COURSE OUTLINE

(1) GENERALLY

SCHOOL	SCHOOL OF SCIENCES		
DEPARTMENT	DEPARTMENT OF CHEMISTRY		
LEVEL OF STUDIES	ISCED level 6 – Bachelor's or equivalent level		
COURSE CODE	YN403	**SEMESTER OF STUDIES**	**4th**
COURSE TITLE	Organic Chemistry Laboratory II		

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, then please indicate the teaching hours per week and the corresponding ECTS Credits.*	**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
LAB	4	7

COURSE TYPE *Background, General Knowledge, Scientific Area, Skill Development*	Specific background
PREREQUISITES:	There are no prerequisite courses. To better understand the course, students should have studied the material from Organic Chemistry I, Organic Chemistry II and Organic Chemistry Laboratory II.
TEACHING & EXAMINATION LANGUAGE:	GREEK
COURSE OFFERED TO ERASMUS STUDENTS:	NO
COURSE URL:	https://eclass2.emt.duth.gr/courses/CHEM_F106/

(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 aim of the Organic Chemistry Laboratory is to:
a) Familiarize students with the laboratory environment, including the use of instruments, apparatus, and reagents.
b) Teach laboratory techniques and help students acquire essential experimental skills.
c) Reinforce Organic Chemistry knowledge by connecting theory with practical experiments.

Upon completing the laboratory course, students will have acquired the knowledge and skills to:
✓ Gather all necessary information regarding properties, hazards of substances, synthesis literature, and more.
✓ Organise and carry out the synthesis of organic molecules, either in single or multiple steps.
✓ Process and present the results of the experimental exercises performed.
✓ Utilize spectroscopic methods to identify and confirm reaction products.

Participating in the Organic Chemistry Laboratory II will cultivate critical thinking and scientific reasoning, enhance initiative and active learning, and foster teamwork and collaboration through group exercises. Additionally, students will develop an awareness of the importance of waste management and environmental protection, and practice adherence to hygiene and safety rules within the laboratory.

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

Synthesis of organic compounds, including both simple and multi-step processes. Reaction mechanisms. Laboratory safety. A thorough discussion of the theoretical and practical aspects of the experiments. Collection and analysis of spectroscopic data of starting materials and products (NMR, IR, MS). Chemical literature exercise.

1. Local anaesthetics. Preparation of benzocaine. Esterification. Heating with reflux. Crystallisation (solvent mixture). Melting point.
2. Esters – Flavours and Fragrances. Preparation of acetic acid esters. Fisher esterification. Extraction. Determination of boiling point. Refractive index. GC-MS analysis of reaction products. Spectroscopic identification of the product.
3. Hydrolysis of esters. Saponification of salicyl methyl ester. Isolation of salicylic acid. Recrystallisation.
4. Properties of carbohydrates. Detection and differentiation tests for carbohydrates.
5. Oxidation reactions. Oxidation of cyclohexanol. Synthesis of cyclohexanone oxime and conversion to caprolactam. Beckmann rearrangement.
6. Electrophilic aromatic substitution. Nitration of acetanilide – Synthesis of 3-nitroacetanilide.
7. Synthetic azo dyes. Synthesis of methyl orange. Relationship between colour and structure. UV-Vis spectra.
8. Reduction of monoterpenes and aromatic compounds with aldehyde groups. Oxidation of monoterpenes with secondary hydroxyl groups.
9. Aldol condensation. Preparation of benzalacetophenone (chalcones). Recrystallisation. Identification. Melting point. UV spectroscopy.
10. Cannizzaro reaction of benzaldehyde.
11. Diels-Alder reaction with microwaves (Green Chemistry).
12. Preparation of p-methylacetophenone (Friedel-Crafts reaction).
13. Chemical literature exercise.

(4) TEACHING AND LEARNING 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>Use of ICT (PowerPoint and videos) in teaching. Support of the learning process through the e-class electronic platform. Specifically, the slides from tutorials are uploaded, along with the theory and experimental instructions, the pre-lab test is conducted, and laboratory reports are submitted. Communication with students is maintained via email, and any queries are addressed.</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>Laboratory exercises (3 hours weekly × 13 weeks)</td><td>39</td></tr>
<tr><td>Tutoring (1 hour weekly × 13 weeks) with presentation of the theory and the experimental procedure of the laboratory exercises</td><td>13</td></tr>
<tr><td>Pre lab quiz</td><td>13</td></tr>
<tr><td>Laboratory report. Literature review and analysis</td><td>39</td></tr>
<tr><td>Student's study hours and preparation for the final exam</td><td>37</td></tr>
<tr><td>Τελική εξέταση (3 ώρες)</td><td>3</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>
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</td></tr>
<tr><td>STUDENT EVALUATION
Description of the evaluation process

Language of Assessment, Assessment Methods, Formative or Inferential, Multiple Choice Test, Short Answer Questions, Essay Development Questions, Problem Solving, Written Assignment, Report / Report, Oral Examination, Public Presentation, Laboratory Work, Clinical Examination of a Patient, Artistic Interpretation, Other / Others

Explicitly specified evaluation criteria are mentioned and if and where they are accessible to students.</td><td>The laboratory grade is determined by the following:
i. Prelab quiz before starting the experimental procedure, grade A1, accounting for 10%.
ii. Successful execution of the experiments—Laboratory participation, grade A2, accounting for 15%.
iii. Laboratory Report, which includes the presentation and evaluation of experimental results (reactions, reaction mechanisms, yields, observations) and comprehension questions, grade A3, accounting for 25%.
iv. Final written exam on the laboratory exercises, grade B, accounting for 50%.

*To be considered as having successfully attended the laboratory, a student must have received a grade of at least 5 in each component, i.e., A (=A1+A2+A3) ≥ 5 and B ≥ 5.
➢ At the end of each semester, a one-week makeup session for laboratory exercises is organised. Only students who have missed one session during the current semester are eligible to participate. If a student has more than one</td></tr>
</table>

	absence, they are required to repeat the uncompleted laboratory experiments in the following academic year. Students with four or more missed laboratory exercises (≥4) must re-enrol in the course in a future semester and repeat all experiments. ➢ Successful completion of all laboratory experiments is a prerequisite for students to attend the final written exam. If a student's grade A (=A1+A2+A3) is less than 5, they cannot participate in the laboratory written exam. They must re-enroll in the course in a future semester and repeat all experiments. ➢ If a student has completed the laboratory part of the exercises but has a laboratory grade below 5, they are allowed to participate in a partial laboratory exam in September.

(5) RECOMMENDED BIBLIOGRAPHY

- Recommended Bibliography:

1. Εργαστηριακές Τεχνικές και Πειράματα Οργανικής Χημείας, Συγγραφείς: Pavia L. Donald, Lampman M. Gary, Kriz S. George, 2020. ISBN 9789963274789, Διαθέτης (Εκδότης):BROKEN HILL PUBLISHERS LTD, Κωδικός Βιβλίου στον Εύδοξο: 94643616

2. Πυρηνικός Μαγνητικός Συντονισμός. Συγγραφείς: Μαυρομούστακος Θ.,Τζάκος Α.,Σπυρούλιας Γ.,Μικρός Ε.,Κολοκούρης Α.,Παπακωνσταντίνου Κ.,Γεροθανάσης Ι.,Ματσούκας Ι. Έκδοση: 1η/2018. ISBN: 9789602665046. Τύπος: Σύγγραμμα. Διαθέτης (Εκδότης): Σ.ΑΘΑΝΑΣΟΠΟΥΛΟΣ & ΣΙΑ Ι.Κ.Ε. Κωδικός Βιβλίου στον Εύδοξο: 77114375

3. ΕΙΣΑΓΩΓΗ ΣΤΗ ΦΑΣΜΑΤΟΣΚΟΠΙΑ, Συγγραφείς: Pavia L. Donald, Lampman M. Gary, Kriz S. George, Vyvyan A. James, 2020. ISBN: 9789925575640, Διαθέτης (Εκδότης): BROKEN HILL PUBLISHERS LTD. Κωδικός Βιβλίου στον Εύδοξο: 86055668

- Relevant Scientific Journals:

Journal of Chemical Education