



<b>Title:</b>	Separation Science <b>APPROVED</b>
<b>Long Title:</b>	Separation Science
<b>Module Code:</b>	CHEA9002
<b>Duration:</b>	1 Semester
<b>Credits:</b>	10
<b>NFQ Level:</b>	Expert
<b>Field of Study:</b>	Analytical Chemistry
<b>Valid From:</b>	Semester 1 - 2021/22 ( September 2021 )
<b>Module Delivered in</b>	<a href="#">2 programme(s)</a>
<b>Module Coordinator:</b>	Donagh OMahony
<b>Module Author:</b>	Mary Lehane
<b>Module Description:</b>	This module presents an overview of Advanced Separation techniques associated with sample preparation, primarily from Chromatography applications. This includes including principles of phase separation, separation method development, method optimisation and relevant analysis techniques.
<b>Learning Outcomes</b>	
<i>On successful completion of this module the learner will be able to:</i>	
LO1	Assess in detail the principles governing chromatographic separations
LO2	Analyse the principles of operation of chromatographic equipment and multistep complex separations
LO3	Develop and evaluate appropriate sample preparation protocols for trace analytes in complex matrices as a precursor to separation and/or purification
LO4	Perform a strategic assessment of an analytical problem problem and design a systematic and logical, step-wise approach to solving that problem
LO5	Critique various detection systems including advanced hyphenated techniques and assess their abilities and limitations in answering an analytical question
LO6	Assess and analyse chromatographic data to enable the validation of newly created methods and produce protocols to verify instrument performance
LO7	Design formalised techniques for method optimisation and troubleshooting of problems
<b>Pre-requisite learning</b>	
<b>Module Recommendations</b>	
<i>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 CIT module(s) it also allows for learning (in another module or modules) which is equivalent to the learning specified in the named module(s).</i>	
<b>Incompatible Modules</b>	
<i>These are modules which have learning outcomes that are too similar to the learning outcomes of this module. You may not earn additional credit for the same learning and therefore you may not enrol in this module if you have successfully completed any modules in the incompatible list.</i>	
No incompatible modules listed	
<b>Co-requisite Modules</b>	
No Co-requisite modules listed	
<b>Requirements</b>	
<i>This is prior learning (or a practical skill) that is mandatory before enrolment in this module is allowed. You may not enrol on this module if you have not acquired the learning specified in this section.</i>	
No requirements listed	



**Module Content & Assessment**
**Indicative Content**
**Chromatography Theory**

Separation parameters and equations. Optimisation parameters and equations. Sorption mechanisms, plate theory versus rate theory, problem-solving. Sample preparation, Method Validation, Instrument Performance Verification, and Troubleshooting.

**Liquid solid chromatography**

Liquid chromatography (LC) instrumentation. LC mobile phase optimisation. LC column characteristics. Stationary phase technology. Peak shape optimisation, Van Deemter Equation. Multidimensional chromatography. Ion Chromatography. Ultra Performance LC (UPLC) Derivatisation methods for LC, and 2D-LC

**Gas chromatography (GC)**

GC instrumentation. GC column design and stationary phases. Sampling and injection methods for GC. Derivatisation methods in GC analysis. Solid Phase Micro Extraction

**Chromatography-Mass Spectrometry**

Liquid chromatography-mass spectrometry (LC-MS and LC-MS/MS) instrumentation: Principles, operation, and applications. Gas chromatography-mass spectrometry (GC-MS and GC-MS/MS) instrumentation: Principles, instrumentation and operation. Matrix Effects and Sample clean-up by Solid Phase Extraction. Solid Phase Micro Extraction (SPME) sampling

**Supercritical Fluid Chromatography (SFC)**

Principles, operation and applications of SFC and SCF extraction

**Preparative Chromatography and Electrophoresis**

Theory, Principles and Applications. LC, Size Exclusion Chromatography and Chiral Chromatography. Large scale GC and TLC. Theory of electrophoresis and techniques (High resolution, PAGE, 2-d, CE, IEF)

**Planar Chromatography**

Thin Layer Chromatography (TLC), principles and applications, 2-dimensional TLC, detection systems.

**Assessment Breakdown**

	%
Course Work	75.00%
End of Module Formal Examination	25.00%

**Course Work**

Assessment Type	Assessment Description	Outcome addressed	% of total	Assessment Date
Presentation	Selected applications of chromatographic methods.	1,2,3,4,7	30.0	Week 10
Multiple Choice Questions	Theoretical principles of Chromatography	1,2,5,6	15.0	Week 6
Practical/Skills Evaluation	Assessment of practical skills, troubleshooting, data evaluation, and report writing	2,3,4,6,7	30.0	Every Second Week

**End of Module Formal Examination**

Assessment Type	Assessment Description	Outcome addressed	% of total	Assessment Date
Formal Exam	End-of-Semester Final Examination	1,2,3,4,5,6	25.0	End-of-Semester

**Reassessment Requirement**
**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.

The institute reserves the right to alter the nature and timings of assessment

## Module Workload

<b>Workload: Full Time</b>				
<i>Workload Type</i>	<i>Workload Description</i>	<i>Hours</i>	<i>Frequency</i>	<i>Average Weekly Learner Workload</i>
Lecture	Lectures on Separation Science theory with emphasis on advanced chromatography applications	2.0	Every Week	2.00
Lab	Laboratory practical work focussed on developing skills in separation and chromatography instrumentation, sample measurement and data analysis principles	4.0	Every Second Week	2.00
Independent Learning	Theory/practical skills review and problem-based learning associated with separation methodologies and chromatography measurement & data analysis	10.0	Every Week	10.00
Total Hours				16.00
Total Weekly Learner Workload				14.00
Total Weekly Contact Hours				4.00
<b>Workload: Part Time</b>				
<i>Workload Type</i>	<i>Workload Description</i>	<i>Hours</i>	<i>Frequency</i>	<i>Average Weekly Learner Workload</i>
Lecture	Advanced Chromatography	2.0	Every Week	2.00
Lab	Separation laboratories	4.0	Every Second Week	2.00
Independent Learning	Problem Solving	10.0	Every Week	10.00
Total Hours				16.00
Total Weekly Learner Workload				14.00
Total Weekly Contact Hours				4.00

## Module Resources

### Recommended Book Resources

- Veronika R. Meyer 2010, *Practical High-Performance Liquid Chromatography*, 5th Ed., Wiley-Blackwell N.J., U.S. [ISBN: 0470682175]

### Supplementary Book Resources

- David O. Sparkman 2009, *Gas Chromatography and Mass Spectrometry*, 2nd Ed., Elsevier Oxford, U.K. [ISBN: 0471498017]
- Gerard Rosse 2018, *Supercritical fluid Chromatography*, de Gruyter Germany [ISBN: 9783110500752]

*This module does not have any article/paper resources*

### Other Resources

- website: S. Gottlieb, J. Hofelt 2020, *Chromatography*, Libretexts  
[https://chem.libretexts.org/Bookshelves/Analytical\\_Chemistry/Supplemental Modules \(Analytical Chemistry\)/Instrumental Analysis/Chromatography](https://chem.libretexts.org/Bookshelves/Analytical_Chemistry/Supplemental_Modules_(Analytical_Chemistry)/Instrumental_Analysis/Chromatography)
- website: Chromatography online. Editor-in-Chief: A. Matheson 2020, *Chromatography*, MJH Life Sciences™ and Chromatography Online, European edition: UK  
<https://www.chromatographyonline.com/>
- Website: NIST  
<https://chemdata.nist.gov/>
- Website: *ejournals science engineering*  
[https://library.cit.ie/ejournals/science engineering](https://library.cit.ie/ejournals/science_engineering)

**Module Delivered in**

<b>Programme Code</b>	<b>Programme</b>	<b>Semester</b>	<b>Delivery</b>
CR_SASIV_9	<a href="#"><u>MSc in Analytical Sciences with Instrument Validation</u></a>	1	Mandatory
CR_SANIV_9	<a href="#"><u>Postgraduate Diploma in Analytical Sciences with Instrument Validation</u></a>	1	Mandatory