APPROVED

INST S7Z02: Analytical Science

Module Details

Module Code:	INST S7Z02
Full Title:	Analytical Science APPROVED
Valid From::	Semester 1 - 2019/20 (June 2019)
Language of Instruction:	
Duration:	1 Semester
Credits::	7.5
Module Owner::	Sinead Loughran
Departments:	Unknown
Module Description:	The aims of this module are to: introduce students to selected aspects of modern chemical and biochemical analytical instrumentation and techniques; increase students' confidence in undertaking analysis (independently and in a team) and in designing and executing experiments; encourage students to take careful measurements to assess the validity of their results.

Module Learning Outcome	
On successful completion of this module the learner will be able to:	
#	**Module Learning Outcome Description**
MLO1	Describe the fundamental theoretical basis of some chromatographic and spectroscopic including their applications and limitations.
MLO2	Compare and contrast common analytical techniques in separation science (GC and HPLC) and spectroscopy (Atomic and Molecular).
MLO3	Demonstrate proficiency in using a range of analytical instrumentation and techniques by following standard operating procedures.
MLO4	Combine technical skills and theoretical knowledge to define a problem in analytical science and select the most suitable technique to solve the problem.
MLO5	Assess the validity of analytical procedures and assays with reference to the ICH Harmonised Tripartite Guidelines on assay validation.

Pre-requisite learning
Module Recommendations *This is prior learning (or a practical skill) that is strongly recommended before enrolment in this module. You may enrol in this module if you have not acquired the recommended learning but you will have considerable difficulty in passing (i.e. achieving the learning outcomes of) the module. While the prior learning is expressed as named DkIT module(s) it also allows for learning (in another module or modules) which is equivalent to the learning specified in the named module(s).*
No recommendations listed

Module Indicative Content
Chromatography Introduction and general principles of chromatography, modes including Adsorption, Partition, Ion Exchange and Size Exclusion. Focus on gas liquid chromatography, including instrumentation, mobile/stationary phase selection, packed/capillary columns, detectors (FID, MS), applications and associated problems. Focus on HPLC; overview of HPLC, normal/reverse phase, column /mobile phase selection, diode-array detection and applications. Comparison of GC and HPLC. Chromatographic Parameters; Efficiency defined mathematically, Resolution defined and its dependence on chromatographic parameters will be illustrated for optimisation of resolution.
Molecular Spectroscopy The electromagnetic spectrum, absorption of UV/visible radiation, excitation of electrons, relationship of structure to absorption, Beer-Lambert Law. The range of colorimeters and spectrophotometers and a survey of the main components parts. Applications of UV and visible spectroscopy and quantitative calculations.
Atomic Spectroscopy Principle of absorption of energy by ground state atoms in gaseous state, electronic transitions, absorption/emission. Flame-based analytical systems; instrumentation, processes involved and examples of applications. Plasma-based techniques (ICP); comparison with flame-based techniques. Spectral, molecular, ionization and physical interferences. Quantitative techniques (including standard addition, internal standard). Application of atomic spectroscopy for sustainable environmental monitoring.
Validation of Analytical Procedures/Assays Focus on ICH (International Conference on Harmonisation) Harmonised Tripartite Guidelines on assay validation, validation characteristics; accuracy, precision, specificity, detection limit, quantitation limit, linearity, range will be defined and equations will be used in practice to validate data obtained by students during laboratory practicals and (where available).
Learning and Teaching Methods Teaching methods will comprise delivery of lectures and practical sessions with an emphasis on deep learning in a student-centred learning. A variety of blended and eLearning techniques will be deployed including in-class demonstrations, classroom assessment techniques, problem-based learning, peer assisted learning, self assessment and use of multi-media (animations, videos, eAssessments).
Virtual Learning Environment The DkIT Virtual Learning Environment (Moodle) page for Analytical Science will be used extensively as a repository for lecture material, past exam papers, video links, online resource links, online quizzes, feedback, peer-reviewed articles as well as documents pertaining to practical lab sessions (Material Safety Data Sheets).
Virtual Laboratory Experiments The use of virtual laboratory experiments in chromatography, spectroscopy and immobilisation reaction systems will complement laboratory practical sessions and reinforce fundamental theoretical concepts (for example; students will gain access to a CHROMacademy account managed by lecturer for full access to chromatography database, including HPLC, GC and hyphenated techniques, eLabs, assessments, webcasts, tutorials, lab simulations/ tools, peer-reviewed technical articles and application notes. Certification by CHROMacademy is also available to students upon completion of assessments).
Laboratory Practical Sessions The following list is designed to serve as an illustration of possible practical exercises which would illustrate key concepts and techniques: • Separation of pigments by thin layer chromatography, • Use of gas liquid chromatography to identify and quantify components in a mixture, • Use of internal and external standards in gas liquid chromatography for quantification, • Use of high performance liquid chromatography to detect and quantify selected analytes, • To assess column quality in HPLC separations, • To verify Beer-Lambert Law in UV-Vis spectroscopy, • To study absorption of visible light by compounds and their absorption spectra, • To study practical aspects of spectroscopy including accuracy, precision, sources of error and procedure validation, • To determine metal content by atomic absorption spectrophotometry using the standard addition method, • To determine metal content by flame photometry using an internal standard.

Module Assessment

Assessment Breakdown	%
Course Work	10.00%
Project	10.00%
Practical	30.00%
Final Examination	50.00%

Module Special Regulation

Assessments

Full Time On Campus

Course Work

Assessment Type	Continuous Assessment	**% of Total Mark**	10
Marks Out Of	0	**Pass Mark**	0
Timing	S1 Week 12	**Learning Outcome**	5
Duration in minutes	0		

Assessment Description
In class written evaluation of validation data.

Project

Assessment Type	Group Project	**% of Total Mark**	10
Marks Out Of	0	**Pass Mark**	0
Timing	End-of-Semester	**Learning Outcome**	4
Duration in minutes	0		

Assessment Description
Using the problem-based learning technique, students (small group work) will be given a problem to solve in forensic/pharmaceutical/environmental science for which they should combine technical skills (developed in practical sessions) and theoretical knowledge (developed through classroom and self-directed learning) to define the problem and select and apply the most suitable technique to solve the problem and present their findings.

Practical

Assessment Type	Practical/Skills Evaluation	**% of Total Mark**	30
Marks Out Of	0	**Pass Mark**	0
Timing	Every Week	**Learning Outcome**	3
Duration in minutes	0		

Assessment Description
A programme of weekly 3-hour laboratory practical sessions will run concurrently with lectures to reinforce fundamental theoretical concepts. Students will perform common analytical techniques using a suite of analytical instrumentation by following basic operating procedures, thereby gaining hands-on experience. Each student will be required to write a formal laboratory report for three experiments.

Final Examination

Assessment Type	Formal Exam	**% of Total Mark**	50
Marks Out Of	0	**Pass Mark**	0
Timing	End-of-Semester	**Learning Outcome**	1,2
Duration in minutes	0		

Assessment Description
End-of-Semester Final Examination

Reassessment Requirement
A repeat examination *Reassessment of this module will consist of a repeat examination. It is possible that there will also be a requirement to be reassessed in a coursework element.*

Module Workload

Workload: Full Time On Campus

Workload Type	*Contact Type*	*Workload Description*	*Frequency*	*Average Weekly Learner Workload*	*Hours*
Lecture	Contact	Learning and Teaching Methods described in Module Content	Every Week	3.00	3
Practical	Contact	A programme of weekly 3-hour laboratory practical sessions will run concurrently with lectures to reinforce fundamental theoretical concepts in separation science and spectroscopy.	Every Week	3.00	3
Directed Reading	Non Contact	Lecture notes, Peer-reviewed papers, Textbooks, e-Resources	Every Week	3.00	3
Independent Study	Non Contact	Independent/Group study	Every Week	4.00	4
Tutorial	Contact	Problem solving, recap and revision tutorial.	Every Week	1.00	1
				Total Weekly Learner Workload	14.00
				Total Weekly Contact Hours	7.00

This module has no Part Time On Campus workload.

Module Resources

Recommended Book Resources

Harris D C. (2012), Exploring chemical analysis, 5th. WH Freeman.

Skoog D. A., Holler F. J., and Crouch S.R.. (2017), Principles of instrumental analysis, 7th. Thomson Publ,.

Harris, D.C.. (2007), Quantitative chemical analysis, 7th. WH Freeman.

Watson D. G.. (2012), Pharmaceutical analysis, 3rd. Elsevier.

Supplementary Book Resources

Sinead T. Loughran, Dermot Walls. (2011), Protein Chromatography - Methods and Protocols; Methods in Molecular Biology, Humana Press, Copies available from Sinead Loughran.

De Levie, Robert. (2001), How to Use Excel in Analytical Chemistry : And in General Scientific Data Analysis [electronic resource], Cambridge University Press, DkIT Ebrary Collection.

This module does not have any article/paper resources

Other Resources

Website, ChromAcademy. E-learning in analytical science, lab simulation tools, webcasts, tutorials, peer-reviewed technical articles, http://www.chromacademy.com

Website, Chemistry Hypermedia Project - Virginia Polytechnic Institute and State University. Chromatography, http://www.files.chem.vt.edu/chem-ed/cro ssref/ac-separations.html

Website, Michigan State University Department of Chemistry. http://www2.chemistry.msu.edu/faculty/re usch/VirtTxtJml/Spectrpy/UV-Vis/spectrum .htm.

Website, Sam Houston State University Analytical Science resources. http://www.shsu.edu/~chm_tgc/sounds/soun d.html.

Website, Atomic Spectroscopy for Environmental Applications, http://www.chem.agilent.com/Library/prim ers/Public/Primer_Environmental_elementa l_analysis.pdf

Website, European Medicines Agency;. Validation of Analytical Procedures: Text and Methodology, http://www.ema.europa.eu/docs/en_GB/docu ment_library/Scientific_guideline/2009/0 9/WC500002662.pdf