

CHEM08024 Advanced Analytical Techniques

Full Title	Advanced Analytical Techniques		
Status	Uploaded to Banner	Start Term	2020
NFQ Level	08	ECTS Credits	10
Module Code	CHEM08024	Duration	Semester - (13 Weeks)
Grading Mode	Numeric	Department	Physical & Life Sciences
Module Author	Cormac Quigley		
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Module Description

This module will bring together the theory and practice from semester one and explore advanced analytical techniques. A particular focus will be on mass spectrometry and its use within chromatographic analytical techniques in theory and practice. In addition, the application of other hyphenated techniques and the theory behind them will be investigated. The application of these techniques to emerging areas within the biopharmaceutical industry will also be considered.

Learning Outcomes

On completion of this module the learner will/should be able to:

1. Critically assess different methods of analysis and their application to real analytical problems.
2. Evaluate the application of emerging and existing analytical techniques to a variety of sample types
3. Explain the theoretical principles underlying mass spectrometry and its suitability for analysis range of sample types
4. Explain the operation of a mass spectrometer as part of a GC, ICP and HPLC systems.
5. Analyse and interpret chromatographic data using chromatography/mass spectrometry software applications (Waters®, Agilent®) including integration, processing and reporting.
6. Describe the use of mass spectrometry as part of biocompatibility testing.

Indicative Syllabus

Theory:

- The fundamentals of mass spectrometry, ionisation, separation by m/z ratio and detection.
- MS and MS/MS instruments - scan mode, interpretation of chromatograms and creation of SIM and MRM modes.
- Ionization techniques - EI/CI, APCI, ESI, MALDI, FAB, DESI etc ICP and MP for the testing of metals.
- Hyphenated techniques and the intergration of MS with other analytical techniques.
- Advanced detector instrumentation - QTOF, Orbitrap, Ion traps, Mass Spectrometry Imaging and 3D Imaging techniques, how they work and what can they be used for.
- Mass spectrometry applications - the application of mass spectrometry to common sample types in chemical, biopharmaceutical and medical device industries.
- New and emerging analytical techniques and their applications - the application of analytical techniques to emerging sample types in chemical, biopharmaceutical and medical device industries.

Laboratory practicals:

- Hands on practice with instruments such as LC-MS and GC-MS
- The use of sample preparation techniques and the requirements of different chromatographic systems
- Qualitative and quantitative interpretation and evaluation of chromatograms using Waters® and Agilent® software.

Teaching and Learning Strategy

This module will be delivered in a blended format.

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.

Students will be exposed to a range of new techniques and pieces of equipment and will be given the opportunity to work in a hands on fashion to give students valuable experience on a range of instruments. Students will be encouraged to reflect on their practical activities and integrate their learning with the theoretical portion of the module. Students will also be encouraged to reflect on their experience and how it prepares them for potential work place situations.

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

This module will be assessed as follows:

Overall continuous assessment: 65%

- Laboratory reports: 50%
- Online assessment: 15%

Final exam: 35%

NOTE: To be awarded a pass in this module, a candidate must obtain a minimum of 35% in both the overall CA 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:		65 %		
Form	Title	Percent	Week (Indicative)	Learning Outcomes
Written Report	Laboratory skills and report writing	50 %	OnGoing	1,2,5,6
Assessment	Online assessment	15 %	TBA	3,4,5,6

End of Semester / Year Formal Exam:		35 %		
Form	Title	Percent	Week (Indicative)	Learning Outcomes
Closed Book Exam	Exam	35 %	End of Term	1,2,3,4,5,6

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

Required Reading Book List

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

Recommended Reading Book List

Taylor, M., (2001). *Inductively Coupled Plasma-Mass Spectrometry*. Academic Press.
ISBN 0126838658 ISBN-13 9780126838657

Orrin, Z., (2011). *Gas Chromatography and Mass Spectrometry*.
ISBN 0123736285 ISBN-13 9780123736284

Downard, K., (2004). *Mass Spectrometry*. Royal Society of Chemistry.
ISBN 9780854046096 ISBN-13 0854046097

Online Resources

<http://www.chromatographyonline.com/>
<https://www.chromacademy.com/>
<https://www.chromatographytoday.com/>
<https://www.rsc.org/>

Other Resources

Learners are encouraged to access the library for details of all journal and book holdings. Learners will be also directed to the virtual learning environment Moodle for educational resources.

Programme Membership

GA_SAACG_L08 202000 Higher Diploma in Science in Advanced Analytical Chemistry