General information		
Academic subject	***Organic Chemistry I + Organic Chemistry II***	
Degree course	*Environmental Sciences (L32)*	
Academic Year		
European Credit Transfer and Accumulation System (ECTS)		*12*
Language	*Italian*	
Academic calendar (starting and ending date)	*I Semester (28 September 2021 – 14 January 2022)*	
Attendance	*Strongly recommended*	

Professor/ Lecturer	
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Virtual headquarters	*Microsoft Teams : https://teams.microsoft.com/l/team/19%3a9a43e325397d482a8ece41c946a6e6d5%40thread.tacv2/conversations?groupId=258d9055-f268-455f-8afb-f0408b590fea&tenantId=c6328dc3-afdf-40ce-846d-326eead86d49*
Tutoring (time and day)	*Friday (16.00-18.00) to be planned. Microsoft Teams: https://teams.microsoft.com/l/team/19%3a678aac104a284f57a14aedeba43f216c%40thread.tacv2/conversations?groupId=97230d02-9ba5-41a8-9d48-da241e6e125c&tenantId=c6328dc3-afdf-40ce-846d-326eead86d49*

Syllabus	
Learning Objectives	*The course aims at providing the basic knowledge of nomenclature, reactivity, and structure-properties relation of the main classes of organic compounds, as well as the knowledge of the main classes of organic biomolecules and pollutants. The course also contributes to provide graduated students a multidisciplinary know-how in Environmental Sciences.*
Course prerequisites	*The knowledge of general principles learnt during the General and Inorganic Chemistry course is necessary for a good understanding of lessons in Organic Chemistry. In particular, preliminary knowledge of the theories on atomic and molecular structures, as well as on chemical bond formation, is recommended.*
Contents	***Organic Chemistry I*** *Introduction and summary of chemical bond and orbital hybridisation theories, polarity in molecules. Intermolecular interactions. Atomic formal charge.* *Saturated hydrocarbons. Alkanes: chemical structures, nomenclature, chemical-physical properties, isomers, reactivity. Cycloalkanes. Configurational and conformational stereoisomers. Conformational study of alkanes and cycloalkanes. Chirality: enantiomers and diastereoisomers. Configurations of chiral centres. Optical activity of enantiomers.* *Alkenes and alkynes: chemical structures, nomenclature, chemical-physical properties. Geometrical isomers in alkenes and dienes. Reactivity of alkenes: electrophilic addition to double C-C bonds. Hydroalogenation, hydration, halogenation reactions. The Markovnikov's rule. Dihydroxylation, oxidation and reduction reactions of alkenes.*

	Haloalkanes: nomenclature and chemical-physical properties. Aliphatic nucleophilic substitution reactions SN1 ed SN2, β-elimination reactions E1 and E2. Effects of nucleophiles, leaving groups and solvents in the SN/E competition. *Aromatic hydrocarbons: the benzene and its derivatives. Nomenclature and general structural features of aromatic hydrocarbons. Heterocyclic aromatic compounds. Electrophilic aromatic substitution reactions: halogenation, sulfonation, nitration, Friedel-Crafts alkylation and acylation reactions. Electronic effects of substituents.* *Alcohols, ethers, epoxides and thiols: nomenclature and chemical-physical properties. Reactivity of alcohols: acid properties, conversion to haloalkanes, dehydration and oxidation reactions. Synthesis and reactivity of ethers and epoxides. Oxidation of thiols.* *Phenols: nomenclature, chemical-physical properties and reactivity.* *Aldehydes and ketones: chemical structures, nomenclature and properties. Reactivity of carbonyl groups: oxidation, reduction and nucleophilic addition reactions. Synthesis of imines, acetals and emiacetals.* *Carboxylic acids: nomenclature, properties and reactivity. The Fischer esterification reaction.* ***Organic Chemistry II*** *Derivatives of carboxylic acids: acyl chlorides, anhydrides, esters and amides. Nomenclature and properties. Nucleophilic acyl substitution reactions: hydrolysis, alcoholysis, ammonolysis. Comparison of the reactivity of acyl derivatives.* *Structural effects in organic acids and bases.* *Carbohydrates: introduction and structural properties. Monosaccharides: D and L aldoses and ketoses. The Fischer and Haworth chemical structures. Mutarotation. Disaccharides and polysaccharides.* *α-Aminoacids: structures, nomenclature and properties. The L steric series of natural α-aminoacids.* *Nucleosides and bases in DNA and RNA. Nucleotides and oligonucleotides.* *Saturated and unsaturated fatty acids. Triglycerides: chemical structures and saponification reaction.* *Surfactants: soaps and detergents. Chemical structures and properties.* *Main classes of organic pollutants: chemical structures, properties and toxic effects. Polycyclic Aromatic Hydrocarbons (PAH).* *Chlorinated organic pesticides: DDT, toxaphenes, polychlorophenols, chlorinated cyclopentadienes, chlorophenossyacetic acids. Polychlorobiphenyls (PCB), Dioxins and Polychlorodibenzofurans.* *Petroleum: chemical composition, topping and environmental effects.* ***Exercises in classroom:*** *Exercises of IUPAC nomenclature and reactivity of organic compounds. Exercises with Prentice Hall molecular model kits: conformational analysis of alkanes and cycloalkanes.* ***Experimental activity in Laboratory:*** *Column chromatography of a mixture of organic dyes.* *Extraction and thin layer chromatography of photosynthetic pigments from spinach leaves.* *Synthesis of fragrant esters by the Fischer reaction of carboxylic acids and alcohols.* *Synthesis of soap from olive oil by the saponification reaction.* *Synthesis of Nylon6,6*

Books and bibliography	*W.H. Brown. Introduzione alla Chimica Organica II Ed. (EdiSES, Napoli)* *J. McMurry. Chimica Organica. Un approccio Biologico (Zanichelli)*
Additional materials	

Work schedule			
Total	Lectures	Hands on (Laboratory, working groups, seminars, field trips)	Out-of-class study hours/ Self-study hours
Hours			
300	*90*	*30*	*180*
ECTS			
12	*10*	*2*	

Teaching strategy	*Teaching will occur by blended learning strategy (both in presence and online). Microsoft Office Power Point slides will be provided to students as supporting learning material. Lectures will include both teaching of theorical principles and solving exercises with active participation of students. Prentice Hall molecular models are provided to students as efficient tools for understanding molecular structures and reaction mechanisms. Laboratory experiences occur immediately after the lectures dealing with the theorical principles related to the experimental work. Each student individually performs the experimental work with the assistance of the teacher.*
Expected learning outcomes	*Students will learn the main classes of organic compounds, the basic principles of their reactivity, the main classes of biomolecules and organic pollutants, as well as their environmental effects.*
Knowledge and understanding on:	○ Knowledge of the main classes of organic compounds and their reactivity.
Applying knowledge and understanding on:	○ Understanding the environmental effects of organic pollutants ○ Knowledge of the basic principles for the synthesis, purification and isolation of organic products in laboratory.
Soft skills	• *Making informed judgments and choices* ○ Ability in problem solving by application of theoretical principles to real cases of study ○ Autonomous ability of understanding molecular interactions in chemical processes in a multidisciplinary approach • *Communicating knowledge and understanding* ○ Autonomous exposition of learnt topics using proper scientific language • *Capacities to continue learning* ○ Ability of implement the information provided by lectures using scientific literature and books.

Assessment and feedback	
Methods of assessment	Assessment occurs by a final oral exam. The exam score will result from the evaluation of the student's scientific knowledge, attendance to lessons and experimental activity in laboratory.
Evaluation criteria	• *Knowledge and understanding* ○ To demonstrate the knowledge of theoretical and experimental principles of the whole programme of study • *Applying knowledge and understanding*

	• Assessment of multidisciplinary problem-solving skills • *Autonomy of judgment* ○ Ability in prediction of possible chemical processes occurring in an environmental context explored with a multidisciplinary approach. • *Communication skills* • Communication of knowledge in a logical and critical way • *To achieve the skills necessary to attend subsequent studies*
Criteria for assessment and attribution of the final mark	*The evaluation will be made considering:* *1. the student's scientific knowledge;* *2. the accuracy and precision of answers provided;* *3. the use of proper scientific language;* *4. the student's autonomy of judgement and the logic skill to solve a question availing of all the principles learnt in the course.* *The fulfilment of the above mentioned aspects 1. and 2. is necessary to pass the exam with the minimal score (18/30), while the maximum score (30/30 cum laude) is provided when all the aspects 1-4 are fulfilled and an excellent knowledge of all the topics included in the scientific program is demonstrated.*
Additional information	

Bari, September 10th 2021

Roberta Ragni

Prof. Roberta Ragni