COURSE OUTLINE

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES		
DEPARTMENT	DEPARTMENT OF CHEMISTRY		
LEVEL OF STUDIES	ISCED level 6 – Bachelor's or equivalent level		
COURSE CODE	YN203	**SEMESTER OF STUDIES**	**2nd**
COURSE TITLE	Organic Chemistry I		

INDEPENDENT TEACHING ACTIVITIES *If the ECTS Credits are distributed in distinct parts of the course e.g. lectures, labs etc. If the ECTS Credits are awarded to the whole course, please indicate the teaching hours per week and the corresponding ECTS Credits.*	**TEACHING HOURS PER WEEK**	**CREDIT UNITS**
THEORY	4	6

COURSE TYPE *general background, specific background, specialization, general knowledge, skills development*	SPECIFIC BACKGROUND
PREREQUISITE COURSES:	There are no prerequisite courses. To better understand the course, students should have a basic understanding of General Chemistry.
LANGUAGE OF INSTRUCTION and EXAMS :	Greek
THE COURSE IS OFFERED TO ERASMUS STUDENTS	NO
COURSE WEBSITE (URL)	https://eclass2.emt.duth.gr/courses/CHEM-N2103/

(2) LEARNING OUTCOMES

Learning Outcomes
Please describe the learning outcomes of the course: Knowledge, skills and abilities acquired after the successful completion of the course.

The course aims to equip students with the essential knowledge and skills to understand the fundamental principles of Organic Chemistry and apply them to problem-solving scenarios.

Specifically, throughout the course, students will gain expertise in the following areas:

- The structural theory of matter. The role of electrons in bond formation and their influence on the molecular properties of organic compounds. Hybridized atomic orbitals and the geometry of organic molecules. Polarity, Intermolecular Forces and Solubility of Molecules. Molecular representations, functional groups, and the nomenclature rules of organic compounds. Three-dimensional bond-line structures, resonance structures, and formal charges. Delocalized and localized electron pairs.
- Bronsted-Lowry and Lewis Acids and Bases.
  - Understanding the quantitative and qualitative approaches to acidity
  - The position of equilibrium in acid-base organic reactions and choice of reagents
  - Leveling Effect. Solvating Effects.
- Alkanes and Cycloalkanes.
  - The relative stability of isomers
  - Newman projections and conformational analysis of alkanes
  - Conformations of cyclohexane
  - Cis-trans stereoisomerism in cycloalkanes

- Stereoisomerism
  - Concepts of symmetry and chirality
  - Determination of stereoisomers through imaging
  - Enantiomers and diastereomers
  - Fischer projections
- Chemical Activity and Mechanisms
  - Terms related to enthalpy, entropy, and free energy according to Gibbs in organic reactions
  - Equilibrium and kinetics of reactions
  - Energy diagrams, nucleophilic and electrophilic reagents
  - Electron movement patterns and carbocation rearrangements
- Substitution Reactions
  - Mechanisms of SN2 and SN1 reactions
  - Factors determining which mechanism prevails
- Alkenes
  - Stereoisomerism in alkenes and their relative stability
  - E2 and E1 elimination mechanisms
  - Factors that influence the choice between substitution and elimination mechanisms
  - Product prediction
- Addition Reactions of Alkenes
  - Rules governing the addition mechanism
  - Types of addition reactions: hydrogenation, hydration, oxyhydration-dehydration, hydroboration-oxidation, catalytic hydrogenation, halogenation, anti and syn dihydroxylation, and oxidative degradation
- Alkynes
  - Acidity of terminal alkynes
  - Preparations and reactions of alkynes, including reduction, hydrogenation, hydration, halogenation, ozonolysis, and alkylation
- Synthesis Strategies
  - Selecting reagents for the transformation of functional groups

Skill Development

- Identification of the Structural Formula
- Designing Lewis structures and calculating the formal charge of atoms
- Prediction of geometry, molecular dipole moments, and physical properties
- Identification and design of skeletal structures
- Drawing significant resonance structures and assigning formal charges
- Identifying localized and delocalized lone pairs
- Design of the proton transfer mechanism
- Utilization of pKa values to compare acidic and basic character and predict equilibrium position
- Prediction of equilibrium position without using pKa values by evaluating relative stability based on ARIO factors
- Selection of the appropriate reagent for a proton transfer reaction
- Identification of organic acids and Lewis bases
- Name organic compounds
- Designing structural isomers
- Creating Newman projections and evaluating the relative energy of various configurations
- Design of chair conformations for cyclohexane, including axial and equatorial positions, and identification of the most stable configuration for multi-substituted cyclohexane
- Identification of cis-trans stereoisomerism
- Finding and naming chiral centers. The R- and S- system.
- Calculation of the specific rotation and enantiomeric excess

- Determination of the stereoisomeric relationship between two compounds and identification of meso compounds
- Identification of nucleophilic and electrophilic centers
- Drawing curved arrows and sequences of electron flow patterns
- Predicting carbocation rearrangements
- Designing the complete mechanism of an SN2 process and predicting the product
- Designing the complete mechanism of an SN1 process and predicting the product
- Determining whether a reaction proceeds via an SN1 mechanism or an SN2 mechanism
- Identifying the reagents needed for a substitution reaction
- Defining the stereoisomerism of the C=C double bond
- Comparing the stability of isomeric alkenes
- Designing the mechanism of an elimination reaction
- Predicting the topochemical and stereochemical effects of E2 and E1 reactions
- Determining whether a reagent acts as a nucleophile or a base and predicting the expected mechanism
- Predicting the products of substitution and elimination reactions.
- Predicting the products of alkene addition reactions
- Predicting the equilibrium position for the deprotonation of a terminal alkyne
- Designing the mechanism of keto-enol tautomerization
- Predicting the products of alkyne reactions
- Developing synthesis strategies, selecting suitable reagents, and interconverting alkanes, alkenes, and alkynes

Upon completing the course, students will have developed the following skills: the ability to search, analyze, and synthesize data and information using necessary technologies; respect for the natural environment; and the promotion of free, creative, and inductive thinking.

General Skills

Taking into account the general competencies that the graduate must have acquired (as listed in the Diploma Supplement and listed below), which of these does the course aim to achieve?

Search, analysis and synthesis of data and information, using the necessary technologies	*Project planning and management*
Adapting to new situations	*Respect for diversity and multiculturalism*
Decision making	*Respect for the natural environment*
Autonomous work	*Demonstrate social, professional and ethical responsibility and sensitivity to gender issues*
Teamwork	*Practicing criticism and self-criticism*
Working in an international environment	*Promoting free, creative and inductive thinking*
Working in an interdisciplinary environment	*……*
Generation of new research ideas	*Other…*
	…….

(3) COURSE CONTENT

1. General Chemistry Review: Electrons, Bonds and Molecular Properties. Atomic and molecular orbitals, hybrid orbitals. Geometry of organic molecules, molecular polarity. Intermolecular forces and physical properties. Solubility.
2. Synthesis, Classification and Nomenclature of Organic Compounds. Molecular Representations. Skeletal Structures. Functional Groups. Induction and Polar Covalent Bonds. Typical Charges. Resonance Structures. Delocalized and Localized Electron Pairs.
4. Stereoisomerism. Symmetry and chirality . Optical activity. Definition of the representation of stereoisomers. Enantiomers and Diastereomers . Fischer projections.
5. Alkanes and Cycloalkanes . Origin, uses, preparations, reactions. Relative stability. Newman projections . Conformational analysis. Equatorial and axial positions. Cis - trans stereoisomerism .
6. Chemical Reactivity. Enthalpy, entropy and Gibbs free energy of organic reactions. Equilibrium. Kinetics. Energy diagrams. Nucleophiles and Electrophiles . Arrow electron-pushing models. Carbocation rearrangements .
7. Substitution Reactions. S_N2 Mechanism. S_N1 Mechanism . Selecting Reagents to Accomplish

Functional Group Transformation.
8. Alkyl halides . Physical and Chemical Properties. Preparations. Reactions.
9. Alkenes: Structure and preparations. Elimination reactions. Mechanism E2. Mechanism E1. Substitution versus Elimination, identification of reagents, mechanism and prediction of products.
10. Alkenes: Addition Reactions. Hydrohalogenation , hydration, oxymercuration-demercuration , hydroboration -oxidation, catalytic hydrogenation, halogenation , *anti* and *syn* dihydroxylation , oxidative cleavage.
11. Alkynes . Acidity of terminal alkynes . Preparations, Reactions. Reduction, hydrohalogenation , hydration, halogenation , ozonolysis , alkylation .
12. Synthesis Strategies. Selection of appropriate reagents. Interconversion alkanes , alkenes and alkynes .

(4) LEARNING AND TEACHING METHODS – EVALUATION

<table>
<tr><td>DELIVERY METHOD
Face to face, Distance learning, etc.</td><td>Face to face</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES
Use of ICT in Teaching, Laboratory Education, Communication with students</td><td>The use of Information and Communication Technology (ICT), such as PowerPoint, enhances the teaching process. It involves a problem-solving methodology and the development of effective teaching strategies. Providing exemplary solutions to exercises and conducting self-assessment tests are also key components. Additionally, the learning process is supported by the e-Class platform, which facilitates communication with students via email to address any doubts or questions they may have.</td></tr>
<tr><td>TEACHING ORGANIZATION
The ways and methods of teaching are described in detail.
Lectures, Seminars, Laboratory Exercise, Field Exercise, Bibliographic research & analysis, Tutoring, Internship (Placement), Clinical Exercise, Art Workshop, Interactive learning, Study visits, Study / creation, project, creation, project. Etc.

The supervised and unsupervised workload per activity is indicated here, so that total workload per semester complies to ECTS standards
.</td><td>
<table>
<tr><th>Activity</th><th>Load Monthly Work</th></tr>
<tr><td>Lectures (3 hours per week X 13 weeks)</td><td>39</td></tr>
<tr><td>Tutorial (1 hour per week X 13 weeks) with solving representative exercises</td><td>13</td></tr>
<tr><td>Final exam (3 hours)</td><td>3</td></tr>
<tr><td>Literature study and analysis</td><td>13</td></tr>
<tr><td>Self-assessment test</td><td>13</td></tr>
<tr><td>Student study hours and preparation for the final exam</td><td>65</td></tr>
<tr><td>Total course
(24 hours of workload per credit unit)</td><td>146 hours (total workload)</td></tr>
<tr><td></td><td></td></tr>
</table>
</td></tr>
<tr><td>STUDENT EVALUATION
Description of the evaluation process

Assessment Language, Assessment Methods, Formative or Concluding, Multiple Choice Test, Short Answer Questions, Essay Development Questions, Problem Solving, Written Assignment, Essay / Report, Oral Exam, Presentation in audience, Laboratory Report, Clinical examination of a patient, Artistic interpretation, Other/Others

Please indicate all relevant information about the course assessment and how students are informed</td><td>Student evaluation is conducted through a written final exam (in Greek) that includes:
✓ multiple choice questions (formative)
✓ short answer questions (inferential)
✓ responses to critical questions (conclusions)
✓ combinatorial problems (inferential)

Rate 100</td></tr>
</table>

(5) RECOMMENDED BIBLIOGRAPHY

- Recommended Bibliography:

1. Οργανική Χημεία. Αριθμός τόμου: Ι. Έκδοση: 4η αμερικανική-2η ελληνική/2024 Συγγραφείς: David Klein. ISBN: 9786185800130. Τύπος: Σύγγραμμα Διαθέτης (Εκδότης): UTOPIA ΕΚΔΟΣΕΙΣ Μ. ΕΠΕ. Κωδικός Βιβλίου στον Εύδοξο: 122094654

2. Βασική Οργανική Χημεία. Έκδοση: 1/2023. Συγγραφείς: Bruice P.Y. ISBN: 9789963258208. Τύπος: Σύγγραμμα. Διαθέτης (Εκδότης): BROKEN HILL PUBLISHERS LTD Κωδικός Βιβλίου στον Εύδοξο: 122074092

3. ΟΡΓΑΝΙΚΗ ΧΗΜΕΙΑ. Συγγραφείς: John McMurry. ISBN: 978-960-524-491-0. Κωδικός Βιβλίου στον Εύδοξο: 68370521

4. ΟΡΓΑΝΙΚΗ ΧΗΜΕΙΑ. Συγγραφείς: Carey Francis A., Giuliano Robert M., Allison Neil T., Bane Susan L. (Συγγρ.) - Τρογκάνης Αναστάσιος, Ρασσιάς Γεράσιμος, Τσοτίνης Ανδρέας (Επιμ.), Έκδοση: 1η έκδ./2020, ISBN: 978-960-586-343-2. Κωδικός Βιβλίου στον Εύδοξο: 94645265, Διαθέτης (Εκδότης): ΕΚΔΟΣΕΙΣ ΚΡΙΤΙΚΗ ΑΕ

- Relevant Scientific Journals:

Journal of Chemical Education
European Journal of Organic Chemistry
Organic Chemistry Frontiers
Organic Syntheses
Organic Letters