Instrumental Chemical Analysis-2

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**XA 454**	**SEMESTER**	**4th**
COURSE TITLE	INSTRUMENTAL CHEMICAL ANALYSIS-2		

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	3	10
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 (Analytical Chemistry)
PREREQUISITE COURSES:	There are no prerequisite courses. It is however recommended that students have basic knowledge of Physics, Organic chemistry, Qualitative analysis and Quantitative analysis.
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. However, the course can be taught in English if foreign students enrolled.
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://www.chem.upatras.gr, http://eclass.upatras.gr

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*

At the end of this course the student will know:

1. Properties of electromagnetic radiation. Parts of optical instruments.
2. UV/Vis molecular spectroscopy: Transmittance and absorbance measurements. Beer's Law. Instrumentation.
3. Applications of UV/Vis molecular spectroscopy: Requirements for absorption at the UV/Vis range. Applications in qualitative and quantitative analysis. Photometric titrations.
4. Molecular luminescence spectroscopy: Theory of fluorescence and phosphorescence. Instrumentation. Applications and luminescence methods. Chemiluminescence.
5. Infrared absorption spectroscopy: Theory, instrumentation and applications.

6. Atomic absorption and atomic fluorescence spectroscopy: Atomization techniques, instrumentation for atomic absorption, interferences, analytical techniques in atomic absorption spectroscopy, atomic fluorescence spectroscopy.
7. Atomic emissions spectroscopy: Atomic emission spectroscopy based on plasma sources.
8. Atomic mass spectrometry: mass spectrometry (general), inductively coupled plasma/mass spectrometry.
9. Molecular mass spectrometry: mass spectra, various ion sources (electron impact, chemical ionization, field desorption, etc), Instrumentation for Mass Spectrometry. Mass analysers (magnetic sectors, quadruple, time of flight, etc). MALDI and Electrospray Ionization. Applications of MS to the identification and quantification of a plethora of analytes. Tandem MS. Coupling of chromatography with mass spectrometry. Inductively coupled plasma-mass spectrometry (ICP-MS).
10. Automated methods of analysis. Principles, Instrumentation and Applications.

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	

At the end of the course the student will have further developed the following skills/competences:

1. Critical knowledge of the advantages and disadvantages of various spectroscopic techniques.
2. How can we choose a spectroscopic technique in order to address a particular analytical challenge in real samples?
3. Quantitative aspects of spectroscopic techniques, including calibration.
4. Effect of interferences and how to avoid them.
5. How can we choose a particular instrument (cost versus performance).
6. Advantages and disadvantages of various instruments.

3. SYLLABUS

1. Introduction to spectroscopic techniques: Properties of electromagnetic radiation. Parts of optical instruments.
2. UV/Vis molecular spectroscopy: Transmittance and absorbance measurements. Beer's Law. Instrumentation.
3. Applications of UV/Vis molecular spectroscopy: Requirements for absorption at the UV/Vis range. Applications in qualitative and quantitative analysis. Photometric titrations.
4. Molecular luminescence spectroscopy: Theory of fluorescence and phosphorescence. Instrumentation. Applications and luminescence methods. Chemiluminescence.
5. Infrared absorption spectroscopy: Theory, instrumentation and applications.
6. Atomic absorption and atomic fluorescence spectroscopy: Atomization techniques, instrumentation for atomic absorption, interferences, analytical techniques in atomic absorption spectroscopy, atomic fluorescence spectroscopy.
7. Atomic emission spectroscopy: Atomic emission spectroscopy based on plasma sources. Multielement analysis.
8. Atomic mass spectrometry: Mass spectrometry (general), Inductively coupled plasma/mass spectrometry.
9. Molecular mass spectrometry: mass spectra, various ion sources (electron impact, chemical ionization, field desorption, etc), Instrumentation for Mass Spectrometry. Mass analyzers (magnetic sectors, quadruple, time of flight, etc). MALDI and Electrospray Ionization. Applications of MS to the identification and

quantification of a plethora of analytes. Tandem MS. Coupling of chromatography with mass spectrometry. Inductively coupled plasma-mass spectrometry (ICP-MS).

10. Automated methods of analysis. Instrumentation. Flow injection analysis, Discrete automated analyzers. Analysis based on multilayered films.

Laboratory Exercises:

- Potensiometry.
- Electrogravimetric analysis.
- Conductimetry.
- UV/Vis Spectroscopy (quantitative analysis, standard addition method).
- UV/Vis Spectroscopy (binary mixtures).
- Photometric titrations.
- Fluorescence spectroscopy.
- Atomic emission (Flame photometry).
- Gas chromatography.
- HPLC ion exchange.
- HPLC reverse phase.
- Automated titration.
- Kinetic photometric determination of an enzyme.

4. TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Lectures, tutorials and laboratory practice
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of Information and Communication Technologies (ICTs) (PowerPoint) in Lectures. Communication with the students via e-mail or the e-class electronic platform: http://eclass.upatras.gr. Personal Codes are given to the students with their registration at the department. Seminars. Problems are solved in an exemplary way summarizing before the theory behind each problem.
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*	see table below
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice*	One written examination at end of Semester 80% of the final grade. One written examination for the Laboratory at end of Semester 20% of the final grade.

Activity	***Semester workload***
Lectures (3 contact hours per week x 13 weeks)	39
Seminars (1 contact hour per week x 13 weeks) - solving representative problems	13
Laboratory exercises (3 contact hours per week x 12 weeks)	36
Final written examination (3 contact hours)	3
Final written examination of the lab (1 contact hour)	1
Private study time of the student and preparation for the half-term evaluations and final examination	158
Course total	***250***

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.*	Minimum passing grade: 5.

5. ATTACHED BIBLIOGRAPHY

1. D.A. Skoog, F.J. Holler, T.A. Nieman, "Principles of Instrumental Analysis", 6th Edition, Thomson Brooks Cole Publications, 2007.
2. T.P. Hadjiioannou and M.A. Kouppari, "Instrumental Analysis", Mavrommatis Publications, 2003.
3. D.C. Harris, "Quantitative Chemical Analysis", 8th Edition, W. H. Freeman and Company Publications, 2010.