CHEM08030
Spectroscopy

Full Title	Spectroscopy		
Status	Uploaded to Banner	**Start Term**	2020
NFQ Level	08	**ECTS Credits**	10
Module Code	CHEM08030	**Duration**	Semester - (13 Weeks)
Grading Mode	Numeric	**Department**	Physical & Life Sciences
Module Author	Aisling Crowley		
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Module Description

This module focuses on the application atomic and molecular spectroscopic methods in quantitative and qualitative analysis. Methods discussed include atomic absorption, atomic emission, X-ray fluorescence, UV/Visible, IR, Raman and NMR spectroscopies. The underlying theoretical principles, instrumentation and interpretation of results are examined. Applications in the analysis of environmental and pharmaceutical samples are emphasized..

	Learning Outcomes ***On completion of this module the learner will/should be able to:***
1.	Discuss the theoretical principles underlying FTIR, Raman, UV/Vis, Fluorescence and NMR spectroscopy
2.	Discuss the theoretical principles underlying atomic spectrometric techniques (AA/AE/XRF)
3.	Process, analyse and interpret spectra
4.	Evaluate and compare the suitability of different analytical techniques for a variety of sample types
5.	Create methods of analysis using FTIR, UV/Vis, AA and AE including adapting published methods to suit new samples.

Indicative Syllabus

Theory content:
1. Introduction to chemistry - Introduction to spectroscopy, electromagnetic radiation, atomic and molecular structure, models of chemical bonding, molecular symmetry and applications. (In tandem with introductory topics covered in chromatography)

2. Atomic absorption - atomisation using flame and furnace techniques. Interferences. Enrichment, separation and extraction techniques. Hydride and cold vapour techniques. Background correction. Atomic emission - flame and ICP methods. Applications of both absorption and emission in industry (pharmaceutical, forensic, environmental, etc...)

3. Ultraviolet and Visible spectroscopy: Common chromophores in pharmaceutical substances. Calculation of drug solubility, drug release, pKa values etc. Use of standard absorptivity values. Multicomponent analysis. Chemical derivatisation and derivative spectrometry.

4. Molecular emission spectrometry: Molecular structure and fluorescence. Applications of fluorescence spectrophotometry.
5. Infrared spectrophotometry: Mid-infrared in structure elucidation and as an identification technique. Applications of near-infrared IR.

6. NMR for characterisation of pharmaceutical substances and for impurity profiling.

Practical programme:
Twelve laboratory sessions will be conducted which will guide the student from fundamental laboratory skills such as volumetric analysis and sample preparation to more advanced topics such as the examination of pharmaceutical ingredients or presence of samples in environmental samples using analytical techniques including atomic absorption (AA), atomic emission (AE), UV-Vis, fluorimetry, infrared and NMR spectroscopy. Students will gain experience in processing and interpreting spectra and results.

Teaching and Learning Strategy

This module will be delivered in a blended format.

An initial on-campus day will be used for introductions, sharing of experiences and team building. The module will consist of weekly face to face practical classes in combination with online delivery of theoretical content.

The weekly practical classes will be used to engage students and promote a learning environment where learner development is nurtured through staff – student interactions. The practical classes will be task oriented and provide focus to students online learning. This will enable students to meaningfully engage with the online portion of the module and also become adept at self-directed learning. The profile of incoming student who will already have completed a level eight will make them particularly suited to developing skills in self directed learning.

In practical sessions, students will learn in a hands-on environment. Students will perform appropriate sample preparation using key lab techniques such as solvent extraction, suction filtration, volumetric analysis, etc... Students will have hands-on experience analysing samples using instruments such as UV spectrophotometers, fluorimeters, AAS, AES, IR spectrophotometers and NMR spectrometers. Students will gain experience processing, interpreting, and evaluating their own raw data.

New techniques will be demonstrated at the beginning of the labs and students will be encouraged to work independently and take initiative throughout the lab. Discussions will be held regarding the students results, their precision/accuracy in comparison to expected results or reference values (such as those found in the British Pharmacopeia), and implications of such results in industry, medicine, health, environment, etc... These discussions will help inform students lab reports.

The online learning environment will also be adapted to encourage student interaction through the use of scaffolding and workflow creation with students able to engage with materials that allow for self-assessment. Topic sections will be identified and planned in advance. A varied mix of content will be developed and delivered. Content will be developed in bite size elements. Each week there will be an activity planned. Activities can include (but not exclusive) discussion forums, quizzes etc.. The activity instructions will be defined & posted in advance. The lecturer will actively participate and give timely feedback in an appropriate manner, monitor students' progress, read the online "body language" via participation, progression, lurking and respond appropriately. In addition, use of automated personalised feedback and progress reports will provide students with an oversight of their own development and promote learner engagement.

At the same time, the lecturer as facilitator and moderator will encourage and enable quality communication both offline and online. Ground rules for acceptable and expected communication will be outlined at the start of the module. The lecturer will lead by example, by initiating discussion, giving prompts/questions, participating. Online and offline discussion will be encouraged and enabled as part of the learning process.

Assessment Strategy

To be awarded a pass in this module, a candidate must obtain a minimum of 35% in both the overall practical and the final exam elements of the module, separately. If the mark of the overall CA **or** the final exam falls below 35%, then the result for the module in question will be reviewed. As a consequence, the results for the module may be entered as 'Failed Element' subject to the candidate carrying out further work/assessment/exam, at the discretion of the programme board.

Repeat Assessment Strategies

Repeat assessment will be accommodated in line with GMIT Code of Practice No. 3 Student Assessment: Marks & Standards procedures and in compliance with programme board decisions.

Where a student fails to attend sufficient practical classes they may be required to repeat and attend.

Where a student has failed the practical component of the module the nature of assessment will be linked to the need to achieve particular learning outcomes. They may be in the form of a written assessment/assignment, a practical assessment or other relevant assessment.

Students who fail the theoretical component will be required to retake the theoretical exam at a subsequent exam session.

Individuals may be interviewed or asked to present their work in a formal context to validate authenticity and ownership of work.

Indicative Coursework and Continuous Assessment:		**60 %**		
Form	***Title***	***Percent***	***Week (Indicative)***	***Learning Outcomes***
Practical Evaluation	Practical Evaluation, Laboratory Assessments, Lab Reports, Lab Tests	40 %	OnGoing	3,4,5
Assessment	In-Class Assessments	20 %	OnGoing	1,2,4

End of Semester / Year Formal Exam:		**40 %**		
Form	***Title***	***Percent***	***Week (Indicative)***	***Learning Outcomes***
Closed Book Exam	Final Exam	40 %	End of Semester	1,2,3,4,5

Blended Delivery Mode Average Weekly Workload:			**5.00 Hours**		
Type	***Description***	***Location***	***Hours***	***Frequency***	***Weekly Avg***
Lecture	Lecture	Online	2	Weekly	2.00
Practical	Laboratory Practicals	Laboratory	3	Weekly	3.00

Required Reading Book List

Francis, A., (2013). *Chemical Analysis*. John Wiley & Sons.
ISBN 9781118681879 ISBN-13 1118681878

Vitha, F., (2018). *Spectroscopy*. Wiley.
ISBN 9781119436645 ISBN-13 1119436648

Recommended Reading Book List

Dasgupta, K., (2013). *Analytical Chemistry*. Wiley.
ISBN 0470887575 ISBN-13 9780470887578

Journal Resources

ISSN 1364-5528 - RSC: Analyst

Online Resources

pubs.acs.org

www.rsc.org

www.webofknowledge.com

Programme Membership

GA_SAACG_L08 202000 Higher Diploma in Science in Advanced Analytical Chemistry