

Module Details	
Module Title	Advanced Methods in Analytical Science
Module Code	CFS7029-B
Academic Year	2023/4
Credits	20
School	School of Chemistry and Biosciences
FHEQ Level	FHEQ Level 7

Contact Hours	
Type	Hours
Laboratories	5
Directed Study	163
Practical Classes or Workshops	4
Tutorials	13
Online Lecture (Asynchronous)	5
Interactive Learning Objects	10

Availability	
Occurrence	Location / Period
BDA	University of Bradford / Semester 1

Module Aims
<p>This module provides fundamental knowledge concerning strategies for sampling, data analysis, reporting, quality assurance and quality control, numerical, statistical, information technology, reporting and safety in relation to analytical science.</p>

Outline Syllabus

Module introduction. Fundamental principles of analytical science and introduction to chemical metrology. Course philosophy. The Analytical Method.

Laboratory notebooks and other writing styles (SOP, expert witness, reports, academic publications), references, plagiarism. Health and Safety: Laboratory, Biological, COSHH, Fieldwork.

Accuracy, Precision and Calibration Exercise: Micropipettes. Experimental errors. Systematic errors, random errors, estimating and combining, normal distribution, standard deviation.

Sampling. Sample selection, numbers, size, contamination issues, storage, destructive/non-destructive analysis, in-situ analysis.

Numerical and IT skills: Data interpretation and calculations. Statistical methods: Normal distributions.

Propagation of errors: Preparation of standard calibration solutions. Statistical methods: Histograms and CV.

Experimental design, hypothesis testing. Data analysis: Descriptive, Outliers, One, two, three, Multivariate analysis. Visualisation of data.

Method validation - statistics. Samples and Populations. Confidence Interval, t-tests, Significance testing, Hypothesis testing.

Quality assurance and Quality control. Selectivity/specificity, robustness, stability, precision, sensitivity, accuracy (SRMs). Quantification: External standards (linearity), Internal standards (drift), Isotope dilution. critical areas. Calibration curve uncertainty. LOD, LOQ, LOL: Dynamic Range.

The interaction of electromagnetic radiation and matter. Spectroscopy. Biological assays. COVID testing.

Advanced methods in complex samples. SEM and TEM data interpretation. Experimental design, complex samples. Experimental design: AAS and AES. Mass Spectrometry and chromatography experimental design. Other methods.

Recent article review.

Revision and exam advice.

Learning Outcomes

Outcome Number	Description
01	Critically understand experimental design; from selection, preparation, instrumental analysis of samples, to data analysis and reporting.
02	To select and use appropriate statistical and reporting methods.
03	Apply descriptive, significance testing and hypothesis testing statistical methods to analytical data and problems.
04	Critically analyse, interpret and apply method validation, quality assurance and quality control methods.
05	Critically review experimental data.
06	Apply advanced analytical and problem-solving skills.
07	Apply safety legislation and best practice with regards to chemical and biological samples.
08	Manipulate and present analytical data using numerical, statistical and IT skills.
09	Be familiar with different formats for reporting scientific methods and results (including group working).

Learning, Teaching and Assessment Strategy

The module uses a blended approach to support learning and achievement. Students will engage with a series of weekly online learning packages. These will include short videos that address key concepts, a set of structured activities (reading, online discussions etc.) that 'scaffold' the learning, and a range of formative tasks that generate feedback on progress. Online and on-campus practical sessions and workshops will provide opportunity to apply knowledge and gain experience with instrumentation. Online tutorials will also be used to support learning and monitor progress as students move through the curriculum.

Mode of Assessment

Type	Method	Description	Weighting
Summative	Examination - Closed Book	A formal exam covering the taught syllabus. Short questions followed by longer essay type questions. (2 Hrs)	50%
Summative	Coursework - Written	Problem solving.	50%

Reading List

To access the reading list for this module, please visit <https://bradford.rl.talis.com/index.html>

Please note:

This module descriptor has been published in advance of the academic year to which it applies. Every effort has been made to ensure that the information is accurate at the time of publication, but minor changes may occur given the interval between publishing and commencement of teaching. Upon commencement of the module, students will receive a handbook with further detail about the module and any changes will be discussed and/or communicated at this point.