Module Title:

Please provide a module title which should have only 30 characters including punctuation and spaces .

Water Framework Directive

Module Code:

AM 0101

Maximum Number of Students:

Please include any limitation on the number of students able to take the module.

50 total (both EMQAL and WCM Students will attend)

Total ECTS Credits

This should be the sum of the credits for each of the semesters in which the module is to run.

2

Notional Learning Hours

(a) Contact Time - __10_____h
(b) Private Study - __40_____ h

Format of Teaching:

Lectures ___10____h
Laboratories or Practicals ____h
Other (preparation of report) __40__h

Teaching Strategy:

Please show how the contact hours are to be allocated in terms of the type of class involved.

Lectures and discussion.
During the lectures the students are introduced to concepts and given exercises to complete.
These will form the basis of the structured report.

Convener:

The name of the member of permanent staff responsible for the module.

Alice Newton

University / Department:

The name of the University and Department responsible for the module.

UAlg - DQBF

Language of Tuition:

Please state whether module is to be taught through the medium of English or another language. If bi-lingual please indicate % of each language

English
Students may submit report in English, French, Portuguese or Spanish

Module Description - The Purpose or Aims:

This should specify the purpose of the module where it fits into the programme specification and what it aims to provide. Please list the Aims in numerical order.

Introduction to environmental legislation on water quality.
The examples are based on EU legislation, the Water framework Directive and other EU environmental legislation on water quality.
Relevant monitoring, parameters, ISO and CEN are covered

Specific Learning Outcomes for this module: (contributing to general learning outcomes GLO 1 – GLO 10)

Learning Outcomes should provide statements which articulate what the student has achieved upon completion of the course. What will a student know, understand or be able to do?

Students will know what the main pieces of EU legislation regulating water quality are in Europe
Students will understand how this legislation is to be implemented with respect to monitoring, analysis and reporting.
Students will be able to investigate the legislation regulating water quality in their country / region of origin with respect to monitoring, analysis and reporting.

Summary of Course Content:

This should be a summary paragraph of list of the topics to be covered by the module.

Environmental Legislation and water quality in Europe

- Water Framework Directive
- Urban Waste Water Directive
- Nitrate Directive
- Shellfish Water Directive
- Bathing Water Directive
- Drinking Water Directive
- Relevant CEN and ISO

Transferable Skills Taught:

Please list in numerical order the key skills taught e.g. communication, information technology, interpersonal skills, teaching/study skills. Please relate these to benchmark statements.

Information technology, use of software such as word and excel, report writing, organization of information

Assessment Methods:

Details of assessment methods should include forms of assessment and the contribution of each to the summative assessment of the module. The relationship to the learning outcomes of the module should be explicit and the numbers of the various learning outcomes should be attached to the assessment methods listed. Please list in numerical order

Students prepare a structured report on environmental legislation relevant to water quality

Assessment Criteria:

Details of assessment methods should include forms of assessment and the contribution of each to the summative assessment of the module. The relationship to the learning outcomes of the module should be explicit and the numbers of the various learning outcomes should be attached to the assessment methods listed. Please list in numerical order.

Threshold: student presents tables and graphs with descriptive text.

Good: student presents tables and graphs with descriptive text. The student is able to interpret information and related to water quality criteria

.Excellent: student presents tables and graphs with descriptive text. The student is able to interpret information and related to water quality criteria and gives clear statements to the water quality and potential uses of the water.

Resource Implications of Proposal and Proposed Solutions:

Details on any resources required and should be included. Please also list e.g core texts; recommended reading material; equipment; films etc.

Lecture room equipped with computer and video projector;

Computer room with access to web of science and "office-type" software

Bibliography: provided in pdf format at beginning of course

- Water Framework Directive
- Urban Waste Water Directive
- Nitrate Directive
- Shellfish Water Directive
- Bathing Water Directive
- Drinking Water Directive
- Peter Chave 2001
  The EU Water Framework Directive
  IWA publishing
  208pp

Internet: access to CIRCA http://circa.europa.eu/irc/env/wfd/info/data/get%20registered%20on%20wfd%20circa.htm

Pre-Requisites:

Any module(s) which must have been taken prior to the current module, or any specific background required to take this module.

None

Module Title:
Please provide a module title which should have only 30 characters including punctuation and spaces .
Water. Sampling and general characteristics

Module Code:
Please code according to the code QM-xx-xx, AM-xx-xx or DA-xx-xx
AM0102

Maximum Number of Students:
Please include any limitation on the number of students able to take the module.
24 students

Total ECTS Credits
This should be the sum of the credits for each of the semesters in which the module is to run.
2

Notional Learning Hours
(a) Contact Time - 15_____h
(b) Private Study - 5___ h

Format of Teaching:
Lectures 9_____h
Laboratories or Practicals _____h
Other 6 ____h

Teaching Strategy:
Please show how the contact hours are to be allocated in terms of the type of class involved.
Lectures will cover criteria of water quality classification and strategy, techniques and devices of water sampling
Each student prepares a short PP presentation based on the paper selected in scientific journal and accepted by the teacher

Convener:
The name of the member of permanent staff responsible for the module.
Professor Bogdan Zygmunt, PhD, DSc or Professor Waldemar Wardencki, PhD, DSc

University / Department:
The name of the University and Department responsible for the module.
Gdansk University of Technology, The Chemical Faculty, Department of Analytical Chemistry

Language of Tuition:
Please state whether module is to be taught through the medium of English or another language. If bi-lingual please indicate % of each language
English

Module Description - The Purpose or Aims:
This should specify the purpose of the module where it fits into the programme specification and what it aims to provide. Please list the Aims in numerical order.
1. To show the importance of scientifically reliable and legally defensible data to the students
2. To provide the students with the strategy of water sampling (where, when, how often and how many samples should be taken to get information representative for the population studied)
3. To provide skills s of selection of techniques and devices to sample different waters

Specific Learning Outcomes for this module: (contributing to general learning outcomes GLO 1 – GLO 10)
Learning Outcomes should provide statements which articulate what the student has achieved upon completion of the course. What will a student know, understand or be able to do?

The student will learn the importance of sampling for obtaining reliable and meaningful analytical results. Sammpling strategy, techniques and devices for water sampling will be taught, especially to make the students capable to evaluate if sampling for a given purpose was properly planned and executed. (GLO3, 4, 6).

Summary of Course Content:
This should be a summary paragraph of list of the topics to be covered by the module.
1. classification of ground and surface waters with respect to their quality
2. presentation of quality criteria;
3. general comments on sampling importance
4. types of samples;
5. strategy of sampling (where, when, what, how, and how many samples)
6. approaches in environmental sampling
7. general guidelines of techniques
8. techniques and corresponding devices of collection of ground and surface water
9. advantages and disadvantages of manual and automated sampling
10. future trends in sampling

Transferable Skills Taught:
Please list in numerical order the key skills taught e.g. communication, information technology, interpersonal skills, teaching/study skills. Please relate these to benchmark statements.
The module should contribute to enhance students' communication and study skills.

Assessment Methods:

Details of assessment methods should include forms of assessment and the contribution of each to the summative assessment of the module. The relationship to the learning outcomes of the module should be explicit and the numbers of the various learning outcomes should be attached to the assessment methods listed. Please list in numerical order

The student will be assessed on the basis of presentation prepared (quality of slides, material selected, way of presentation and answer to question related to the topic presented) and a short written exam

Assessment Criteria:

Details of assessment methods should include forms of assessment and the contribution of each to the summative assessment of the module. The relationship to the learning outcomes of the module should be explicit and the numbers of the various learning outcomes should be attached to the assessment methods listed. Please list in numerical order.

Treshold: Achieving 50% score at the closed written exam and acceptable presentation

Good: Minor errors in the closed written exam and good presentation with correct answers to teachers questions

Excellent: Almost perfect closed written exam and excellent presentation with correct answers to students and teachers questions and asking a reasonable question/s concerning some other presentations

Resource Implications of Proposal and Proposed Solutions:

Details on any resources required and should be included. Please also list e.g core texts; recommended reading material; equipment; films etc.

Keith, L.H., Principles of Environmental Sampling, Second Edition, Chapter 13: Automatic Water and Wastewater Sampling, American Chemical Society, Washington, 1996.
Liess, M. and Schulz, R., in: Nollet, L.M.L., Editor, Handbook of Water Analysis, Chapter 1: Sampling Methods in Surface Waters, Marcel Dekker, New York, 2000.
Wardencki, W. and Namiesnik, J., in: Pawliszyn, J, Editor, Sampling and sample preparation for field and laboratory. Fundamentals and new directions in sample preparation, Chapter 2: Sampling water and aqueous solutions, Elsevier, Amsterdam, 2002.
Madrid, Y. and Zayas, Z.P., Water sampling: Traditional methods and new approaches in water sampling strategy, *Trends Anal. Chem.,* 26, 4, 2007.
Hildebrandt, A., Lacorte, S. and Barcelo, D., Sampling of water, soil and sediment to trace organic pollutants at a river-basin scale, *Anal. Bioanal. Chem.*, 386, 1075, 2006.
Zhang Chunlong, Fundamentals of environmental sampling and analysis, John Wiley and Sons, Hoboken, New Jersey, 2007
Copy of PP lectures

Pre-Requisites:

Any module(s) which must have been taken prior to the current module, or any specific background required to take this module.

Basics of Analytical Chemistry
AM101Water Directive and CN standards

Module Title:
WATER- METAL ANALYSIS

Module Code:
AM0104

Maximum Number of Students:
20

Total ECTS Credits
2

Notional Learning Hours
(a) Contact Time - 10 h
(b) Private Study - 10 h

Format of Teaching:
Lectures 10 h
Laboratories or Practicals 0 h
Other 0 h

Teaching Strategy:
Formal lectures in 60/90 min timetable.

Convener:
M.D. Galindo Riaño

University:
University of Cádiz

Language of Tuition:
English

Module Description - The Purpose or Aims:

1. To introduce on the topic of water in the environment and metal analysis.
2. To introduce general strategies for metal analysis
3. To introduce fundamentals of the most important techniques for metal analysis in water.
4. To define the concept of metal speciation
5. To understand the importance of important principles of environmental analysis: planning, sampling, representativeness, precision and accuracy, validation, measurement and quality assurance.

Learning Outcomes:

At the end of the module the learner is expected to be able to:

1. Know the importance of metals in water and define appropriately the origin, distribution, different chemical forms and types of chemical interaction among metals species in water
2. Detail the most important techniques of sampling, handling, preservation, pretreatment and preconcentration of water for metal analysis.
3. Correctly report the different commonly techniques for metal analysis and their applicability depending on water matrices, chemical forms of the elements and the metal concentration in water.
4. Know the importance of speciation analysis.
5. Manage the quality assurance in water analysis.

Summary of Course Content:

Water has an important significance as an integral part of the environment and it is essential to man and to all living beings. However, the impacts of human activities on environmental systems and in particular chemical pollution are becoming increasingly important issues. Ensuring availability of adequate amounts of water of appropriate quality is crucial task in protecting the environment.
Water contains naturally occurring components and contaminants. Metals belong one of types of substances that are presented in water and can be classified into non-toxic and toxic.
This course deals with various aspects of the significance and determination of metals in different types of water at macro, micro and trace concentrations. Their origin, distribution, different chemical forms and types of chemical interaction among metals species in water will be considered.
Analysis of water may seem simpler. However, natural water matrices vary wide in composition and laboratories deal with samples ranging from rain, hard river, lake, sea or estuarine waters. Therefore, the contents of most metals are below the limits of detection of the majority of direct methods and pre-treatment and preconcentration of samples are usually required. The choice of methods for determination of metals will depend on factors as sensitivity, accuracy, available equipment, costs, etc., in addition to the chemical form of the element to be determined and to matrix effects.
Metal determinations are preferentially carried out by flame or flameless atomic absorption spectroscopy, voltammetric stripping and spectrophotometry. They are commonly used in routine analyses. Kinetic methodology and neutron activation technique are more advantageously.
Speciation analysis is concerned with the determination of the forms in which a given element occurs in water. They are usually conducted for to study the transport and biogeochemical cycling processes and to predict their biological impact. They rely on both chemical and physical criteria, being chemical speciation very important in controlling metal toxicity and bioavailabity to biota. Hyphenated techniques for speciation analysis focus on the determination of redox species of metals and the discrimination between inorganic and organometallic species in water samples. Gas chromatography and HPLC are widely used for that.

Transferable Skills Taught:

Communication:

To be able to select and report the selection of a method of analysis depending on the type of water, the metal, and its concentration in water.

Interpersonal skills:

Elaborate and show a group written assignment

Assessment Methods:

1. LO1 – Written Examination (20%)
2. LO2 – Written Examination (20%)
3. LO3 – Written Examination (20%)
4. LO4 – Work assignment (20%)
5. LO5 – Group Work Discussion (20%)

Assessment Criteria:

Treshold

To correctly describe the concepts related to LO1, LO2, LO3, LO4 and LO5.

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Good

To correctly describe and apply the concepts, and establish correlations between aspects included in LO1, LO2, LO3, LO4 and LO5.

Excellent

To correctly describe and apply the concepts and establish correlations between aspects included in LO1, LO2, LO3, LO4 and LO5, and to be able to choose the best analytical method for metal analysis in water, determining the best analytical methodology and knowing the reason for its election.

Resource Implications of Proposal and Proposed Solutions:

Lecture notes will be available for students.
Recommended reading:

- E. Popek. “Sampling and analysis of Environmental Chemical Pollutants. A complete guide”. Elsevier. California (USA), 2003.
- J.R. Dean. “Methods for Environmental Trace Analysis”. Elsevier. Texas (USA), 2003.
- D. Barceló. “Environmental Analysis. Techniques, applications and quality assurance”. 2ª ed. Elsevier, Amsterdam, 1996.
- D. Pérez Bendito and S. Rubio. “Environmental Analytical Chemistry”. Comprehensive Analytical Chemistry, Vol. XXXII. Elsevier, Amsterdam 1998.
- B.B. Kebbekus, S. Mitra. “Environmental Chemical Analysis”. Stanley Thornes, 2000.
- APHA-AWWA-WPCF. "Standard Methods for the Examination of Water and Wastewater”, 21 ed., 2005.

Module Title:
Please provide a module title which should have only 30 characters including punctuation and spaces .
Water. Analysis of Organic Components

Module Code:
Please code according to the code QM-xx-xx, AM-xx-xx or DA-xx-xx
AM0105

Maximum Number of Students:
Please include any limitation on the number of students able to take the module.
30 students

Total ECTS Credits
This should be the sum of the credits for each of the semesters in which the module is to run.
2

Notional Learning Hours
(a) Contact Time - 15_____h
(b) Private Study - _ 5 ___ h

Format of Teaching:

Lectures	12_____h
Laboratories or Practicals	_3_____h
Other	_ ____h

Teaching Strategy:
Please show how the contact hours are to be allocated in terms of the type of class involved.
Lectures will cover the scope of organic water pollution and its monitoring, problems related to determination of organic water pollutants, techniques of sample preparation and of final determination of organics in water
The students in 3-4 person groups will carry out analysis of a water sample for content of some organic constituent/s (either COD, or total organic carbon, or individual organic compounds), depending on instrumentation available

Convener:
The name of the member of permanent staff responsible for the module.
Prof. Bogdan Zygmunt

University / Department:
The name of the University and Department responsible for the module.
Gdansk University of Technology, The Chemical Faculty, Department of Analytical Chemistry

Language of Tuition:
Please state whether module is to be taught through the medium of English or another language. If bi-lingual please indicate % of each language
English

Module Description - The Purpose or Aims:
This should specify the purpose of the module where it fits into the programme specification and what it aims to provide. Please list the Aims in numerical order.
1. To show the extent of water pollution with organic compounds
2. To provide the students with the techniques of sample preparation for final analysis
3. To provide the principles of techniques (and modern instrumentation) used in final determination of organics in water (mainly gas and liquid chromatography)
4. To form skills in students to choose and apply a given sample preparation technique to isolate and enrich selected pollutant/s from water
5. To form skills to perform determination of selected pollutant/s in the concentrate obtained

Specific Learning Outcomes for this module: (contributing to general learning outcomes GLO 1 – GLO 10)
Learning Outcomes should provide statements which articulate what the student has achieved upon completion of the course. What will a student know, understand or be able to do?

After completion of this module the student will know the problems of trace organic pollutants determination in water, the respective techniques and principles of sample preparation and final determination (GLO3, 4, 6).

Summary of Course Content:
This should be a summary paragraph of list of the topics to be covered by the module.
1. common organic water pollutants
2. problems of determination of organic trace pollutants
3. overview of sample preparation,
4. principles of extraction of semi-volatile and non-volatile organic pollutants
5. extraction of volatile organic compounds (static headspace, dynamic headspace, azeotropic and vacuum distillation);
6. principle of separation techniques (gas and liquid chromatography, and capillary electrphoresis, hyphenated techniques)
7. analytical procedures for some organics in water
8. future trends in determination of trace organics in water

Transferable Skills Taught:
Please list in numerical order the key skills taught e.g. communication, information technology, interpersonal skills, teaching/study skills. Please relate these to benchmark statements.

This module will improve students communication and study skills.

Assessment Methods:

Details of assessment methods should include forms of assessment and the contribution of each to the summative assessment of the module. The relationship to the learning outcomes of the module should be explicit and the numbers of the various learning outcomes should be attached to the assessment methods listed. Please list in numerical order

The student will be assessed on the introductory test before the laboratory experiment, the report and a short written test

Assessment Criteria:

Details of assessment methods should include forms of assessment and the contribution of each to the summative assessment of the module. The relationship to the learning outcomes of the module should be explicit and the numbers of the various learning outcomes should be attached to the assessment methods listed. Please list in numerical order.

Treshold: Achieving 50% score at the closed written exam and introductory test and presenting the report

Good: Minor errors in the closed written exam and introductory test and presenting the report accepted at the first presentation

Excellent: Almost perfect closed written exam and introductory test and presenting the report accepted at the first presentation

Resource Implications of Proposal and Proposed Solutions:

Details on any resources required and should be included. Please also list e.g core texts; recommended reading material; equipment; films etc.

Nollet, L.M.L., Editor, Handbook of Water Analysis, Marcel Dekker, New York, 2000.
Poole C.F., Poole S.K., Chromatography today, Elsevier, Amsterdam1991.
Crompton, T. R. Determination of Organic Compounds in Natural and Treated Waters, Spon Press, Internet 1999
Zhang Chunlong, Fundamentals of environmental sampling and analysis, John Wiley and Sons, Hoboken, New Jersey, 2007
Methods and Guidance for the Analysis of Water (Official EPA Versions), *Environmental Protection Agency*
Copy of PP lectures

Pre-Requisites:

Any module(s) which must have been taken prior to the current module, or any specific background required to take this module.

Basics of Analytical Chemistry
AM101Water Directive and CN standards

Module Title:
Please provide a module title which should have only 30 characters including punctuation and spaces .
Introduction to Measurement Uncertainty

Module Code:
Please code according to the code QM-xx-xx, AM-xx-xx or DA-xx-xx
DA0201

Maximum Number of Students:
Please include any limitation on the number of students able to take the module.
30

Total ECTS Credits
This should be the sum of the credits for each of the semesters in which the module is to run.
10

Notional Learning Hours
(a) Contact Time - 10 h
(b) Private Study - 40 h

Format of Teaching:

Lectures	6 h
Laboratories or Practicals	4 h
Other	0 h

Teaching Strategy:
Please show how the contact hours are to be allocated in terms of the type of class involved.
Formal lectures in 60/90 min timetable and application examples of the evaluation of the uncertainty associated with single analytical steps and simple chemical measurements.

Convener:
The name of the member of permanent staff responsible for the module.
I. Cavaco

University / Department:
The name of the University and Department responsible for the module.
University of Algarve

Language of Tuition:
Please state whether module is to be taught through the medium of English or another language. If bi-lingual please indicate % of each language
English

Module Description - The Purpose or Aims:
This should specify the purpose of the module where it fits into the programme specification and what it aims to provide. Please list the Aims in numerical order.
1. To motivate students for the importance of the evaluation of the measurement uncertainty
2. To introduce the concept of measurement uncertainty
3. To introduce the principles of the ISO guide to the expression of uncertainty in measurement (GUM)

Specific Learning Outcomes for this module: (contributing to general learning outcomes GLO 1 – GLO 10)
Learning Outcomes should provide statements which articulate what the student has achieved upon completion of the course. What will a student know, understand or be able to do?

At the end of the module the learner is expected to be able to:
1. Establish the traceability of a simple chemical measurement
2. Estimate the uncertainty associated with single analytical steps (volumetric, gravimetric and instrumental quantification steps)
3. Estimate the uncertainty associated with simple chemical measurements
4. Evaluate the compliance of a sample with a legal or specification limit considering the measurement uncertainty.

Summary of Course Content:
This should be a summary paragraph of list of the topics to be covered by the module.
This module aims to motivate students for the need for reporting measurements traced to adequate chemical references and with an objective estimation of their quality (i.e. measurement uncertainty).
Basic concepts in measurement traceability and uncertainty are introduced. The principles of the GUM are presented and applied to the evaluation of the uncertainty associated with simple analytical methods.

Transferable Skills Taught:

Please list in numerical order the key skills taught e.g. communication, information technology, interpersonal skills, teaching/study skills. Please relate these to benchmark statements.

Communication:

Communication with use of metrology terminology

Information Tecnhology:

Elaboration of spreadsheets for the evaluation of measurements uncertainty

Assessment Methods:

Details of assessment methods should include forms of assessment and the contribution of each to the summative assessment of the module. The relationship to the learning outcomes of the module should be explicit and the numbers of the various learning outcomes should be attached to the assessment methods listed. Please list in numerical order

1. *LO1 – final work assignment (50%)*
2. *LO2, LO3 - Homework Assignments (50%)*

Assessment Criteria:

Details of assessment methods should include forms of assessment and the contribution of each to the summative assessment of the module. The relationship to the learning outcomes of the module should be explicit and the numbers of the various learning outcomes should be attached to the assessment methods listed. Please list in numerical order.

Treshold

LO1 – State the relevance of reporting measurements with uncertainty.
LO2 – Clarify the role of measurements traceability on their comparability.
LO3 – Describe how measurement uncertainty should be considered in the evaluation of the compliance of a sample with a legal or specification limit.

Good

LO1 – Distinguish different measurands associated with the analysis of the same analyte in the same item.
LO2 – Describe the traceability of simple chemical measurements.
LO3 – Evaluate the uncertainty associated with single analytical steps

Excellent

LO1 – Evaluate the uncertainty associated with simple analytical methods.
LO2 - Develop strategies for the optimization of the cost and performance of an analytical method considering the uncertainty budget.
LO3 – Develop models for the evaluation of “worst-case” uncertainty estimations.

Resource Implications of Proposal and Proposed Solutions:

Details on any resources required and should be included. Please also list e.g core texts; recommended reading material; equipment; films etc.

Lecture notes will be available for students. These will eventually be included in the course textbooks.
Recommended reading: ISO GUM (introductory material), Eurachem/CITAC: Quantifying Uncertainty in Analytical Measurement, 2nd Edition (2000) [http://www.eurachem.org/guides/QUAM2000-1.pdf], Eurachem/CITAC, Traceability in Chemical Measurement (2003) [http://www.eurachem.org/guides/EC_Trace_2003.pdf]

Pre-Requisites:

Any module(s) which must have been taken prior to the current module, or any specific background required to take this module.

QM03 - Traceability
DA01 - Basic Statistics

Module Title:
Foods. Sample treatment

Module Code:
AM 0205

Maximum Number of Students:
20

Total ECTS Credits
2

Notional Learning Hours
(a) Contact Time - 12 h
(b) Private Study - 38 h

Format of Teaching:

Lectures	*8 h*
Laboratories or Practicals	*0 h*
Other	*4 h*

Teaching Strategy:
Formal lectures in 60/90 timetable. Case study sessions in 60/90 timetable.

Convener:
Mercè Granados

University / Department:
Universitat de Barcelona/ Department of Analytical Chemistry

Language of Tuition:
English

Module Description - The Purpose or Aims:

1. To introduce the fundamentals of sample treatment in food analysis.
2. To introduce extraction techniques in the field of food analysis.
3. To introduce clean-up and/or preconcentration techniques.

Specific Learning Outcomes for this module: (contributing to general learning outcomes GLO 1 – GLO 10)

1. Understanding of the principles of extraction.
2. Knowledge of main extraction techniques in the field of food analysis.
3. Knowledge of clean-up techniques and modes.
4. Knowledge of trace analysis methodological aspects.

Summary of Course Content:

A general introduction to food analysis and requirements for sample treatment in this field will be given. Then, the principles of extraction will be presented, and attention will be paid to the most relevant techniques for sample extraction, such as conventional solid-liquid extraction or microwave assisted extraction, ultrasound assisted extraction and pressurized liquid extraction. On the other hand clean-up and/or preconcentration of sample extracts will be discussed and techniques such as liquid-liquid extraction, solid phase extraction or solid phase microextraction will be introduced. Problems related with trace analysis, such as contamination and losses will be discussed. Finally selected sample treatment procedures will be described and discussed.

Transferable Skills Taught:

- Ability to use scientific literature, technical reports, etc.
- Ability to work in small groups.
- Ability to communicate with specific terms related to sample treatment and food terminology.

Assessment Methods:

1. LO1- Written exam (20%)
2. LO2- Written exam (35%)
3. LO3- Written exam (35%)
4. LO4- Written exam (10%)

Assessment Criteria:

Treshold:
LO1- Understanding of the principles of extraction
LO2- Basic knowledge of relevant extraction techniques in the field of food analysis
LO3- Basic knowledge of clean-up techniques and modes
L04- Basic knowledge of trace analysis

Good:
LO1- Good understanding of the principles of extraction
LO2- Advanced knowledge of relevant extraction techniques in the field of food analysis. Ability to discuss about proposed extraction methods from the scientific literature.
LO3- Advanced knowledge of clean-up techniques and modes. Ability to discuss about clean-up methods proposed in the scientific literature
L04- Good knowledge of trace analysis

Excellent:
LO1- Good understanding of the principles of extraction
LO2- Ability to design/optimize an extraction procedure for a given sample/analyte(s)
LO3- Ability to design/optimize a clean-up procedure for a given sample/analyte(s)
L04- Ability to identify potential risks related with trace analysis for a given procedure and to propose alternative solutions.

Resource Implications of Proposal and Proposed Solutions:

Lecture notes will be available for students.

Recommended reading: “Methods for environmental trace analysis”, John R. Dean. John Willey & Sons, 2003.

Moreover selected scientific publications related with sample treatment in food analysis will be provided to the students and used during case study sessions

Module Title:
Foods. Sample treatment

Module Code:
AM 0205

Maximum Number of Students:
20

Total ECTS Credits
2

Notional Learning Hours
(a) Contact Time - 12 h
(b) Private Study - 38 h

Format of Teaching:

Lectures	*8 h*
Laboratories or Practicals	*0 h*
Other	*4 h*

Teaching Strategy:
Formal lectures in 60/90 timetable. Case study sessions in 60/90 timetable.

Convener:
Mercè Granados

University / Department:
Universitat de Barcelona/ Department of Analytical Chemistry

Language of Tuition:
English

Module Description - The Purpose or Aims:

1. To introduce the fundamentals of sample treatment in food analysis.
2. To introduce extraction techniques in the field of food analysis.
3. To introduce clean-up and/or preconcentration techniques.

Specific Learning Outcomes for this module: (contributing to general learning outcomes GLO 1 – GLO 10)

1. Understanding of the principles of extraction.
2. Knowledge of main extraction techniques in the field of food analysis.
3. Knowledge of clean-up techniques and modes.
4. Knowledge of trace analysis methodological aspects.

Summary of Course Content:

A general introduction to food analysis and requirements for sample treatment in this field will be given. Then, the principles of extraction will be presented, and attention will be paid to the most relevant techniques for sample extraction, such as conventional solid-liquid extraction or microwave assisted extraction, ultrasound assisted extraction and pressurized liquid extraction. On the other hand clean-up and/or preconcentration of sample extracts will be discussed and techniques such as liquid-liquid extraction, solid phase extraction or solid phase microextraction will be introduced. Problems related with trace analysis, such as contamination and losses will be discussed. Finally selected sample treatment procedures will be described and discussed.

Transferable Skills Taught:

- Ability to use scientific literature, technical reports, etc.
- Ability to work in small groups.
- Ability to communicate with specific terms related to sample treatment and food terminology.

Assessment Methods:

1. LO1- Written exam (20%)
2. LO2- Written exam (35%)
3. LO3- Written exam (35%)
4. LO4- Written exam (10%)

Assessment Criteria:

Treshold:
LO1- Understanding of the principles of extraction
LO2- Basic knowledge of relevant extraction techniques in the field of food analysis
LO3- Basic knowledge of clean-up techniques and modes
L04- Basic knowledge of trace analysis

Good:
LO1- Good understanding of the principles of extraction
LO2- Advanced knowledge of relevant extraction techniques in the field of food analysis. Ability to discuss about proposed extraction methods from the scientific literature.
LO3- Advanced knowledge of clean-up techniques and modes. Ability to discuss about clean-up methods proposed in the scientific literature
L04- Good knowledge of trace analysis

Excellent:
LO1- Good understanding of the principles of extraction
LO2- Ability to design/optimize an extraction procedure for a given sample/analyte(s)
LO3- Ability to design/optimize a clean-up procedure for a given sample/analyte(s)
L04- Ability to identify potential risks related with trace analysis for a given procedure and to propose alternative solutions.

Resource Implications of Proposal and Proposed Solutions:

Lecture notes will be available for students.

Recommended reading: “Methods for environmental trace analysis”, John R. Dean. John Willey & Sons, 2003.

Moreover selected scientific publications related with sample treatment in food analysis will be provided to the students and used during case study sessions

Module Title:
Functional Foods Analysis

Module Code:
AM0206

Maximum Number of Students:
20

Total ECTS Credits
2

Notional Learning Hours
(a) Contact Time - 10 h
(b) Private Study - 10 h

Format of Teaching:
Lectures *10* h
Laboratories or Practicals 0 h
Other 0 h

Teaching Strategy:
Formal lectures in 60/90 min timetable.

Convener:
M. Palma

University:
University of Cádiz

Language of Tuition:
English

Module Description - The Purpose or Aims:

1. To introduce fundamentals of functional foods and nutraceuticals
2. To introduce fundamentals of analysis of nutraceuticals
3. To illustrate several practical conditions for nutraceuticals' analyses

Learning Outcomes:

At the end of the module the learner is expected to be able to:
1. Correctly recognizing functional foods and nutraceuticals
2. Select adequate analytical methods for analysis of several nutraceuticals
3. Choose between different analytical methodologies for the analysis of nutraceuticals

Summary of Course Content:

Functional foods are going to be presented as a special kind of samples. In some cases functional foods have to be analyzed on line, without sample pre-treatment and without sample modifications. On the other hand, another functional food samples can be destroyed during the analysis. Moreover, depending on the chemical structure of nutraceutical and how it has been added to the food, the most adequate analytical methodology is going to be different. Several analytical methodologies including both chromatographic methods and spectrophotometric methods for the analysis of nutraceuticals will be presented.

Transferable Skills Taught:

Communication:
To be able to describe a functional food and a nutraceutical

Interpersonal skills:
Elaborate and show a group written assignment

Assessment Methods:

1. LO1 – Written Examination (30%)
2. LO2 – Written Examination (30%)
3. LO3 – Group Work Discussion (40%)

Assessment Criteria:

Treshold
LO1 – to correctly describe the concepts of functional foods
LO2 – to be able to identify what analytical technique cannot be applied for some nutraceuticals
LO3 – to determine what analytical methodologies are not useful for the analysis of some functional foods

Good
LO1 – to correctly distinguish between the concepts of functional foods and drug
LO2 – to be able to determine the analytical methodologies capable for the analysis of several nutraceuticals
LO3 –to determine the differences between the capabilities of different analytical methods related to the determinations of nutraceuticals..

Excellent
LO1 – to be able to describe the main advantages of functional foods
LO2 – to be able to choose the best analytical method for different nutraceuticals analysis
LO3 – to be able to determine the best analytical methodology for the analysis of nutraceuticals and functional foods

Resource Implications of Proposal and Proposed Solutions:

Lecture notes will be available for students.
Recommended reading:
"Methods of Analysis for Functional Foods and Nutraceuticals" W J Hurst. CRC Press 2002
"New Techniques in the Analysis of Foods" M. H. Tunick, S. A. Palumbo, P. M. Fratamico. Springer 1998

Module Title:
Extraction methods for solid foods

Module Code:
AM0207

Maximum Number of Students:
20

Total ECTS Credits
2

Notional Learning Hours
(a) Contact Time - 10 h
(b) Private Study - 10 h

Format of Teaching:
Lectures 10 h
Laboratories or Practicals 0 h
Other 0 h

Teaching Strategy:
Formal lectures in 60/90 min timetable.

Convener:
M. Palma

University:
University of Cádiz

Language of Tuition:
English

Module Description - The Purpose or Aims:

1. To introduce fundamentals of the following analytical techniques: ultrasound assisted extraction (UAE), microwave assisted extraction (MAE) and pressurized fluid extraction (PFE)
2. To introduce the special problems working on the extraction of compounds from solid samples, specifically solid foods
3. To show the problems related with the stability of samples under different extraction conditions

Learning Outcomes:

At the end of the module the learner is expected to be able to:
1. Correctly describe the principles of the extraction techniques for solid foods
2. Select the most adequate extraction technique on the basis on the kind of compounds they are trying to extract
3. Correctly develop and optimize an extraction method

Summary of Course Content:

The fundamentals and limitations of ultrasound assisted extraction, microwave assisted extraction and pressurized fluid extraction are going to be introduced. Moreover, the applicability of these extraction techniques to field of food analysis is going to be also introduced. Several applications are going to be presented in order to make the students able to choose the best extraction technique on the basis of the composition of the food sample.

Transferable Skills Taught:

Communication:
Ability to write a laboratory report

Information Tecnhology:
Optimization of extraction methods

Assessment Methods:

1. LO1 – Written Examination (20%)
2. LO2 – Written Examination (50%)
3. LO3 – Group Work Discussion (30%)

Assessment Criteria:

Treshold
LO1 – to correctly describe the components of a given extraction system (UAE, MAE and PFE) system
LO2 – to be able to identify if what extraction technique(s) can be applied for some compounds
LO3 – to identify the most important extraction variables for each extraction technique

Good
LO1 – to identify what kind of samples can be extracted in each extraction system
LO2 – to be able to determine what compound cannot be extracted by some extraction techniques
LO3 – to be able to determine the influence of different extraction variables on the recovery

Excellent
LO1 – to be able to determine the operational conditions for each extraction techniques
LO2 – to be able to choose the most adequate extraction technique depending on the compound to be extracted
LO3 – to develop an extraction method

Resource Implications of Proposal and Proposed Solutions:

Lecture notes will be available for students.
Recommended reading:
"Analytical Chemistry", R. Kellner, J.M. Mermet, M. Otto, H.M. Widmer, Wiley-VCH Verlag, Weinheim, Germany, 1998.
“Supercritical Fluid Extraction” L. Taylor. Wiley, New York, 1996
“Handbook on Analytical Separations” R.M. Smith Ed. Vol. 3. “Environmental Analysis” W. Kleibohmer. Elsevier, 2004.

Module Title: Clinical Pathology

Module Code: AM0304

Maximum number of students: 10

Total ECTS: 2 credits

Notional learning hours:

(a) Contact time – 10
(b) Private study - 40

Format of teaching:

Lectures	8
Laboratories or Praticals	2
Other	0

Teaching Strategy:

Formal lectures in 120 min. timetable

Convener:

Isabel Cavaco

University:

University of Algarve

Language of tuition:

English

Module Description – The Purpose of aims

1. To motivate students for the importance to study haematological malignancies and immunodeficiency disorders;
   Pathogenesis and spectrum of diseases;
2. Laboratory diagnosis.

Learning Outcomes:

1. Haematopoiesis: cells in blood and their precursors;
2. Erythrocytes disorders;
3. Leucocytes disorders;
4. Platelets disorders;
5. Autoimmunity, Autoimmune diseases;
6. Laboratory practices.

Summary of Course Content:

This module aims to motivate the learners to:

- Clinical features;
- Laboratory assays useful in the diagnosis of haematological malignancies and immunodeficiency disorders;
- Course.

Transferable Skills Taught:

Theorical classes using data-show.
Exercise and problems solving, giving articles and lecture notes.

Assessment Methods:

Individual work.
Students must elaborate a protocol for diagnosis, consultation and control relative to the following subjects:

1. Systemic Lupus Erythematosous;
2. Rheumatoid Arthritis;
3. Von Willebrand's Disease;
4. Haemophilia A;
5. Thalassemia;
6. Acute Linphoblastic Leukaemia .

Assessment criteria:
Individual work:

Organization of the protocol for items		0-20 points
Content of the protocol	Theorical knowledge	0-20 points
	Criteria for laboratorial and clinical diagnosis	0-20 points
	Procedures	0-20 points
Global presentation and findings		0-20 points
FINAL CLASSIFICATION		**100 points**

Resource Implications of Proposed Solutions:
Lecture notes will be available for students. Will be included textbooks.
Recommended readings:

- Hematology: Principles and procedures, Barbara A Brown;
- Hematology, Clinical and laboratory practice, Bick, Bennett, Brunes, Cline, Kass, Murano, Shohet; Mosby;
- Henry's Clinical Diagnosis and Management by Laboratory Methods, 21 st edition; Saunders.

Module Title: Medical Microbiology

Module Code: AM307

Maximum number of students:

Total ECTS credits: 2

Notional learning hours:

Contact time - 10
Private study - 40

Format of teaching:

Lectures 7
Laboratories or Praticals: 3
Other

Teaching Strategy:

Formal lectures in 120 min timetable

Convener:

Isabel Cavaco

University:

University of Algarve

Language of tuition: English

Module Description – The Purpose of aims

1. To motivate students for the importance to study medical microbiology:
   Signs and symptoms of infection and infectious diseases;
   Pathogenesis and spectrum of diseases;
2. Role of the microbiology laboratory in the diagnosis of infectious diseases (Bacteria, blood and tissue protozoa).
3. Phases of the diagnostic cycle (preanalytic, analytic and postanalytic)
4. Approach to prevention and epidemiology.

Learning Outcomes:

At the end of the module, the learner is expected to be able to:

1. Approach to microbial classification of bacteria:
   Procedures for identification of bacteria: direct detection, stains, cultivation and immunoserodiagnosis.
2. Recognize some medical important organisms (Bacteria, blood and tissue protozoa):
   Gram-Negative:Bacilli, Coccobacilli (*Pseudomonas*, *Enterobacteriaceae*, *Haemophilus*, *Legionella*) and Cocci (*Neisseria*).
   Gram-Positive Cocci (*Staphylococcus* and *Streptococcus*)
   Mycobacteria tuberculosis
   Blood and tissue parasites (*Plasmodium spp, Trypanosoma sp, Leihsmania donovani*).

Summary of Course Content:

This module aims to motivate the learners that clinical data derived from proper procedures and accurate test results are essential to make appropriate diagnosis and administer the proper therapy to patients.
Provide users with recommendations for the collection and transport of specimen, procedures for specimen processing and identification of bacteria.

Transferable Skills Taught:

Theorical classes using data-show.
Exercise and problems solving, giving articles and lecture notes.

Assessment Methods:
Students must elaborate a pamphlet about one of the following subjects:

1. Legionellosis
2. Meningitis
3. Tuberculosis
4. Malaria
5. Leishmaniasis
6. Chaga's Disease

Assessment criteria: Individual work.

Organization of the pamphlet	0-20
Content of the work	
Theorical knowledge	0-15
Criteria for laboratorial and clinical diagnosis	0-15
Procedures	0-15
Consideration by the target audience	0-15
Global presentation and findings	0-20
FINAL CLASSIFICATION	**0-100**

Resource Implications of Proposed Solutions:
Lecture notes will be available for students. Will be included textbooks.
Recommended reading:

- Henry's Clinical Diagnosis and Management by Laboratory Methods, 21 st edition; Saunders
- Pathologic basis of disease, Cotran, Kumar, Collins, 6th Edition, Sauders Company
- Color atlas and textbook of Diagnostic Microbiology, Elmer Koneman, 6th Edition, Lippincott Williams & Wilkins.

Module Title: Medical Microbiology

Module Code: AM307

Maximum number of students:

Total ECTS credits: 2

Notional learning hours:

Contact time - 10
Private study - 40

Format of teaching:

Lectures 7
Laboratories or Praticals: 3
Other

Teaching Strategy:

Formal lectures in 120 min timetable

Convener:

Isabel Cavaco

University:

University of Algarve

Language of tuition: English

Module Description – The Purpose of aims

1. To motivate students for the importance to study medical microbiology:
   Signs and symptoms of infection and infectious diseases;
   Pathogenesis and spectrum of diseases;
2. Role of the microbiology laboratory in the diagnosis of infectious diseases (Bacteria, blood and tissue protozoa).
3. Phases of the diagnostic cycle (preanalytic, analytic and postanalytic)
4. Approach to prevention and epidemiology.

Learning Outcomes:

At the end of the module, the learner is expected to be able to:

1. Approach to microbial classification of bacteria:
   Procedures for identification of bacteria: direct detection, stains, cultivation and immunoserodiagnosis.
2. Recognize some medical important organisms (Bacteria, blood and tissue protozoa):
   Gram-Negative:Bacilli, Coccobacilli (*Pseudomonas*, *Enterobacteriaceae*, *Haemophilus*, *Legionella*) and Cocci (*Neisseria*).
   Gram-Positive Cocci (*Staphylococcus* and *Streptococcus*)
   Mycobacteria tuberculosis
   Blood and tissue parasites (*Plasmodium spp, Trypanosoma sp, Leihsmania donovani*).

Summary of Course Content:

This module aims to motivate the learners that clinical data derived from proper procedures and accurate test results are essential to make appropriate diagnosis and administer the proper therapy to patients.
Provide users with recommendations for the collection and transport of specimen, procedures for specimen processing and identification of bacteria.

Transferable Skills Taught:

Theorical classes using data-show.
Exercise and problems solving, giving articles and lecture notes.

Assessment Methods:
Students must elaborate a pamphlet about one of the following subjects:

1. Legionellosis
2. Meningitis
3. Tuberculosis
4. Malaria
5. Leishmaniasis
6. Chaga's Disease

Assessment criteria: Individual work.

Organization of the pamphlet	0-20
Content of the work	
Theorical knowledge	0-15
Criteria for laboratorial and clinical diagnosis	0-15
Procedures	0-15
Consideration by the target audience	0-15
Global presentation and findings	0-20
FINAL CLASSIFICATION	**0-100**

Resource Implications of Proposed Solutions:
Lecture notes will be available for students. Will be included textbooks.
Recommended reading:

- Henry's Clinical Diagnosis and Management by Laboratory Methods, 21 st edition; Saunders
- Pathologic basis of disease, Cotran, Kumar, Collins, 6th Edition, Sauders Company
- Color atlas and textbook of Diagnostic Microbiology, Elmer Koneman, 6th Edition, Lippincott Williams & Wilkins.

Module Title:
Urine and Body Fluid Analysis

Module Code:
AM0305

Maximum number of students:12

Total ECTS credits:
2

Notional learning hours:
(a) Contact time – 10h
(b) Private study – 40h

Format of teaching:

Lectures	6h
Laboratories or Praticals	4h
Other	0h

Teaching Strategy:
Formal lectures in 120 min timetable

Convener:
Isabel Cavaco

University:
University of Algarve

Language of tuition:
English

Module Description – The Purpose of aims

1. To motivate students for the importance of study and examination of the urine and other body fluid, as an important laboratory function
2. To introduce the concepts for the collection and transport of urine and body fluids, numeration and identification of cellular components.
3. To introduce the recommendations for standardizing and guidance for qualitative and quantitative assessment of body fluids.

Learning Outcomes:
At the end of the module, the learner is expected to be able to:

- Justify clearly the importance of pre-analytic, analytic and post-analytic steps.
- Appropriate laboratory examination of these fluids for the diagnosis numerous diseases.
- Accurate test interpretation depends on appropriate specimen collection, turnaround time, physician/laboratory communication and reliable reference values.
- Analysis of body fluids in the clinical laboratory:
    1. Urine
    2. Cerebrospinal fluid
    3. Synovial fluid
    4. Pleural fluid
    5. Pericardial fluid
    6. Peritoneal fluid

Summary of Course Content:
This module aims to motivate the learners that clinical data derived from proper body fluid procedures and accurate test results are essential to make appropriate diagnosis and administer the proper therapy to patients.
Provide users with recommendations for the collection and transport of body fluids,

procedures for the numeration and identification of cellular components and guidelines for the qualitative and quantitative assessment of body fluids.
Transferable Skills Taught: Lectures, case studies and laboratory practices.
Assessment Methods: The assessment of the module will be conducted by a written test.
Assessment criteria: The examination criteria will be the ECTS gradin scale, according to the grading system in EMQAL.
Resource Implications of Proposed Solutions: Lecture notes will be available for students. Will be included textbooks. Recommended reading: • Hematology: Principles and procedures, Barbara A Brown. • Hematology, Clinical and laboratory practice, Bick, Bennett, Brunes, Cline, Kass, Murano, Shohet; Mosby • Urinalysis and body fluids, Susan King Strasinger; F.A Davis Company • Henry's Clinical Diagnosis and Management by Laboratory Methods, 21 st edition; Saunders • Clinical and Laboratory Standards Institute H56-A

Module Title:
Fundamentals of Biochemical Analysis

Module Code:
AM0309

Maximum Number of Students:
20

Total ECTS Credits
2

Notional Learning Hours
(a) Contact Time - 10 h
(b) Private Study – 40 h

Format of Teaching:
Lectures 10h

Teaching Strategy:
Formal lectures in 60/90 min timetable.

Convener:
Vera Ribeiro

University / Department:
University of Algarve/Department of Chemistry, Biochemistry and Pharmacy

Language of Tuition:
English

Module Description - The Purpose or Aims:

1. To provide the basis and practical aspects of the methodologies which are commonly used in a biochemistry and molecular biology laboratory for the preparation and characterisation of macromolecules and the study of their interactions.
2. To present specific examples of application, focusing on clinical correlations and significance of results.

Specific Learning Outcomes for this module: (contributing to general learning outcomes GLO 1 – GLO 10)

At the end of the module the learner is expected to be able to:
1. correctly describe the principles underlying the most commonly used methods in biochemical analysis
2. propose strategies for the isolation, characterization or quantification of a biomolecule in a specific tissue or clinical setting

Summary of Course Content:

Overview of the most commonly used methods of macromolecule purification (centrifugation, chromatography, electrophoresis), characterization (eg. sequencing, tryptic digest, mass spectrometry, prediction of protein sequence from DNA, prediction/determination of structure), quantification (enzymatic and immunological techniques) and cellular localization (eg. immunohistochemistry, in situ hybridization, fluorescent fusion proteins).

Transferable Skills Taught:

Communication:
Writing literature-based reports
Information Technology:
Use of Web resources for database search (literature, sequences, structure)

Assessment Methods:
1. LO1 and LO2 – Written Examination (format to be decided - either a test or an essay about one specific topic)

Assessment Criteria:

Threshold
LO1 – to correctly describe the principles of a given biochemical technique
LO2 – to identify the information that can be obtained from each technique

Good
LO1 – to describe the advantages and limitations of each method
LO2 – to be able to choose the most adequate technique to solve a specific biological/clinical problem

Excellent
LO1 – to understand the most recent and emergent technological developments in biochemistry/molecular biology
LO2 – to be able to design complex experimental approaches to analyse biological molecules *in vivo* or *in vitro*

Resource Implications of Proposal and Proposed Solutions:

Lecture notes and selected papers will be available for students.

Recommended reading:

Burtis,CA, Ashwood, ER, Bruns, DE, Tietz Fundamentals of Clinical Chemistry, Saunders 2007, ISBN 0721638651
Wilson, K, Walker, JM, Principles and techniques of practical biochemistry, Cambridge University Press1994, ISBN 0-521-42809-2
Plummer, D, Introduction to practical biochemistry, McGraw-Hill 1987, ISBN 0-07-084165-9

Module Title:
Genetic Testing

Module Code:
AM0310

Maximum Number of Students:
20

Total ECTS Credits
2

Notional Learning Hours
(a) Contact Time - 15 h
(b) Private Study – 35 h

Format of Teaching:
Lectures 10h
Laboratories or Practicals 5h

Teaching Strategy:
Formal lectures in 60/90 min timetable. One 5h laboratory practical.

Convener:
Vera Ribeiro

University / Department:
University of Algarve/Department of Chemistry, Biochemistry and Pharmacy

Language of Tuition:
English

Module Description - The Purpose or Aims:

1. To provide the basis and practical aspects of the methodologies available for genetic testing
2. To present specific examples of application, focusing on clinical correlations, significance of results as well as ethical aspects.

Specific Learning Outcomes for this module: (contributing to general learning outcomes GLO 1 – GLO 10)

At the end of the module the learner is expected to be able to:
1. correctly describe the principles underlying the most commonly used methods in molecular diagnostics
2. propose strategies for the characterization of specific genetic traits in individuals and the detection/quantification of gene expression levels in organisms, tissues or cells.
3. correctly perform genotyping tests and interpret the results

Summary of Course Content:

Nature of the hereditary material and the flow of information from DNA to protein. Inter-individual genetic variability and its impact in the predisposition to disease and in the response to therapeutics. The Human Genome Project. Genetic polymorphisms. Restriction digestion and electrophoresis. Southern and Northern blotting. DNA sequencing (chemical, chain termination, pyrosequencing). Recombinant DNA. Polymerase chain reaction (PCR) and PCR-based techniques (PCR-RFLP, PCR-ARMS, PCR-ASO, OLA, SSCP). Real-time PCR. Microarrays. Applications: microbiology, GMOs, forensics, prenatal/newborn screening, disease risk testing, pharmacogenetics. Benefits and risks of gene testing.

Transferable Skills Taught:

Communication:
Writing literature-based reports and practical reports
Information Technology:
Use of Web resources for database search (literature, DNA sequence)

Assessment Methods:

1. LO1 and LO2 – Written Examination, 75% (format to be decided - either a test or an essay on one specific topic)
2. LO3 – lab report, 25%

Assessment Criteria:

Threshold
LO1 – to correctly describe the principles of a given technique used in genetic testing
LO2 – to identify the information that can be obtained from each technique
LO3 – to adequately perform a genotyping protocol

Good
LO1 – to describe the advantages and limitations of each method
LO2 – to be able to choose the most adequate technique to answer a specific biological/clinical question
LO3 – to correctly assign the individual genotype for a specific gene polymorphism

Excellent
LO1 – to understand the most recent and emergent technological developments in genotyping strategies
LO2 – to be able to discuss the implications of the results that can be obtained as well as the ethical issues involved
LO3 - to critically analyse the lab results obtained in terms of clinical outcome

Resource Implications of Proposal and Proposed Solutions:

Lecture notes and selected papers will be available for students.

Recommended reading:

Hartl, DL, Jones, EW Genetics / analysis of genes and genomes, 2000, ISBN 0-7637-0913-1

Module Title:
Neonatal Screening for Congenital Diseases

Module Code:
AM0312

Maximum Number of Students:

15

Total ECTS Credits

2

Notional Learning Hours
(a) Contact Time - 10 h
(b) Private Study - 40 h

Format of Teaching:

Lectures	10 h
Laboratories or Practicals	0 h
Other	0 h

Teaching Strategy:
Please show how the contact hours are to be allocated in terms of the type of class involved.

Formal lectures in 120 min timetable.

Convener:

Susana Etcheverry

University / Department:
National University of La Plata, Biological Sciences Department

Language of Tuition:

English

Module Description - The Purpose or Aims:

1 To motivate students about the importance of Newborn Screening as part of Health Prevention Programs, with emphasis in the organization, components and structure of a Newborn Screening Laboratory, the selection criteria for diseases to be screened, and the implementation of Quality Systems in Neonatal screening laboratories.
2. Introduction to the clinical and the biochemical bases and methods for detection of the most frequent congenital diseases: PKU and Congenital hypothyroidism
3. Brief mention to other pathologies currently involved in Newborn Screening Programs

Specific Learning Outcomes for this module: (contributing to general learning outcomes GLO 1 – GLO 10)

At the end of the module the learner is expected to be able to:

1. Understand clearly the importance of Newborn Screening Program in the frame of a prevention health system.
2. Highlight the importance of Quality Systems in Newborn screening Laboratories.
3. Recognize the elements required in the structure of a Newborn Screening Laboratory and the components of a Quality System.
4. Identify correctly the criteria for including pathologies in a Newborn Screening Program.
5. Understand clearly the clinical and biochemical bases of PKU and Congenital hypothyroidism
6. To develop students abilities to address the methodological strategies for the detection of other pathologies subjected to Newborn Screening

Summary of Course Content:

This module aims to motivate the students to understand the need of a Newborn Screening Program in the frame of a Public Health Systems and also to emphasize the importance of Quality Systems in the laboratories.
The identification of the variables in the pre-analytical and post analytical processes; method validation and the development of an integral Quality System
The application, in detail, of the previous concepts to the Newborn Screening for PKU and Congenital Hypothyroidism
Brief description of clinical and biochemical bases of other pathologies included in Newborn Screening Programs

Transferable Skills Taught:

IInformation Tecnhology:

Web searching for Procedure Manuals of different Newborn Screening Programs

Communication:

Communication with use of terminology based on **Lexicon** version 8
http://www.isns-neoscreening.org/pdf/Lexicon8.pdf

Assessment Methods:

Students will be organized in five groups of three persons and:

I) . Each group will give a short seminar (30 min) for the whole class related to the NS of one of the following congenital diseases, included in the bibliography

1. *Galactosemia*
2. *Congenital Adrenal Hyperplasia*
3. *Maple Syrup Urine Disease*
4. *Biotinidase Deficiency*
5. *Cystic Fibrosis*

Probably discussion of a short simple paper could be included.

or

II) A short written presentation of one of the above topics performed by each group of three students

Assessment Criteria:

Threshold Student has Newborn screening (NS) concepts but is not able to plan or interpret a NS Program

Good: has the criteria for NS but with limitations in methods validation or the implementation of a NS Program

Very good: has the criteria for NS, methods validation and implementation of a NS Program but he is not able to implement an Integral Quality Control System

Excellent: has the criteria for NS, methods validation and he is able to develop a complete Newborn Screening Program

Resource Implications of Proposal and Proposed Solutions:
Details on any resources required and should be included. Please also list e.g core texts; recommended reading material; equipment; films etc.

Lecture notes will be available for students. These will eventually be included in the course textbooks.
Recommended reading:

-International Atomic Energy Agency (IAEA): Screening of Newborns for Congenital Hypothyroidism. Guidelines for Developing Programs. International Atomic Energy Agency Ed. , Vienna, 2005.
-CLSI: Blood Collection on Filter Paper for Newborn Screening Programs. Aproved Standards.-Fifth edition. CLSI Document LA4-A5, Vol 27 (20), 2007.
-Therrell BL, Panny SR, Davidson A, Eckman J, Hannon WH, Henson MA, Hillard M, Kling S, Levy HL, Meany FJ, MCCabe ERB, Mordaunt V, Pass K, Shapira E and Tuerck J. U.S. Newborn Screening System Guidelines: Statement of rhe Council of Regional Networks for Genetics Services, Screening 1: 135-147, 1992
- Pass KA, Lane PA, Fernhoff PM, Hinton CF, Panny SR, Parks JS, Pelias MZ, Rhead WJ, Ross SI, Wethers DL and Elsas LJ; "U.S. Newborn Screening System Guidelines II: Follow-up of Children, Diagnosis, Management, and Evaluation Statement of the Council of Regional Networks for Genetic Services (CORN)". Journal of Pediatrics 137, S1-S46, 2000.
-Guthrie R. Organization of a Regional Newborn Screening Laboratory, in: Neonatal Screening for Inborn Errors of Metabolism. Bickel H, Guthrie RHammersen G Eds, , Springer-Verlag, Berlin Heidelberg new York 259-270, 1980

Pre-Requisites:

Students may have knowledge of biochemistry, genetics, analytical methods, and quality control

Module Title:
Please provide a module title which should have only 30 characters including punctuation and spaces .
Development of metal compounds for inorganic medicinal chemistry purposes.

Module Code:
Please code according to the code QM-xx-xx, AM-xx-xx or DA-xx-xx
AM0313

Maximum Number of Students:
Please include any limitation on the number of students able to take the module.
50

Total ECTS Credits
This should be the sum of the credits for each of the semesters in which the module is to run.
2

Notional Learning Hours
(a) Contact Time - 10 h
(b) Private Study - 40 h

Format of Teaching:

Lectures	10 h
Laboratories or Practicals	0 h
Other	0 h

Teaching Strategy:
Please show how the contact hours are to be allocated in terms of the type of class involved.
Formal lectures in 60/90 min timetable and, depending on the number of students, seminars

Convener:
The name of the member of permanent staff responsible for the module.
Dinorah Gambino

University / Department:
The name of the University and Department responsible for the module.
University of Algarve
Faculdade de Ciências e Tecnologia

Language of Tuition:
Please state whether module is to be taught through the medium of English or another language. If bi-lingual please indicate % of each language
English

Module Description - The Purpose or Aims:
This should specify the purpose of the module where it fits into the programme specification and what it aims to provide. Please list the Aims in numerical order.

Aims:
1. To get a general background on metal coordination compounds and their current applications in medicinal chemistry
2. To introduce students on main biological targets for metal-based drugs
3. To get insight in the use of selected spectroscopic techniques like IR, Raman, NMR or others as tools for the characterization of metal coordination compounds.

Specific Learning Outcomes for this module: (contributing to general learning outcomes GLO 1 – GLO 10)
Learning Outcomes should provide statements which articulate what the student has achieved upon completion of the course. What will a student know, understand or be able to do?

At the end of the module the student is expected to be able to:
1. Understand the chemical nature of important metal-based drugs, their potential biological targets and the significance of metal nature and chemistry on their biological activity
2. Interpret simple spectroscopic results in order to get knowledge of chemical structure of metal compounds

Summary of Course Content:
This should be a summary paragraph of list of the topics to be covered by the module.

The module aims to involve the students in medicinal chemistry related work. It will involve: a description of nature of metal coordination compounds, medicinal chemistry aspects of bioinorganic chemistry including main therapeutic and diagnostic applications of inorganic compounds and a presentation of metals used for these purposes, some sample compounds and their main biological targets. A description of metal compounds used for chelating therapy, supplementation of essential elements, therapy and diagnosis will be included. In addition, using selected examples features of the application of some selected spectroscopic techniques to characterize metal coordination compounds will be briefly shown.

Transferable Skills Taught:

Please list in numerical order the key skills taught e.g. communication, information technology, interpersonal skills, teaching/study skills. Please relate these to benchmark statements.

1. interpretation of graphical or spectroscopic data
2. reading and comprehension of scientific manuscripts

Assessment Methods:

Details of assessment methods should include forms of assessment and the contribution of each to the summative assessment of the module. The relationship to the learning outcomes of the module should be explicit and the numbers of the various learning outcomes should be attached to the assessment methods listed. Please list in numerical order

Students will take one or two of three possible assessments:

1. Give a short seminar by a small group to the whole class related to a specific topic of the module. Probably discussion of a short simple paper could be included.
2. Short written presentation of a selected topic included in the bibliography, performed by a small group of students
3. Solve a simple spectroscopic example involving for instance IR results of a metal coordination compound.

Assessment Criteria:

Details of assessment methods should include forms of assessment and the contribution of each to the summative assessment of the module. The relationship to the learning outcomes of the module should be explicit and the numbers of the various learning outcomes should be attached to the assessment methods listed. Please list in numerical order.

Treshold: Describe some examples of metal-based drugs and interpret simple spectroscopy results

Good: For a given example of a metal-based drug, describe its action in detail, its biological targets and the relation between metal nature and its biological activity. Infer the chemical structure of a given metal compound from spectroscopy data.

Excellent: Fully understand and clearly describe the relation structure-reactivity in the action of metal-based drugs. Know about mechanisms of action of metal based drugs.

Resource Implications of Proposal and Proposed Solutions:

Details on any resources required and should be included. Please also list e.g core texts; recommended reading material; equipment; films etc.

Lecture powerpoint presentations and some short notes will be available for students.
Recommended reading: Available inorganic biochemistry book including medicinal chemistry topics and basic book including uses of spectroscopy in inorganic chemistry:
For example those available in the Library of the University of Algarve:

- Bioinorganic chemistry, Ivano Bertini
- Biological chemistry of the elements / the inorganic chemistry of life, J.J.R. Fraústo da Silva
- Principles of bioinorganic chemistry, Stephen J. Lippard
- Physical methods in bioinorganic chemistry / spectroscopy and magnetism

Pre-Requisites:

Any module(s) which must have been taken prior to the current module, or any specific background required to take this module.

Basic background in General Chemistry and very basic background on Inorganic Chemistry and on spectroscopy (IR, Raman, NMR).

Module Title:
Natural Water Speciation

Module Code:
AM0501

Maximum Number of Students:
20

Total ECTS Credits
2

Notional Learning Hours
(a) Contact Time - 20h
(b) Private Study - 30h

Format of Teaching:

Lectures	10,5 h
Laboratories or Practicals	8 h
Other	1,5 h

Teaching Strategy:
7 X Formal lectures in 90 min timetable. One 8h laboratory practical.
1 X 90 min tutorial

Convener:
J. P. Pinheiro

University:
University of Algarve

Language of Tuition:
English

Module Description - The Purpose or Aims:

To introduce the fundamentals of equilibrium trace metal speciation and bioavailability
To teach the basic concepts of the analytical techniques used in speciation studies
To illustrate the concepts of measurement of trace metal uptake by organisms
To demonstrate the dynamic nature of trace metal speciation and bioavailability

Learning Outcomes:

At the end of the module the learner is expected to be able to:

1. explain the meaning of trace metal speciation and bioavailability
2. select an adequate speciation technique and develop an experiment to perform trace metal speciation for a given natural sample
3. critically analyse and evaluate the dynamic nature of the biouptake of trace metals by microorganisms and its relation with metal speciation.

Summary of Course Content:

This module will discuss the influence of trace metal speciation on the biouptake of metals by microorganisms in natural waters. An introduction will be given about the thermodynamic trace metal speciation and bioavailability, covering the equilibrium speciation modeling and the Free ion activity model for trace metal biouptake. Then we will introduce the concepts of trace metal dynamic speciation and briefly describe the analytical techniques that are used in its study. Finally we will discuss the problematic of dynamic bioavailability and its consequences regarding both toxic and essential trace metals.

Transferable Skills Taught:

Communication:
Ability to write a laboratory report

Interpersonal skills:
Elaborate a group written assignment

Assessment Methods:

1. LO1 and LO3 – Written Examination (30%)
2. LO2 – Laboratory Work Assignment (30%)
3. LO3 – Group Written Work assignment (40%)

Assessment Criteria:

Treshold
LO1 – to correctly describe the concept of trace metal speciation and bioavailability
LO2 – to identify the different speciation techniques and the when they can be applied
LO3 – to understand the basic relationship between dynamic metal speciation and metal uptake by microorganisms

Good
LO2 – to be able to choose the most adequate speciation technique to perform the analysis of a given sample
LO1 and LO3 – to correctly analyze the influence of changes in the matrix over trace metal speciation and the respective variation on metal biouptake.

Excellent
LO2 – given a set of samples, to choose the best available speciation techniques to analyze each sample and devise an experimental protocol to perform the respective study.
LO1 and LO3 – to quantify the influence of changes in the trace metal speciation on the respective metal biouptake.

Resource Implications of Proposal and Proposed Solutions:

Lecture notes will be available for students.
Recommended reading:
"Metal speciation and bioavailability", A. Tessier e D. Turner (eds.), John Wiley & Sons, New York, 1995.
"In Situ Monitoring of Aquatic Systems: Chemical Analysis and Speciation", J. Buffle and G. Horvai (eds.), John Wiley & Sons, New York, 2000.

Module Title:
Atmospheric analysis

Module Code:
AM0502

Maximum Number of Students:
30

Total ECTS Credits
This should be the sum of the credits for each of the semesters in which the module is to run.
2

Notional Learning Hours
(a) Contact Time - 15__h
(b) Private Study - 5__ h

Format of Teaching:
Lectures 10__h
Laboratories or Practicals 3___h
Other(seminars) 2___ h

Teaching Strategy:
Please show how the contact hours are to be allocated in terms of the type of class involved.
Lectures will cover the following issues: the basic atmospheric chemistry, air pollution, general problems of environmental analysis, sampling, sample preparation for analysis, analytical techniques of final analysis, typical analyzers, air monitoring. Lectures will prepare the students to analyze practical issues and understand and/or design procedures needed in specific practical applications (case studies). Some aspects of air monitoring will be discussed in the form of seminars prepared by the students. The students in 3-5 person groups will carry out analysis of air (depending on instrumentation available).

Convener:

Professor Waldemar Wardencki, PhD, DSc

University / Department:
The name of the University and Department responsible for the module.
Gdańsk University of Technology, Faculty of Chemistry, Department of Analytical Chemistry

Language of Tuition:
English

Module Description - The Purpose or Aims:
This should specify the purpose of the module where it fits into the programme specification and what it aims to provide. Please list the Aims in numerical order.
Specifically the following aims should be achieved:

1. to acknowledge the student with the basic atmospheric chemistry and air pollution.
2. to provide the students with knowledge on the techniques of air sampling
3. to familiarize the students with principles of techniques used for final analysis
4. to provide the students with modern instrumentation (monitors, analyzers) used for air monitoring
5. to form skills in students to choose and apply sampling procedure, sample preparation technique and adequate instrumentation.

Specific Learning Outcomes for this module: (contributing to general learning outcomes GLO 1 – GLO 10)
Learning Outcomes should provide statements which articulate what the student has achieved upon completion of the course. What will a student know, understand or be able to do?

1. Getting general orientation in the scope and opportunities of atmospheric analysis (GLO3)
2. Understanding the advantages and limitations of individual techniques used in analysis of air (GLO3)
3. Learning the instrumentation needed in the techniques, sample pretreatment methods employed, typical analytical procedures (GLO3, 4)
4. Learning by examples (case studies) the application of the techniques in question for solving chosen specific problems in environmental analysis (GLO4, 6)

Summary of Course Content:
This should be a summary paragraph of list of the topics to be covered by the module.
Global atmosphere (structure, physical and chemical parameters of the atmosphere)
Air pollution (classification, emissions, effects)
Atmospheric aerosols (particles, aerosols and clouds)
Environmental monitoring strategies
Sampling techniques for atmospheric samples
Analytical techniques for identification and quantification of reactants and reaction products
Measurements of atmospheric trace gases
Application of biological methods in analysis of atmospheric air pollution
Total parameters for studies of atmospheric air
Remote sensing of pollutants

Transferable Skills Taught:

Please list in numerical order the key skills taught e.g. communication, information technology, interpersonal skills, teaching/study skills. Please relate these to benchmark statements.

Communication: Usage of the relevant terminology

Assessment Methods:

Details of assessment methods should include forms of assessment and the contribution of each to the summative assessment of the module. The relationship to the learning outcomes of the module should be explicit and the numbers of the various learning outcomes should be attached to the assessment methods listed. Please list in numerical order

Final assessment will be done on the basis of a written test, laboratory report and grade for preparation of seminar.

Assessment Criteria:

Details of assessment methods should include forms of assessment and the contribution of each to the summative assessment of the module. The relationship to the learning outcomes of the module should be explicit and the numbers of the various learning outcomes should be attached to the assessment methods listed. Please list in numerical order.

Treshold:

Achieving 50% score at the closed question test and a minimum understanding of the issue covered by the open question.

Good:

Minor errors in the closed question test (in more advanced issues). Solid and thorough covering the open issue.

Excellent:

Almost perfect closed test score. Individually suggested by the student (and accepted by the instructor) case study in the open question issue.

Resource Implications of Proposal and Proposed Solutions:

Details on any resources required and should be included. Please also list e.g core texts; recommended reading material; equipment; films etc.

Recommended textbooks:

1. B.J.Finlayson-Pits, J.N.Pitts, Jr., Atmospheric Chemistry, Fundamentals and Experimental Techniques, John Wiley@ Sons, any edition
2. Zhang Chunlog, Fundamentals of environmental sampling and analysis, John Wiley@ Sons, 2007
3. R.N. Reeve, Environmental analysis, John Wiley@ Sons, 1994

Resources needed: multimedia projector, usage of the laboratory facilities is planned when the module is taught at the home university (otherwise, individual contacts are needed to establish whether an opportunity exists to carry out any lab experiment, if not – seminars will be adequately enhanced).

Pre-Requisites:

Any module(s) which must have been taken prior to the current module, or any specific background required to take this module.

Basics of analytical chemistry

Module Title:
Soil and sediment analysis

Module Code:
AM0503

Maximum Number of Students:
25

Total ECTS Credits
2

Notional Learning Hours
(a) Contact Time - 10 h
(b) Private Study - 40 h

Format of Teaching:

Lectures	10 h
Laboratories or Practicals	0 h
Other	0 h

Teaching Strategy:
Formal lectures in 60/90 min sessions.

Convener:
José Fermín López-Sánchez
Miquel Vidal

University / Department:
University of Barcelona / Department of Analytical Chemistry

Language of Tuition:
English

Module Description - The Purpose or Aims:

- To describe the principal sediment and soil phases and parameters.
- To understand basic concepts and practical aspects of trace element and radionuclide analysis in soil and sediment matrices.
- To acquire basic knowledge on operationally defined procedures for solid speciation.
- To recognize and understand the main problems associated with speciation studies in solid materials.
- To fully understand the current state of standardization and comparability of analytical data in soil and sediment analysis.
- To introduce the fundamentals of pollutant interaction in soils and sediments
- To impart knowledge on the main sorption and desorption experiments to be applied at laboratory level to understand the pollutant interaction in soils and sediments, and to predict pollutant fate in environment.
- To introduce the complexity of the management of contaminated soils and sediments, and of the risk assessment models.

Specific Learning Outcomes for this module: (contributing to general learning outcomes GLO 1 – GLO 10)

SLO 1. Knowledge of the main soil and sediment constituents and how to analyse them.
SLO 2. Understanding of the main chemical processes occurring in soils and sediments.
SLO 3. Understanding of the practical use of analytical techniques in the analyses of soils and sediments.
SLO 4. Knowledge of the main sorption and desorption tests used at laboratory level to examine pollutant interaction in soils and sediments.
SLO 5. Ability to evaluate scenarios of contaminated soils/sediments on the basis of soil/sediment parameters, type and concentration of the pollutant, and understanding of the basic principles of the risk assessment.
SLO 6. Recognize the main problems associated with the analyses of solid materials, and learning of the use of reference materials and validation methods.

Summary of Course Content:

This module explores the fundamental aspects of soil and sediment analysis, focusing on trace element pollutants (heavy metals, metalloids), and radionuclides. Topics that will be discussed include:

- Definition and soil uses. Soil profile and classification. Soil phases. Main soil parameters. Definition and analyses.
- Sediments: origin and composition. Role of sediments in the hydrological cycle.
- Occurrence of trace elements in soils and sediments: from reference to intervention levels.
- Sediment analysis: sampling, characterization and trace element determination.
- Pollutant interaction in soils and sediments. Sorption and desorption experiments. Speciation. Implications for risk assessment.
- Validation of analytical methodologies and use of reference materials.

Transferable Skills Taught:

Ability to communicate with specific terms related to soil/sediment science.
Ability to work in small groups and to elaborate written reports.
Knowledge on how to find information on available reference materials and standardization bodies.

Assessment Methods:

1. Written examination (60 %). Evaluation of SLO1 – SLO6
2. Work assignment (40 %). Evaluation of SLO4- SLO6.

Assessment Criteria:

Details of assessment methods should include forms of assessment and the contribution of each to the summative assessment of the module. The relationship to the learning outcomes of the module should be explicit and the numbers of the various learning outcomes should be attached to the assessment methods listed. Please list in numerical order.

Threshold:
SLO1, SLO2, and SLO3: Basic knowledge on the soil/sediment phases and main parameters, and related analytical techniques.
SLO4 and SLO5: Basic knowledge on the pollutant interaction in soils and sediments.
SLO6: General knowledge about analytical procedures and validation strategies.

Good:
SLO1, SLO2, and SLO3: Ability to describe the soil/sediment phases and main parameters, to recognize their role in processes, and to select the appropriate analytical techniques for solid material characterization and pollutant analyses.
SLO4 and SLO5: Ability to select the proper sorption-desorption tests to evaluate the fate of pollutants in soils and sediments, with a basics assessment of the derived risk.
SLO6: Ability to design the correct analytical strategies and to apply reference materials and validation strategies to guarantee the quality of the methods and obtained data.

Excellent:
SLO1-SLO6: Ability to integrate a deep knowledge on all the issues covered in the module to solve a case study.

Resource Implications of Proposal and Proposed Solutions:

Lectures notes will be available for students.

Recommended reading:

Environmental Chemistry, S. E. Manahan, 7th edition, CRC Press, Boca Raton, Florida, 2000.
Environmental Chemistry, G.Van Loon, S. Duffy eds.. Nueva York, USA: Oxford University Press, 2000.
Manual of physico-chemical analysis of aquatic sediments, edited by A. Mudroch, J. Azcue, P. Mudroch, CRC Press, Boca Raton, Florida, 1997
Metals in the Hidrocycle, W. Salomons, U. Förstner, Springer Verlag,1988.
Trace element speciation: Analytical methods and problemes, edited by G.E. Batley, CRC Press, Boca Raton, Florida, 1989.
Chemical Speciation in the Environment, edited by A.M. Ure, C.M. Davidson, 2nd edition, Blackwell Science Ltd., Oxford, 2002
Methodologies for soil and sediment fractionation studies, edited by Ph. Quevauviller, The Royal Society of Chemistry, Cambridge (UK), 2002
The Chemistry of Soils ,G.Sposito, New York-Oxford: Oxford University Press, 1989.
Metal Speciation and Contamination of Soil, H.E. Allen, C.P.Huang, G.W.Bailey, A.R.Bowers eds.. Boca Raton: Lewis Publishers, 1995.

Pre-Requisites:

Any module(s) which must have been taken prior to the current module, or any specific background required to take this module.

-

Module Title:
Design of sampling strategies and techniques

Module Code:
AM0801

Maximum Number of Students:
25

Total ECTS Credits
2

Notional Learning Hours
(a) Contact Time - 12 h
(b) Private Study - 38 h

Format of Teaching:

Lectures	10 h
Laboratories or Practicals	-
Other (PC seminars)	2 h

Teaching Strategy:
Please show how the contact hours are to be allocated in terms of the type of class involved.

Formal lectures in 60/90 min sessions.
PC seminars: based on practical exercises linked to the quantitative aspects of sampling error estimation. General software (EXCEL) and specific sampling software (Vario) will be used.

Convener:
Anna de Juan
Miquel Vidal

University / Department:
University of Barcelona / Analytical Chemistry Department

Language of Tuition:
English

Module Description - The Purpose or Aims:
- To impart knowledge, understanding and problem solving capabilities regarding the Theory of Sampling (TOS).
- To describe the general principles of representative sampling of both 0-dimensional and 1-dimensional lots
- To impart knowledge on the characterization of lot variabilities and variographic analysis.
- To introduce the complexity and practical guidelines for sampling 2- and 3-dimensional lots.

Specific Learning Outcomes for this module: (contributing to general learning outcomes GLO 1 – GLO 10)
Learning Outcomes should provide statements which articulate what the student has achieved upon completion of the course. What will a student know, understand or be able to do?

SLO1. Understanding of the lot dimensionality, heterogeneity and other fundamental concepts of the theory of sampling, TOS
SLO2. Understanding and ability to use the seven sampling unit operations
SLO3. Understanding of sampling errors for both 0- and 1-dimensional lots
SLO4. Understanding of the complexity of sampling 2- and 3-dimensional lots
SLO5. Capacity to design and carry out replication experiments and to perform variographic analysis to estimate the error associated with any sampling operation
SLO6. Ability to do a critical study of sampling protocols and equipment
SLO7. Ability to design a sampling plan

Summary of Course Content:
Topics that will be discussed include:

1. Basic sampling concepts and TOS terminology. Lot dimensionality. Seven Sampling Unit Operations (SUO).
2. Sampling in 0-dimension lots. Heterogeneity concept. Definition and estimation of sampling errors. Replication experiments. Sample mass reduction.
3. Sampling in 1-dimension lots. Heterogeneity in dynamic systems. Variographic studies.
4. Sampling in 2- and 3-dimension lots.
5. Sampling plan design and quality assurance in the sampling process.

Transferable Skills Taught:

Please list in numerical order the key skills taught e.g. communication, information technology, interpersonal skills, teaching/study skills. Please relate these to benchmark statements.

Ability to communicate with specific terms related to the theory of sampling.
Ability to work in small groups and to elaborate written reports.
Knowledge on how to find information on available sampling guidelines and equipments.

Assessment Methods:

Details of assessment methods should include forms of assessment and the contribution of each to the summative assessment of the module. The relationship to the learning outcomes of the module should be explicit and the numbers of the various learning outcomes should be attached to the assessment methods listed. Please list in numerical order

1. Written examination (60 %). Evaluation of SLO1 – SLO6
2. Work assignment (40 %). Evaluation of SLO6- SLO7.

Assessment Criteria:

Details of assessment methods should include forms of assessment and the contribution of each to the summative assessment of the module. The relationship to the learning outcomes of the module should be explicit and the numbers of the various learning outcomes should be attached to the assessment methods listed. Please list in numerical order.

Threshold:
SLO1, SLO2, SLO3, and SLO4: Basic knowledge on the fundamental concepts of the theory of sampling, sampling unit operations and sampling errors of lots of any dimension.
SLO5: Basic knowledge on replication experiments and variograms.
SLO6 and SLO7: Basic ability to analyse sampling protocols, equipments and sampling plans

Good:
SLO1, SLO2, SLO3, and SLO4: Ability to apply the fundamental concepts of the theory of sampling, and sampling unit operations, to perform simple calculations dealing with the sampling errors of 0-D and 1-D lots, and to understand the complexity related to 2-D and 3-D lots
SLO5: Ability to design replication experiments and to apply variograms to estimate the errors associated with any sampling step
SLO6 and SLO7: Ability to assess sampling protocols, equipments and sampling plans, with the ability to design and/or suggest alternatives.

Excellent:
SLO1-SLO7: Ability to correctly solve a case study: ability to design a complete sampling plan, taking into account the objectives and information sought, the lot characteristics, the strategy, procedure and equipment, the estimation of the sampling error and other external constraints

Resource Implications of Proposal and Proposed Solutions:

- PC classroom
- Lectures will be based on teaching material that students will have beforehand (Powerpoint slides; research articles …).
- Recommended reading material:

1. P. Gy. 'Sampling for analytical purposes'. Wiley (1988).
2. Petersen, L, Minkkinen, P. & Kim H. Esbensen (2005). Representative Sampling for reliable data analysis: Theory of Sampling. *Chemometrics and intelligent laboratory systems*, vol. 77, issue 1-2, p. 261-277.
3. Petersen, L, C. Dahl, K.H. Esbensen (2004). Representative mass reduction in sampling – a critical survey of techniques and hardware. *Chemometrics and Intelligent Laboratory Systems*, vol. 74, Issue 1, p. 95-114.
4. Petersen L. & K. H. Esbensen (2005). Representative Process Sampling for Reliable Data Analysis – a Tutorial. *Journal of Chemometrics*, vol. 19, Issue 11-12. p. 625-647.
5. Esbensen, K.H, H.H.Friis-Petersen, L. Petersen, J.B. Holm-Nielsen & P.P.Mortensen (2007). Representative process sampling – in practise: Variographic analysis and estimation of Total Sampling Errors (TSE). *Chemometrics and Intelligent Laboratory Systems, doi:10.1016/j.chemolab.2006.09.011.*
6. Holm-Nielsen, J.B, C.K. Dahl & K.H. Esbensen (2006). Representative sampling for process analytical characterisation of heterogeneous bio-slurry systems - a reference study of sampling issues in PAT. *Chemometrics and Intelligent Laboratory Systems*, vol. 83, 114-126

Pre-Requisites:

Any module(s) which must have been taken prior to the current module, or any specific background required to take this module.

-

Module Title:
Advanced Volumetric Analysis

Module Code:
AM0902

Maximum Number of Students:
20

Total ECTS Credits
2

Notional Learning Hours
(a) Contact Time: 10h
(b) Private Study: 40h

Format of Teaching:
Lectures: 10h

Teaching Strategy:
Lectures

Convener:
Jacinto Guiteras

University: University of Barcelona, Department of Analytical Chemistry

Language of Tuition:
English

Module Description - The Purpose or Aims:
1. Calculation of theoretical titration curves
2. Use of theoretical titration curves for assessing the feasibility of a volumetric method.
3. Selection of the best possible procedure for end-point detection
4. Development of new methods

Specific Learning Outcomes for this module: (contributing to general learning outcomes GLO 1 – GLO 10)

1. Ability to calculate theoretical titration curves for acid-base, complex-formation and oxidation-reduction equilibria.
2. Ability to assess the influence of factors such as dilution, secondary reactions or the presence of other analytes on a titration.
3. Ability to select the best possible procedure for end-point detection in a particular case and to evaluate the accuracy of the determination.
4. Ability to develop new methods.

Summary of Course Content:
The purpose of this module is to provide the students with a basic knowledge of how theoretical curves can be calculated and of the information that can be obtained from them. Special care will be paid to the influence that several factors may exert, the criteria to choose the best possible end-point indicator and to evaluate the minimum possible error.

Transferable Skills Taught:
Writing reports
Use of basic informatic tools (Spreadsheets or free computer programs)

Assessment Methods:
Written report, combined with personal interview

Assessment Criteria:

Treshold
Ability to obtain titration curves for reactions belonging to acid-base, complex-fomation or oxidation-reduction equilibria and for solutions containing a single analyte, even in the presence of secondary reactions.
Good
Ability to obtain titration curves for reactions belonging to acid-base, complex-fomation or oxidation-reduction equilibria and for solutions containing several analytes, even in the presence of secondary reactions.
Excellent
Ability to propose new procedures for the volumetric determination of several analytes in a mixture.

Resource Implications of Proposal and Proposed Solutions:

Recommended reading:
"Quantitative Chemical Analysis", D.C. Harris, Freeman,, 6th ed., 2003
"Fundamentals of Analytical Chemistry", D.A. Skoog, D.M. West, F.J. Holler, S.R. Crouch, Thomson, 8th ed, 2004

Pre-Requisites:

No pre-requisites are required. However, basic knowledge of ionic equilibria would be useful.

Module Title:
Introduction to Chromatographic Techniques

Module Code:
AM0903

Maximum Number of Students:
20

Total ECTS Credits
2

Notional Learning Hours
(a) Contact Time - 10h
(b) Private Study - 40h

Format of Teaching:

Lectures	10 h
Laboratories or Practicals	0 h
Other	0 h

Teaching Strategy:
Formal lectures in 60/90 min timetable.

Convener:
I. Cavaco, K. Koci

University:
University of Algarve

Language of Tuition:
English

Module Description - The Purpose or Aims:

1. To introduce fundamental concepts on chromatography
2. To introduce analytical techniques of gas chromatography, high performance liquid chromatography, ion chromatography and size exclusion chromatography.

Learning Outcomes:

At the end of the module the learner is expected to be able to:

1. correctly identify and describe the principles and instrumentation in the main column chromatography techniques
2. Select the most adequate chromatographic technique for the analysis of a given system
3. Critically analyze and evaluate the efficiency of a chromatographic system
4. Correctly develop and optimize a chromatographic analytical method

Summary of Course Content:

This module introduces concepts of fundamental chromatography. It then explores the most widely used chromatographic techniques: gas chromatography, high performance liquid chromatography, ion chromatography and size exclusion chromatography. For each technique, the principles, instrumentation, limitations and typical applications are presented.

Transferable Skills Taught:

Assessment Methods:

1. LO1 – Written Examination (100%)

Assessment Criteria:

Threshold
LO1 – to correctly describe the components of a given chromatographic system
LO2 – to identify the main chromatographic techniques and the when they can be applied
LO3 – to correctly calculate efficiency parameters for a chromatographic column
LO4 – to correctly perform a chromatographic analysis using a method already implemented.

Good
LO1 – to correctly identify a chromatographic equipment and define what type of analysis it can perform
LO2 – to be able to choose the most adequate chromatographic technique to perform the analysis of a given sample
LO3 – to correctly analyze the efficiency of a chromatographic system and design solutions to increase its performance
LO4 – to develop and optimize a chromatographic method for a given analysis

Excellent
LO1 – to correctly identify the parts of any chromatographic equipment and define what type of analysis can be performed in each equipment
LO2 – given a set of samples, to choose the best available chromatographic techniques to analyse each sample
LO3 – to develop a laboratory quality control plan for chromatographic equipment, based on the efficiency of each equipment
LO4 – to develop and optimize a chromatographic method for a given analysis, obtaining the best possible relation between time of analysis and efficiency of separation.

Resource Implications of Proposal and Proposed Solutions:

Lecture notes will be available for students.
Recommended reading:
"Quantitative Chemical Analysis", Daniel C. Harris, Freeman, 6th ed., 2003.
"Analytical Chemistry", R. Kellner, J.M. Mermet, M. Otto, H.M. Widmer, Wiley-VCH Verlag, Weinheim, Germany, 1998.
"Principles of Instrumental Analysis", D.A. Skoog, F.J. Holler, T.A. Nieman, 5th ed., Saunders College, Florida, 1998
"Chemical Analysis – Modern Instrumentation Methods and Techniques", F. Rousseac, A. Rousseac, Wiley, 2000
"Analytical Instrumentation – Performance, Characteristics and Quality", G. Currell, Wiley, 2000.

Module Title:
Electrophoresis

Module Code:
AM0904

Maximum Number of Students:
20

Total ECTS Credits
2

Notional Learning Hours
(a) Contact Time - 10h
(b) Private Study - 40h

Format of Teaching:
Lectures 6 h
Laboratories or Practicals 4 h
Other 0 h

Teaching Strategy:
Formal lectures in 60/90 min timetable. One morning/afternoon (4h) of Laboratory Practicals.

Convener:
I. Cavaco

University:
University of Algarve

Language of Tuition:
English

Module Description - The Purpose or Aims:

1. To introduce fundamental concepts of Electrophoresis as an analytical technique.
2. To describe the instrumentation in the most usual electrophoretic techniques: planar and capillary electrophoresis.

Learning Outcomes:

At the end of the module the learner is expected to be able to:

1. correctly identify and describe the principles and instrumentation used in electrophoretic techniques
2. Select the most adequate electrophoretic tecnhique for the analysis of a given system
3. Critically analyse and evaluate the efficiency of a electrophoretic system

Summary of Course Content:

This module introduces concepts of analytical electrophoresis, namely planar and capillary electrophoresis. The principles, instrumentation and optimization of these techniques is discussed

Transferable Skills Taught:

Laboratory skills: adjusting and using equipment for planar electrophoresis.

Assessment Methods:

1. LO1 – LO3 – Laboratory report.

Assessment Criteria:

Treshold
LO1 – to correctly describe the components of a given electrophoretic system
LO2 – to identify the main electrophoretic techniques and when they can be applied
LO3 – to correctly calculate efficiency parameters for an electrophoretic system

Good
LO1 – to correctly identify an electrophoretic equipment and define what type of analysis it can perform
LO2 – to be able to choose the most adequate electrophoretic technique to perform the analysis of a given sample
LO3 – to correctly analyse the efficiency of an electrophoretic system and design solutions to increase its performance

Excellent
LO1 – to correctly identify the parts of any electrophoretic equipment and define what type of analysis can be performed in each equipment
LO2 – given a set of samples, to choose the best available electrophoretic techniques to analyse each sample
LO3 – to develop a laboratory quality control plan for electrophoretic equipment, based on its efficiency

Resource Implications of Proposal and Proposed Solutions:

Lecture notes will be available for students.
Recommended reading:
"Quantitative Chemical Analisys", Daniel C. Harris, Freeman, 6th ed., 2003.
"Analytical Chemistry", R. Kellner, J.M. Mermet, M. Otto, H.M. Widmer, Wiley-VCH Verlag, Weinheim, Germany, 1998.

Module Title:

Molecular Spectroscopy

Module Code:

AM0907

Maximum Number of Students:

30

Total ECTS Credits

2

Notional Learning Hours
(a) Contact Time - 10 h
(b) Private Study - 40 h

Format of Teaching:

Lectures	10 h
Laboratories or Practicals	0 h
Other	0 h

Teaching Strategy:

10 h of formal lectures in 60-120 min timetable.

Convener:

Martí Rosés

University / Department:

Universitat de Barcelona / Departament de Química Analítica

Language of Tuition:

English

Module Description - The Purpose or Aims:

To introduce the fundamentals of molecular spectroscopy techniques
To understand the bases of the equipment used in molecular spectroscopy techniques
To go deeply into the fundamentals, instrumentation and applicability of UV/vis molecular absorption and fluorescence spectroscopy analytical techniques

Specific Learning Outcomes for this module: (contributing to general learning outcomes GLO 1 – GLO 10)

At the end of the module, the learner is expected to be able

To understand, at theoretical and practical level, some analytical techniques based on molecular spectroscopy (GLO3)
To understand the fundamentals of research, developing and validation of some methods of analysis based on molecular spectroscopy techniques (GLO4)
To identify critical aspects in given methods of analysis based on molecular spectroscopy techniques (GLO6)

Summary of Course Content:

This module will discuss the fundamentals and applicability of some analytical techniques based on molecular spectroscopy. The theory implied in transmission, absorption and emission of electromagnetic radiation at the molecular level will be analyzed. The basis of the most common instrument components in the design of instrumentation for optical spectroscopy will be discussed. The module will focus on the theory, instrumentation and practice of molecular absorption (UV/vis.) and fluorescence spectroscopy analytical techniques.

Transferable Skills Taught:

Ability to solve problems
Ability to take decisions

Assessment Methods:

All outcomes (GLO3, GLO4 and GLO6):

1. Written examination (80%)
2. Written assignment (20%)

Assessment Criteria:

Threshold:

To know the fundamentals, basic equipment and most common applications of molecular spectroscopy techniques

Good:

To be able to set up a plan for the application of a molecular spectroscopy technique to a specific analytical problem

Excellent:

To describe in detail UV/vis molecular absorption and fluorescence spectroscopy analytical techniques. Fully understand the theoretical principles that support them. Describe their application, in which fields and what type of samples can be analyzed, and their limitations. Describe the equipment in detail and their variations. Describe how the calibration of the equipment is performed. Identify the most critical steps in the analysis and special cares that must be taken when using these techniques.

Resource Implications of Proposal and Proposed Solutions:

Lecture notes will be available to students
Recommended reading:
- D.A. Skoog, D.M. West and F.J. Holler: "Fundamentals of Analytical Chemistry". 7th ed. Chapters 22-25, Saunders College, 1996.

Pre-Requisites:

Module Title: Vibrational Spectroscopy

Module Code: AM0908

Maximum Number of Students:
Depends on lab space and facilities. Instrument demonstrations will make the upper limit < 12

Total ECTS Credits 2

Notional Learning Hours
(a) Contact Time - *16*h
(b) Private Study - 24h

Format of Teaching:
Lectures 12 h
Laboratories or Practicals 4 h
Other 0 h

Teaching Strategy:
Formal lectures in 60/90 min timetable. Laboratory exercises

Convener:
E.Nodland

University:
University of Bergen

Language of Tuition:
English

Module Description - The Purpose or Aims:

1. To introduce infrared spectroscopy
2. Introducing IR as a qualitative technique
3. Good laboratory practice

Learning Outcomes:

At the end of the module the student is expected to be able to:

1. Perform qualitative IR spectroscopy of pure compounds selecting appropriate measurement techniques
2. Describe why molecules absorb infrared radiation
3. Explain different types of infrared spectrometers
4. Interpret spectra and use search libraries

Summary of Course Content:

IR spectroscopy is a work horse in the analytical laboratory. This module will give knowledge of the theory and practice of how to obtain and recognise high quality spectra for compound identification, explorative analysis and multivariate classification.
The module includes lectures in
- Theory (vibrations, frequencies, selection rules, molecular interactions.)
- instrumentation (instrumental components, spectrometers, sampling accessories)
- sampling techniques
- information enhancement (noise reduction, spectral subtraction, differentiation, library search)
- spectrum interpretation of organic compounds

Transferable Skills Taught:

The ability to use commercially available spectrometers and sampling accessories and choose appropriate sampling technique based on sample phase and state. Recognise the presence of common functional groups.

Assessment Methods:

Oral practical assessment (100%)

Assessment Criteria:

Treshold
LO1 –Describe the principles of the analytical method based on the major components of the instrumentation used.
LO2 – Describe properties of electromagnetic radiation
LO3 – Describe absorption of radiation and molecular vibrations
LO4 – Interpretation of spectra of simple hydrocarbons

Good
LO1 – Describe different designs of IR spectrometers and instrumental components
LO2 – Understand the selection rules, group frequencies and vibrational modes
LO3 – Being able to perform simple IR measurements without guidance, and perform library search
LO4 – Understanding the concepts of signal enhancement such as subtraction, smoothing.

Excellent
LO1 – Understand the inherent advantages of FT spectroscopy
LO2 – Knowledge of more advanced sample preparation techniques and sampling of solids, liquids and gases.
LO3 – Independently selecting sampling and sample preparation techniques and correcting spectra for ambient signals.
LO4 – Understanding of vibrational coupling, Fermi resonance and temperature effects.

Resource Implications of Proposal and Proposed Solutions:

Günzler, Helmut and Gremlich, Hanz-Ulrich: IR spectroscopy : an introduction

Module Title:
Atomic Spectroscopy

Module Code:
AM0910

Maximum Number of Students:
20

Total ECTS Credits
2

Notional Learning Hours
(a) Contact Time - 13h
(b) Private Study - 37h

Format of Teaching:

Lectures	7 h
Laboratories or Practicals	6 h
Other	0 h

Teaching Strategy:
Formal lectures in 60/90 min timetable. One full day (6h) of Laboratory Practicals.

Convener:
I. Cavaco

University:
University of Algarve

Language of Tuition:
English

Module Description - The Purpose or Aims:

1. To introduce fundamental concepts of Atomic Spectroscopy (AS)
2. To introduce the instrumentation used in the most common AS techniques: Flame and Electrothermal Atomic Absorption Spectroscopy; Plasma Emission Atomic Spectroscopy.
3. To introduce the sources of error and methods for validating results in AS.

Learning Outcomes:

At the end of the module the learner is expected to be able to:

1. correctly identify and describe the principles and instrumentation in the main AS techniques
2. Select the most adequate AES technique for the analysis of a given system
3. Critically analyse and evaluate results from AS
4. Correctly develop an analytical method and a procedure for validating results in AES.

Summary of Course Content:

This module introduces concepts of fundamental AS. It then explores the most widely used AS techniques: Flame and Electrothermal Atomic Absorption Spectroscopy; Plasma Emission Atomic Spectroscopy. For each technique, the principles, instrumentation, limitations and typical applications are presented.

Transferable Skills Taught:

Laboratory skills: adjusting and using equipment for Atomic Spectroscopy.

Assessment Methods:

1. LO1 – LO4 – Laboratory report.

Assessment Criteria:

Treshold
LO1 – to correctly describe the components of a given AS system
LO2 – to identify the main AS techniques and when they can be applied
LO3 – to correctly calculate efficiency parameters for an atomic spectrophotometer
LO4 – to correctly perform a AS analysis using a method already implemented.

Good
LO1 – to correctly identify a AS equipment and define what type of analysis it can perform
LO2 – to be able to choose the most adequate AS technique to perform the analysis of a given sample
LO3 – to correctly analyse the efficiency of a AS system and design solutions to increase its performance
LO4 – to develop and optimise an AS method for a given analysis

Excellent
LO1 – to correctly identify the parts of any AS equipment and define what type of analysis can be performed in each equipment
LO2 – given a set of samples, to choose the best available AS techniques to analyse each sample
LO3 – to develop a laboratory quality control plan for AS equipment, based on the efficiency of each equipment
LO4 – to develop and optimise a AS method for a given analysis.

Resource Implications of Proposal and Proposed Solutions:

Lecture notes will be available for students.
Recommended reading:
"Quantitative Chemical Analisys", Daniel C. Harris, Freeman, 6th ed., 2003.
"Analytical Chemistry", R. Kellner, J.M. Mermet, M. Otto, H.M. Widmer, Wiley-VCH Verlag, Weinheim, Germany, 1998.
"Principles of Instrumental Analysis", D.A. Skoog, F.J. Holler, T.A. Nieman, 5th ed., Saunders College, Florida, 1998
"Chemical Analysis – Modern Instrumentation Methods and Techniques", F. Rousseac, A. Rousseac, Wiley, 2000
"Analytical Instrumentation – Performance, Characteristics and Quality", G. Currell, Wiley, 2000.

Module Title:
Mass spectrometry

Module Code:
AM-09-12

Maximum Number of Students:
25

Total ECTS Credits
2

Notional Learning Hours
(a) Contact Time - 10 h
(b) Private Study - 40 h

Format of Teaching:

Lectures	10 h
Laboratories or Practicals	0 h
Other	0 h

Teaching Strategy:
Formal lectures in 60/90 min timetable.

Convener:
Encarnación Moyano

University / Department:
University of Barcelona. Analytical Chemistry Department

Language of Tuition:
English

Module Description - The Purpose or Aims:
- To introduce the fundamentals aspects of mass spectrometry
- To recognize and understand the main components of a mass spectrometer
- To fully understand the fundamentals and the main characteristics of the most common mass analyzers
- To understand the fundamentals of tandem mass spectrometry
- To understand basic concepts and practical aspects of coupling mass spectrometry to separation techniques: GC-MS, LC-MS, CE-MS
- To explore the fundamentals of mass spectrometry data interpretation
- To explore the principles of quantitative analysis in mass spectrometry
- To acquire basic knowledge to use the technology in different application fields (environmental, food analysis, pharmaceutical industry, etc.)

Specific Learning Outcomes for this module: (contributing to general learning outcomes GLO 1 – GLO 10)
At the end of the module the learner is expected to be able to:
1. Critically select the most appropriate ionization technique taking into account the chemical characteristics of the analytes
2. Critically select the most suitable mass analyzer taking into account the structural information and the selectivity required for a given analytical problem
3. Design the most appropriate tandem mass spectrometry experiments to obtain the structural information required
4. Critically select the most suitable coupling technique (separation technique-mass spectrometry) to solve a given analytical problem
5. Full understanding and effective use of mass spectrometric data (mass spectral data interpretation to identity functional groups, to estimate elemental composition and to propose chemical structures).
6. Full understanding the validation and quantitative/confirmatory analysis using mass spectrometry in a regulated environment

Summary of Course Content:
This module explores the fundamental aspects of mass spectrometry and topics that will be discussed include: (a) mass spectrometry basics, (b) theoretical and practical aspects of the most popular ionization techniques, (c) the basics of the main mass analyzers, (d) fundamentals of tandem mass spectrometry and an introduction to popular MS/MS instrument types (e.g., QqTOF, QqQ, QIT, LIT, FTICR), (e) basic aspects of coupling mass spectrometry to separation techniques (GC-MS, LC-MS, CE-MS), (f) mass spectrometry of small and large molecules, (g) the principles of quantitative analysis using mass spectrometry and (h) an overview of mass spectral interpretation.

Transferable Skills Taught:

Information Technology:

Advances in mass spectrometry instrumentation and mass spectrometry database search (NIST)

Communications:

Communication with use of mass spectrometry terminology

Assessment Methods:

LO1-LO6 – Written Examination (80%)

LO1-LO6 – Resolution of practical exercises: real situation-real MS solutions (20%)

Assessment Criteria:

Threshold:

LO1, LO2 and LO4: to understand the principles of the ionization techniques, the mass analyzers and the coupling of separation techniques to mass spectrometry

LO3: to understand the fundamentals of tandem mass spectrometry

LO5: to have a general knowledge about the information than can be obtained from mass spectral data

LO6: to have a general knowledge about quantitative/qualitative analysis using mass spectrometry

Good:

LO1, LO2 and LO4: to be able to choose the most adequate ionization technique, mass analyzer and coupling technique to solve an analytical problem

LO3: to be able to correctly design a tandem mass spectrometry experiment to provide the structural information required

LO5: to identify the possible structure of and organic compound from the interpretation of the mass spectral data

LO6: to design the experimental work to determine a target compound using mass spectrometry under regulated environment

Excellent:

LO1-LO4 and LO6: given a set samples, to choose the best available ionization technique, mass analyzer and coupling technique to analyze each sample and devise an experimental protocol to perform the respective study

LO5: given a set spectral data, to interpret: to correctly assign fragments, to calculate elemental composition, to propose a chemical structure.

Resource Implications of Proposal and Proposed Solutions:

Lectures notes will be available for students.

Recommended reading:

- F.W. McLafferty and F. Turecek. ***Interpretation of mass spectra.*** University Science Books, 4th edition, 1993.
- E. de Hoffmann and V. Stroobant. ***Mass Spectrometry. Principles and Applications.*** J. Wiley and Sons, 3rd edition, 2007.
- J. Barker, D.J. Ando, R. Davis, M.J. Frearson. ***Mass Spectrometry. ACOL,*** 1999.
- B. Ardrey. ***Liquid Chromatography-Mass Spectrometry: An introduction.*** J. Wiley and Sons, 2004.
- www.spectroscopynow.com

Pre-Requisites:

Module Title:
Introduction to Electroanalytical Techniques

Module Code:
AM0914

Maximum Number of Students:
20

Total ECTS Credits
2

Notional Learning Hours
(a) Contact Time - 10 h
(b) Private Study - 40 h

Format of Teaching:

Lectures	10 h
Laboratories or Practicals	0 h
Other	0 h

Teaching Strategy:
Formal lectures in 60/90 min timetable

Convener:

Miquel Esteban

University / Department:

University of Barcelona, Department of Analytical Chemistry

Language of Tuition:
English

Module Description - The Purpose or Aims:

1. To introduce the foundamentals of the main electroanalytical techniques.
2. To ilustrate the main applications of electroanalytical techniques

Specific Learning Outcomes for this module: (contributing to general learning outcomes GLO 1 – GLO 10)
At the end of the module the learner is expected to be able to:

1. know the classification and the principles of the main electroanalytical techniques
2. know the instrumentation of the main electroanalytical techniques
3. select the most adequate electroanalytical technique for the analysis of a give system, and correctly identify the key parameters for the development and optimisation of an electroanalytical method

Summary of Course Content:
This module aims to show the students a general view of the electrochemical techniques of analysis (electroanalytical techniques) and a more detailed description of the most used ones, as conductometry, potentiometry and voltammetry (mainly, modern polarographic and stripping voltammetric techniques). The pedagogical approach will be the same in all cases: at first, the foundamental of the technique will be studied; in a second step, the instumentation used will be described; at last, some examples of the main application will illustrate the use of every technique.

Transferable Skills Taught:
Communication:
Writing electroanalytical reports

Information Technology:
Software programing for electroanalytical instrumentation

Assessment Methods:

1. LO1 – LO3 Written Examination (100%)

Assessment Criteria:

Treshold

LO1 – to identify some of the main electroanalytical techniques
LO2 – to know the main instrumental aspects of the main electroanalytical techniques
LO3 – to define what type of analysis can be performed with some of the main techniques

Good

LO1 – to know the classification of the principles of some of the main electroanalytical techniques
LO2 - to describe the components of some of the main electroanalytical system
LO3 - to define what type of analysis can be performed with the different techniques

Excellent

LO1 – to know the classification and the principles of the main electroanalytical techniques
LO2 - to correctly describe the components of a given electroanalytical system
LO3 – to choose the best available electroanalytical techniques to analyse a given set of samples, and to know the most relevant parameters to develop and optimise an electroanalytical method.

Resource Implications of Proposal and Proposed Solutions:

Lecture notes will be available for students.
Recommended reading:
"Quantitative Chemical Analysis", D. C. Harris, Freeman, 6th ed., 2003.
"Analytical Chemistry", R. Kellner, J.M. Mermet, M. Otto, H.M. Widmer, Wiley-VCH Verlag, Weinheim, Germany, 1998.
"Principles of Instrumental Analysis", D.A. Skoog, F.J. Holler, T.A. Nieman, 5th ed., Saunders College, Florida, 1998

Pre-Requisites:

No pre-requisites are required.

Module Title:
Potentiometric techniques

Module Code:
AM0915

Maximum Number of Students:
20

Total ECTS Credits
2

Notional Learning Hours
(a) Contact Time - 15h
(b) Private Study - 35h

Format of Teaching:

Lectures	10 h
Laboratories or Practicals	5 h
Other	0 h

Teaching Strategy:
Formal lectures in 60/90 min timetable. Two 2h 30m laboratory practicals.

Convener:
J.P. Pinheiro

University:
University of Algarve

Language of Tuition:
English

Module Description - The Purpose or Aims:

1. To describe the fundamental concepts of potentiometry.
2. To introduce analytical potentiometric techniques their operation and applications.

Learning Outcomes:

At the end of the module the learner is expected to be able to:

1. understand the fundaments of potentiometric measurements and their practical application
2. correctly identify and describe the principles and instrumentation in potentiometry
3. critically analyze and evaluate the results of a potentiometric measurement especially the associated errors

Summary of Course Content:

Definition of electrochemical potential and explanation of Nernst equation. The electrochemical cell and the determination of electrode potentials. Potentiometric techniques with emphasis on pH measurement and the operation of the different classes of selective electrodes. New potentiometric sensors and recent applications of potentiometric techniques.

Transferable Skills Taught:

Communication:
Writing chemical analysis reports

Information Tecnhology:
Literature search tools and methodologies

Assessment Methods:

1. LO1 – Written Examination (40%)
2. LO2 – Laboratory Work Assignment (30%)
3. LO3 – Literature search assignment (30%)

Assessment Criteria:

Treshold
LO1 – to understand the concept of electrochemical potential and be able to explain the Nernst equation
LO2 – to understand the operation of an electrochemical cell and the determination of electrode potentials
LO3 – to correctly perform a potentiometric analysis using a method already implemented
LO4 – to be able to find relevant literature to set up a potentiometric analysis methodology for a given sample

Good
LO1 – to critically analyze the operation of an electrochemical cell and the determination of electrode potentials and discuss the errors involved
LO2 – to develop and optimize a potentiometric analysis method for a given analysis
LO3 – to be able to find in the literature the most adequate potentiometric analysis methodology for a given sample

Excellent
LO1 – to relate the fundamental concepts of potentiometry with the experimental set-up and the functioning of the different electrodes, and from there to propose the best strategy to minimize the time and optimize the cost of analysis
LO2 – given a set of samples, to choose the best available potentiometric analysis method to analyze each sample

Resource Implications of Proposal and Proposed Solutions:

Lecture notes will be available for students.
Recommended reading:
Basic:
"Quantitative Chemical Analysis", Daniel C. Harris, Freeman, 6th ed., 2003.
“Electrode Potentials”, Richard G. Compton, Giles H.W. Sanders, Oxford Chemistry Primers, Oxford Science, 1996
“Electrode Dynamics”, Giles H.W. Sanders, Oxford Chemistry Primers, Oxford Science, 1996
Advanced:
‘‘Electrochemical Methods: Fundamentals and applications”, A.J. Bard, L.R. Faulkner, Wiley, 2nd ed. 2001.’’

Module Title:
Sensors and Bionsensors

Module Code:
AM0916

Maximum Number of Students:
20

Total ECTS Credits
2

Notional Learning Hours
(a) Contact Time - 10 h
(b) Private Study - 10 h

Format of Teaching:
Lectures 10 h
Laboratories or Practicals 0 h
Other 0 h

Teaching Strategy:
Formal lectures in 60/90 min timetable.

Convener:
J.M. Palacios

University:
University of Cádiz

Language of Tuition:
English

Module Description - The Purpose or Aims:

1. To introduce fundamentals of sensors and their main applications
2. To introduce fundamentals of biosensors and their main applications
3. To discuss and analyze several scientific publications regarding the state-of-the-art of this module

Learning Outcomes:

At the end of the module the learner is expected to be able to:
1. Define appropriately sensor and biosensor
2. Correctly identify sensors and biosensors
3. Select the adequate type of sensors/biosensors for certain analysis

Summary of Course Content:

Simple sensors become an increasingly attractive tool for monitoring harmful substances, for quality control, and in medicinal and environmental chemistry. Chemical sensors based on electrochemical principles (voltammetry, potentiometry) and optical sensors are between the most important, mainly because of the low cost of manufacture. Membrane designs and mofidifications facilitate immobilization of all required chemicals within the sensor resulting in easy handling and operation. At this point, biosensors acquires relevant role: their potential applications cut across the analytical landscape from the environment to the brain. Nevertheless, each analytical problem requiring a specific type of biosensor is unique, yet there are integrating principles of design and operation that bring some degree of cohesion to the field as a whole. Besides, new legislations and regulations are opening doors to biosensors in many fields, such as food industry, thanks to the possibility to operate in real samples with less or no pretreatment as well as the incorporation to on-line monitoring.

Transferable Skills Taught:

Communication:

To be able to recognize and describe a sensor/biosensor and its possible application

Interpersonal skills:

Elaborate and show a group written assignment

Assessment Methods:

1. LO1 – Written Examination (30%)
2. LO2 – Group Work Discussion (30%)
3. LO3 – Work assignment (40%)

Assessment Criteria:

Treshold

LO1 – to correctly distinguish between sensors and biosensors
LO2 – to know the applicability of different types of sensors and biosensors
LO3 – to identify the main characteristics of a sensor/biosensor

Good

LO1 – to apply adequately the principles and concepts concerning sensors and biosensors
LO2 – to connect the applicability of a sensor or biosensor with its structure
LO3 – to connect the characteristics of a sensor/biosensor with an analytical problem

Excellent

LO1 – to be able to describe the main advantages of a sensor/biosensor related to certain analytical problem
LO2 – to be able to think up an application for a determined sensor or biosensor
LO3 – to be able to select the best sensor or biosensor for certain analysis

Resource Implications of Proposal and Proposed Solutions:

Lecture notes will be available for students.
Recommended reading:
"Principles of Chemical Sensors", J. Janata, Plenum Press, New York, 1989
"Introduction to Bioanalytical Sensors", A. J. Cunningham, John Wiley & Sons, Inc, New York, 1998
"Biosensor and Modern Biospecific Analytical Techniques", L. Gorton, Elsevier, The Netherlands, 2005

Module Title:
Flow injection analysis

Module Code:
AM0918

Maximum Number of Students:
20

Total ECTS Credits
2

Notional Learning Hours
(a) Contact Time - 10 h
(b) Private Study - 40 h

Format of Teaching:

Lectures	10 h
Laboratories or Practicals	0 h
Other	0 h

Teaching Strategy:
Formal lectures in 60/90 min timetable

Convener:

Javier Saurina

University / Department:

University of Barcelona, Department of Analytical Chemistry

Language of Tuition:
English

Module Description - The Purpose or Aims:

1. To introduce the fundamentals of flow injection analysis and related techniques
2. To illustrate representative applications of flow injection analysis and derivative branches

Specific Learning Outcomes for this module: (contributing to general learning outcomes GLO 1 – GLO 10)
At the end of the module the learner is expected to be able to:

1. understand the principles and basic components of a conventional flow-injection method, with special attention in advantages and shortcomings
2. know the relevant features of derivative branches including sequential injection, bead injection and microfluidic systems
3. know the possibilities of flow method for on-line sample treatment, derivatization and coupling instrumental devices
4. critically understand the performance of flow-injection methods in multicomponent analysis
5. adapt and implement a classical batch analytical method to a flow-injection system

Summary of Course Content:
This module is focused on providing a general introduction to flow-injection analysis and related flow methods. Special attention is paid in giving a preliminary description of the historical context and the evolution throughout last decades. Advantages and shortcoming regarding automation, miniaturization, versatility and other relevant features will be discussed. Basic components and pieces for assembling the flow manifold as well as detection devices will be described. Beyond the classical mode, derivative branches such as sequential injection, bead injection and microfluidic systems and gradient manifold will also be introduced. The integration of diverse elements in a common flow system for connecting on-line sample processing, derivatization and instrumental coupling will be remarked. The significance of flow-injection for multicomponent analysis will be also pointed out, with special attention on strategies for gaining selectivity for each analyte. Finally, selected examples will be given to illustrate the potentiality and performance of flow injection analysis in different fields (e.g., food, clinical, environmental and pharmaceutical analysis).

Transferable Skills Taught:
Communication:
Writing chemical analysis reports

Information Technology:
Software programing for instrumentation and data analysis

Assessment Methods:

1. LO1 to LO5 – Written Exam (100%)

Assessment Criteria:

Threshold

LO1 – to know the fundamentals of conventional flow-injection analysis
LO1 – to describe the general components of flow systems and design basic flow manifold schemes
LO1 – to know the principal flow cell systems and detection devices

Good

LO2 – to know the main derivative branches including sequential injection and bead injection analysis
LO3 – to be able to combine and integrate components in a common set-up for on-line implementation of various steps of the method, including sample treatment, reaction, detection and data analysis

Excellent

LO3 – to understand the fundamentals of coupling flow manifolds and separation techniques (liquid chromatography and capillary electrophoresis)
LO4 – to recognize the different types of analytical data that can be generated and identify proper techniques for extracting information from these data sets
LO5 – to know and evaluate critically the applicability of flow methods to multicomponent analysis

Resource Implications of Proposal and Proposed Solutions:

Lecture notes will be available for students.
Recommended reading:
[1] J. Ruzicka, E.H. Hansen, *Flow Injection Analysis*, 2nd ed., John Wiley and Sons, New York, **1988**.
[2] M.Trojanowicz, *Flow Injection Analysis: Instrumentation and Applications*, World Scientific, River Edge, New Jersey, **1999**

Pre-Requisites:

No pre-requisites are required.

Module Title:
Gas Chromatography

Module Code:
AM0919

Maximum Number of Students:
12

Total ECTS Credits
2

Notional Learning Hours
(a) Contact Time - 20h
(b) Private Study - 30h

Format of Teaching:
Lectures 5 h
Laboratories or Practicals 15 h
Other 0 h

Teaching Strategy:
Formal lectures in 60min timetable followed by Practicals of 3h each.

Convener:
M. C. Mateus

University:
University of Algarve

Language of Tuition:
English

Module Description - The Purpose or Aims:

1. To apply fundamental concepts on Gas chromatography
2. To introduce laboratory contact with analytical techniques of Gas chromatography.

Learning Outcomes:

At the end of the module the learner is expected to be able to:

1. Correctly identify and describe the principles and instrumentation in the gas chromatographic techniques, namely GC/FID and GC/MS.
2. Correctly manipulate a gas chromatographer apparatus taking in account the specificities of the different kinds of gas chromatographer technologies (practical application: GC/FID and GC/MS).
3. Correctly develop and optimise a gas chromatography analytical method (practical application: GC-MS).
4. Correctly manipulate the software tools to obtain an acceptable, qualitative and quantitative, analytical cromatoghraphic result (practical application GC/FID and GC/MS).
5. Critically analyse and evaluate a gas chromatographic analytical result (practical application: GC-MS).

Summary of Course Content:

This module reviews basic concepts of fundamental gas chromatography. It then explores the most widely used gas chromatographic instrumental techniques: GC/FID/NPD/ECD/CD and GC/MS. How to choose the best column and stationary phase. For each technique, the principles, instrumentation, limitations and typical applications are presented. For GC/FID and GC/MS laboratory practical applications are executed for qualitative and quantitative proposes. Chromatographic results are critically interpreted.

Transferable Skills Taught:
Communication:
Writing chemical analysis reports
Information Technology:
Hardware and software programing for analytical instrumentation.

Assessment Methods:

1. Laboratory reports (80%).
2. Practical laboratory attitude and expertise (20%)

Assessment Criteria:

Treshold

Good

Excellent

Resource Implications of Proposal and Proposed Solutions:

Lecture notes will be available for students.
Recommended reading:
"Quantitative Chemical Analisys", Daniel C. Harris, Freeman, 6th ed., 2003.
"Contemporary Instrumental Analysis", K. Rubinson, J. Rubinson, M. Otto, Wiley-VCH Verlag, Weinheim, Germany, 1998.
"Principles of Instrumental Analysis", D.A. Skoog, F.J. Holler, T.A. Nieman, 5th ed., Saunders College, Florida, 1998
"Chemical Analysis – Modern Instrumentation Methods and Techniques", F. Rousseac, A. Rousseac, Wiley, 2000
"Analytical Instrumentation – Performance, Characteristics and Quality", G. Currell, Wiley, 2000.

Pre-Requisites:

Module AM0903

Module Title:
Liquid Chromatography

Module Code:
AM0920

Maximum Number of Students:
12

Total ECTS Credits
2

Notional Learning Hours
(a) Contact Time - 20h
(b) Private Study - 30h

Format of Teaching:
Lectures 5 h
Laboratories or Practicals 15 h
Other 0 h

Teaching Strate.
Formal lectures in 60min timetable followed by Practicals of 3h each.

Convener:
M. C. Mateus

University:
University of Algarve

Language of Tuition:
English

Module Description - The Purpose or Aims:

1. To apply fundamental concepts on Liquid chromatography
2. To introduce laboratory contact with analytical techniques of Liquid chromatography.

Learning Outcomes:

At the end of the module the learner is expected to be able to:

1. Correctly identify and describe the principles and instrumentation in the liquid chromatographic techniques, namely HPLC/UV/PDA, LC/MS and ionic chromatography.
2. Correctly manipulate a liquid chromatographer apparatus taking in account the specificities of the different kinds of liquid chromatographer technologies (practical application: HPLC/UV/PDA, LC/MS and ionic chromatography).
3. Correctly develop and optimise a liquid chromatography analytical method (practical application: a) HPLC/UV using a RP stationary phase; ionic chromatography using an anionic exchange column).
4. Correctly manipulate the software tools to obtain an acceptable, qualitative and quantitative, analytical cromatoghraphic result (practical application: HPLC/UV).
5. Critically analyse and evaluate a liquid chromatography analytical result (practical application: HPLC/UV/).

Summary of Course Content:

This module reviews basic concepts of fundamental liquid chromatography. It then explores the most widely used liquid chromatographic instrumental techniques: Solid Phase extraction (SPE), HPLC/UV/PDA/MS, Ionic chromatography and Capillary Electoforesis. For each technique, the principles, instrumentation, limitations and typical applications are presented. For SPE, HPLC/UV/PDA and Ionic Cromatography laboratory practical applications are executed for qualitative and quantitative proposes. Chromatographic results are critically interpreted.

Transferable Skills Taught:

Communication:

Writing chemical analysis reports

Information Technology:

Hardware and software programing for analytical instrumentation.

Assessment Methods:

1. Laboratory reports (80%).
2. Practical laboratory attitude and expertise (20%)

Assessment Criteria:

Treshold

Good

Excellent

Resource Implications of Proposal and Proposed Solutions:

Lecture notes will be available for students.
Recommended reading:
"Quantitative Chemical Analisys", Daniel C. Harris, Freeman, 6th ed., 2003.
"Contemporary Instrumental Analysis", K. Rubinson, J. Rubinson, M. Otto, Wiley-VCH Verlag, Weinheim, Germany, 1998.
"Principles of Instrumental Analysis", D.A. Skoog, F.J. Holler, T.A. Nieman, 5th ed., Saunders College, Florida, 1998
"Chemical Analysis – Modern Instrumentation Methods and Techniques", F. Rousseac, A. Rousseac, Wiley, 2000
"Analytical Instrumentation – Performance, Characteristics and Quality", G. Currell, Wiley, 2000.

Pre-Requisites:

Module AM0903

Module Title:
Voltammetric and Chronopotentiometric techniques

Module Code:
AM0921

Maximum Number of Students:
20

Total ECTS Credits
2

Notional Learning Hours
(a) Contact Time - 15h
(b) Private Study - 35h

Format of Teaching:

Lectures	10 h
Laboratories or Practicals	5 h
Other	0 h

Teaching Strategy:
Formal lectures in 60/90 min timetable. Two 2h 30m laboratory practicals.

Convener:
J.P. Pinheiro

University:
University of Algarve

Language of Tuition:
English

Module Description - The Purpose or Aims:

1. To describe the fundamental concepts of dynamic electrochemical techniques.
2. To introduce analytical voltammetric and chronopotentiometric techniques, in direct and stripping modes, their operation and applications.

Learning Outcomes:

At the end of the module the learner is expected to be able to:

1. understand the fundaments of dynamic electrochemical measurements and their practical application
2. correctly identify and describe the principles of operation and instrumentation in voltammetric and chronopotentiometric techniques
3. critically analyze and evaluate the results of a voltammetric and chronopotentiometric measurements especially the associated errors.

Summary of Course Content:
Kinetics of electrode reactions. Mass transfer by diffusion.
Voltammetric techniques: potential step and potential sweep methods.
Chronopotentiometric techniques.
Methods involving forced convection – Hydrodynamic methods.
Stripping Techniques – voltammetric and chronopotentiometric modes.

Transferable Skills Taught:

Communication:
Writing chemical analysis reports

Information Tecnhology:
Literature search tools and methodologies

Assessment Methods:

1. LO1 – Written Examination (40%)
2. LO2 – Laboratory Work Assignment (30%)
3. LO3 – Literature search assignment (30%)

Assessment Criteria:

Treshold
LO1 – to understand the concept of dynamic electrochemical measurements and their practical application
LO2 – to understand the principles of operation analytical voltammetric and chronopotentiometric techniques, in direct and stripping modes
LO3 – to correctly perform a voltammetric or chronopotentiometric analysis using a method already implemented
LO4 – to be able to find relevant literature to set up a voltammetric or chronopotentiometric analysis methodology for a given sample

Good
- the Treshold plus:
LO5 – to develop and optimize a a voltammetric or chronopotentiometric method for a given analysis

Excellent
- the Treshold and Good plus:
LO6 – to be able to compare the advantages and drawbacks of voltammetric techniques relative to the chronopotentiometric techniques for a given analysis,

Resource Implications of Proposal and Proposed Solutions:

Lecture notes will be available for students.
Recommended reading:
Basic:
"Electrode Dynamics", Giles H.W. Sanders, Oxford Chemistry Primers, Oxford Science, 1996
Advanced:
''Electrochemical Methods: Fundamentals and applications", A.J. Bard, L.R. Faulkner, Wiley, 2nd ed. 2001.''
"Electroanalytical Methods: Guide to experiments and applications", F. Scholz (Ed.), Springer, 2002