4th Semester (IV) (first applied in 2017-18)

Spectroscopy of Organic Compounds – Experimental Organic Chemistry-1

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**XA 404**	**SEMESTER**	**4th**
COURSE TITLE	SPECTROSCOPY OF ORGANIC COMPOUNDS - EXPERIMENTAL ORGANIC CHEMISTRY 1		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	2	5
Seminars	1	
Laboratory work	3	
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Field of Science (Spectroscopy of Organic Compounds) and Skills Development (Experimental Organic Chemistry-1)
PREREQUISITE COURSES:	**Spectroscopy of Organic Compounds:** Typically, there are not prerequisite course. Essentially, the students should possess knowledge of Organic Chemistry and basic knowledge of General Chemistry and Physics. **Experimental Organic Chemistry-1:** Typically, there are not prerequisite course. The students should possess knowledge of Organic Chemistry obtained through the previously attended courses.
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. Teaching may be however performed in English in case foreign students attend the course.
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

By the end of this course the student will be able to:

SPECTROSCOPY OF ORGANIC COMPOUNDS

Use (IR), ^{13}C και ^{1}H nuclear magnetic resonance (NMR), separately or in combination with each other, or with additional information from ultraviolet (UV)/Visible (vis) spectroscopy, mass spectrometry (MS), analytical data or descriptive chemistry, to identify structural features or complete structures of 'unknown' molecules. Determine a molecular formula either from the accurate mass of a molecular ion or from the isotope peak intensities. Calculate a 'double bond equivalent' from a molecular formula and propose possible structural characteristics thereof.

EXPERIMENTAL ORGANIC CHEMISTRY-1

Organize and execute syntheses of relatively simple organic molecules. More specifically, to:

1. Collect all the necessary information (compounds physical properties and hazards, literature information etc.) and then organize an organic synthesis/preparation.
2. Explain the role of the various reagents.
3. Assembly the various apparatuses required in a synthesis and carry out successfully both the synthetic part and the separation and purification of the product(s) part of a synthesis. For this purpose, the student should have been acquainted with the theory and practice of techniques such as extraction, filtration, refluxing, distillation, recrystallization, etc.
4. Use spectroscopic methods (UV-Vis, IR, NMR and MS) for identifying the product(s).
5. Processing and present the results of the syntheses he/she carried out, such as yields, mechanisms, improvement of synthetic routes, etc.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	*Others*
Production of new research ideas	

By the end of this course the student will, furthermore, have developed the following skills (general abilities):

1. Ability to exhibit knowledge and understanding of the essential facts, concepts, theories and applications which are related to Spectroscopy of Organic Compounds.
2. Ability to prepare and carry-out the synthesis and characterization of simple organic molecules.
3. Ability to apply this knowledge to the solution of non-familiar problems.
4. Ability to apply this knowledge to the solution of new compounds.
5. Study skills needed for continuing professional development.
6. Ability to interact with others in chemical or of interdisciplinary nature problems.

Generally, by the end of this course the student will, furthermore, have develop the following general abilities (from the list above):

Searching, analysis and processing of data and information, as well as using the necessary technologies

Adaptation to new situations

Decision making

Autonomous (Independent) work

Group work

Exercise of criticism and self-criticism

Promotion of free, creative and inductive thinking

Respect to natural environment

Work design and management

3. SYLLABUS

SPECTROSCOPY OF ORGANIC COMPOUNDS

1. Matter and Electromagnetic Irradiation.
2. UV-Vis Spectroscopy (theory– applications)
3. IR and Raman Spectroscopy (theory– applications)
4. MS Spectrometry: a) Description of the principle and the various ionization techniques (Electron Impact, Chemical Ionization, MALDI, ES, etc. b) Generally about molecular fragmentation in mass spectrometry and Fragmentation pathways of the various categories of compounds c) Examples – Applications.
5. Nuclear Magnetic Resonance (NMR) spectroscopy, chemical equivalence, the δ scale, chemical shift. ^{1}H NMR spectra, integration, spin-spin coupling, the n+1 rule. ^{13}C NMR Spectroscopy, multiplicity in off-resonance spectra.
6. Combinatorial use of the above spectroscopic/spectrometric techniques for the identification of 'unknown' organic compounds.

EXPERIMENTAL ORGANIC CHEMISTRY-1

1. Introductory concepts of the Organic Chemistry Laboratory and description of techniques.
2. Preparation of tert-butyl chloride.
3. Preparation of acetanilide.
4. Preparation of cyclohexanone oxime.
5. Canizzarro reaction.
6. Nitration of Acetanilide.
7. Thin Layer Chromatography (separation of aminoacids).
8. Microscale reactions (Synthesis of Benzoine).

4. TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Lectures, seminars and laboratory work face to face.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of Information and Communication Technologies (ICTs) (e.g. PowerPoint) in teaching. Tutorials with exemplary analysis of problem solving in Spectroscopy. Tutorials where the experimental steps are thoroughly analysed and combined with theory.
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	

Activity	*Semester workload*
Lectures (2 contact hours per week x 13 weeks)	26
Tutorial (1 contact hour per week x 13 weeks – Analysis of problem solving strategy and solution of representative problems) Tutorial (1 contact hour per week x 13 weeks – Analysis of the laboratory experiments and combination with theory)	26
Laboratory work (4 contact hours per week x 13 weeks)	52
Final examination (3 contact hours)	3

	Hours for private study of the student and preparation of home-works and preparation for the seminars and Laboratory	18
	Course total	***125***
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	**SPECTROSCOPY OF ORGANIC COMPOUNDS:** Written examination (50% of the final grade). Minimum passing grade: 5. **EXPERIMENTAL ORGANIC CHEMISTRY-1:** 1. Written tests of 15 minutes duration at the beginning of each new laboratory period (experiment). The mean mark from these tests consists the 25% of the final grade. 2. Reports following completion of each laboratory experiment. The mean mark from these tests consists the 25% of the final grade.	

5. ATTACHED BIBLIOGRAPHY

1. L. G. Wade,Jr., "Organic Chemistry", Translation to Greek: D. Komiotis et al, A. Tziolas and Sons Publications, 2010.
2. J. McMurry, "Organic Chemistry", Translation to Greek: A. Varvoglis, M. Orfanopoulos, I. Smonou et al, University of Crete Publications, 2012.
3. D. Papaioannou, G. Stavropoulos, T. Tsegenidis, "Spectroscopy of Organic Compounds", in Greek language only, University of Patras Publications Centre, Patras, 2005.
4. Notes of lecturers in Greek.