and technological products are some industrial sectors that are based in the organic chemistry achievements. The reduced amount of credits assigned to general chemistry courses in the engineering study plans have lead to the consequence of a poor coverage of industrial organic chemistry issues. This course is offered as a clear opportunity to develop the principles of structure and reactivity of organic compounds mainly connected to their corresponding industrial activities. As a matter of fact, benefits of superior technology knowledge in organic chemistry are multiple: lower cost raw materials, shorter synthesis routes, improved yields, selectivity and kinetics, resulting in better productivity. Furthermore, this course is also thought as an introduction to the unit operations technology in engineering, which is a subject especially developed in the Master Degree in Industrial Technologies in ETSEIAT. Besides it could be said that process safety is continually upgraded as more intimate knowledge of organic chemical reactions and other unit operations in chemical engineering is achieved. There is also the planned purpose to pay attention to environmental issues and sustainable technology concerns, as long as the organic chemistry sectors considered in this course are developed: petroleum refining, polymers and monomers, natural products industries and fuels.

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Study load

Total learning time: 75h	Hours large group:	30h	40.00%
	Self study:	45h	60.00%

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Content

Module 1: Petroleum. Oil refining processes and products.

Learning time: 18h 40m
Theory classes: 7h 30m
Self study : 11h 10m

Description:
Oil refinery (an overview). Physical processes: Desalting and dehydration. Crude distillation. Propane deasphalting. Thermal processes. Catalytic processes: catalytic cracking, hydro treating, hydrocracking, catalytic reforming and alkylation. Conversion of heavy residues. Treatment of refinery gas streams. Adsorption and membrane separation techniques. Current and future trends in oil refining. Octane and cetane numbers. MTBE and ETBE production routes. The use of zeolites for shape selectivity in the oil refinery. Butene to Isobutene isomerization using ferrierite (a zeolite of medium pore size). Isomerization of pentanes and hexanes (the total isomerization package process, TIP). Steam cracking: production of lower alkenes.

Module 2: Monomers and dienes production. Polymerization processes. Fibers and composites.

Learning time: 18h 45m
Theory classes: 7h 30m
Self study : 11h 15m

Description:
Synthesis of Reactants and Intermediates for Polymers. Reactants for step-reaction polymerization. Synthesis of vinyl monomers and dienes (1,3-butadiene, chloroprene and isoprene). Synthesis of free radical initiators. Free radical polymerization. Ionic polymerization. Coordination polymerization. Mechanism of polymerization on Ziegler-Natta catalysts. Stereoisomerism of Vinyl and Diene Polymers and its causes. Copolymerization. Polymerization techniques. Basic commercial polymers and properties related to their structure. LDPE, HDPE and LLDPE polyethylenes production processes. Plasticizers, stabilizers, flame retardants and other polymer additives. Elastomers and rubbers. Natural and synthetic rubbers. Adhesives, paints, inks and coatings. Man-made and natural fibers. Composites Constituents Materials: Matrices, Reinforcements, Preimpregnated Reinforcements, Core Materials, Adhesives and others. Quality control, characterization and recycling for Composites.

Module 3: Natural products industries and pharmaceuticals. Carbohydrates. Lipids, oils and fats. Aminoacids.

Learning time: 18h 45m
Theory classes: 7h 30m
Self study : 11h 15m

Description:
Position in the industry of fine chemicals such as advanced intermediates, pesticides, vitamins, flavor and fragrance chemicals, and of specialty chemicals such as pharmaceuticals, dyestuffs, perfumes and others. Production of dimethyl carbonate. Production of ibuprofen. Plants for the production of fine chemicals and pharmaceuticals. Batch reactor design. Fermentation technology-cell biomass (Bakers´ yeast production from sugars). Triglycerides. Fat industrial extraction. Soup saponification. Fat hydrogenation. Transesterification. Detergents and surfactants. Enzyme technology (biocatalysts for chemical transformations). Production of L-Aminoacids. Production of artificial sweeteners. Production of D-mannitol. Structure elucidation of natural products and fine chemicals by infrared (IR), visible-ultraviolet (UV), NMR and mass spectroscopies. X-Ray crystallography for structure determination of carbohydrates, proteins and other pharmaceuticals and natural products.

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Module 4: Fuel production processes from petroleum, coal and biomass.	Learning time: 18h 50m Theory classes: 7h 30m Self study : 11h 20m

Description:
Alternative technologies for the production of gasoline and diesel fuels: MTG, MTO, MOGD and Fischer-Tropsch processes. Alternative fuels such as liquefied petroleum gas (LPG), compressed natural gas (CNG), methanol, ethanol, batteries for hybrid-electric vehicles (HEV). Fermentation technology-metabolic products (biomass as renewable energy source). Synthesis gas from natural gas. Coal gasification. Purification and adjustment of synthesis gas.

Qualification system

Final Grade = 0,25 Eval. partial exam + 0,5 Eval. final exam + 0,25 Research Work Project

Any student who cannot attend any of the written tests or that wants to improve the obtained grade, will have the opportunity by taking an additional global witten exam that will take place the dated fixed in the calendar of final exams. The grade obtained in this test will range between 0 and 10, and will replace that of the previous tests only in case it is higher.

Regulations for carrying out activities

Because the contents of the partial exam are included in the final exam, passing the final exam implies having passed also the partial exam. In any case, the best average of the exams will remain.

Bibliography

Basic:

Weissermel, K.; Arpe, H.-J. Industrial organic chemistry. 4th completely rev. ed. Weinheim [etc.]: Wiley-VCH, 2003. ISBN 9783527305780.

Moulijn, J. A.; Makkee, M.; Diepen, A. van. Chemical process technology [on line]. 2nd ed. Chichester: Wiley, 2013 [Consultation: 30/06/2016]. Available on: <http://site.ebrary.com/lib/upcatalunya/reader.action?docID=10683282>. ISBN 9781444320251.

Jess, A.; Wasserscheid, P. Chemical technology: an integral textbook. Weinheim, Germany: Wiley, cop. 2013. ISBN 9783527304462.

Carey, F. A.; Giuliano, R. M. Organic chemistry. 10th ed. New York: McGraw-Hill, 2017. ISBN 9781259253379.

Complementary:

Speight, James G. The chemistry and technology of petroleum. 3rd ed., rev. and expanded. New York: Marcel Dekker, cop. 1999. ISBN 0824702174.