# ICP-OES, ICP-MS and AAS: Elemental Analysis, Interferences and QC

31 May – 4 June 2027
London - Central London four-star



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## Introduction:

Metals and trace element results from ICP-OES, ICP-MS and atomic absorption spectroscopy decide whether crude, catalysts, drinking water, effluent, ores and foodstuffs pass their limits, yet incomplete digestion, uncorrected spectral overlaps, drifting plasma conditions and thin QC records still send wrong numbers to clients and regulators. This Core Concept course takes laboratory analysts from atomic spectroscopy principles through flame and graphite furnace AAS, plasma instrumentation, microwave digestion, interference correction, calibration, QC samples and instrument care. Participants build an Elemental Analysis Method Sheet and QC Plan for one analyte suite from their own laboratory.

## Course Objectives:

- Select flame AAS, graphite furnace AAS, ICP-OES or ICP-MS for an analyte list by matching detection needs, matrix load and sample throughput
- Prepare solid, oil and aqueous samples for metals determination using acid dilution, hotplate and closed-vessel microwave digestion without loss or contamination
- Identify spectral, polyatomic, isobaric and matrix interferences and apply background correction, interelement correction or collision/reaction cell settings to remove them
- Build calibrations with external standards, matrix matching, standard additions and internal standards and verify them with independent check solutions
- Run the QC sample sequence of blanks, fortified blanks, fortified matrices and continuing checks and estimate detection limits, linear range and spike recovery for a metals method
- Maintain nebulisers, spray chambers, torches, interface cones, lamps and graphite tubes and trace drift or sensitivity loss to its cause before results are reported

## Target Audience:

- Analysts who prepare samples and run AAS, ICP-OES or ICP-MS measurements for metals and trace elements
- Chemists who develop, verify and document elemental analysis methods for water, environmental, mining, food or petroleum samples
- Instrument operators who tune plasma and furnace systems and carry out routine user maintenance
- Senior technicians who review metals data batches and approve results for reporting
- Quality control staff who schedule QC samples and follow up failed checks in elemental analysis sections

## Course Outline:

### Day 1: Atomic Spectroscopy Principles and Technique Selection

- Atomic Absorption, Atomic Emission and Ion Formation: Energy Levels and Characteristic Wavelengths
- Beer-Lambert Relationship and Emission Intensity Versus Concentration
- Technique Selection Matrix: Flame AAS, Graphite Furnace AAS, ICP-OES and ICP-MS
- Typical Analyte Suites: Wear Metals in Oils, Heavy Metals in Water, Ore Grades and Food Contaminants
- Elemental Analysis Current-State Review: Instruments, Methods and Analyte Lists

### Day 2: AAS, ICP-OES and ICP-MS Instrument Architecture

- Hollow Cathode Lamps, Air-Acetylene and Nitrous Oxide-Acetylene Flames and Burner Heads
- Graphite Furnace Temperature Program: Drying, Pyrolysis, Atomisation and Cleaning with STPF Conditions
- Sample Introduction for Plasma: Peristaltic Pump, Nebuliser Types and Spray Chambers
- ICP Torch, RF Generator, Radial and Axial Viewing, Grating Optics and CCD Detectors
- ICP-MS Interface: Sampler and Skimmer Cones, Ion Lenses, Collision/Reaction Cell and Quadrupole

### Day 3: Sample Digestion, Calibration Design and Interference Correction

- Closed-Vessel Microwave Digestion Programs, Acid Choice and Vessel Cleaning
- Oil and Organic Sample Handling: Solvent Dilution and Ashing Options
- Calibration Approaches: External Standards, Matrix Matching and Standard Additions
- Internal Standard Selection: Scandium, Yttrium, Indium, Terbium and Bismuth Response Tracking
- Deuterium and Zeeman Background Correction, Interelement Correction Factors and Polyatomic Ion Removal

### Day 4: QC Samples, Detection Limits and Instrument Upkeep

- QC Sequence Design: Calibration Blank, Fortified Blank, Fortified Matrix and Performance Checks
- Method Detection Limit from Seven Replicates and Limit of Quantitation Setting
- Linear Dynamic Range, Spike Recovery and Duplicate Precision Acceptance Windows
- Plasma Tuning Checks with Magnesium and Lead Isotopes and Short-Term Stability Tests
- Maintenance and Fault Tracing: Blocked Nebulisers, Worn Cones, Torch Deposits, Weak Lamps and Tube Ageing

## Day 5: Case Study Workshop: Elemental Analysis Method Sheet and QC Plan

- Case Study: Wear Metal Panel in Used Lubricating Oil by ICP-OES
- Case Study: Trace Arsenic, Lead and Cadmium in Drinking Water by ICP-MS
- Case Study: Failed Internal Standard Recovery and Batch Rerun Decision
- Build: Elemental Analysis Method Sheet and QC Plan for an Own-Laboratory Analyte Suite
- Metals Data Review Checklist and Certificate Reporting Peer Review

## Skills You Will Gain:

- Atomic Spectrometry Technique Selection
- Microwave Acid Digestion
- Spectral Interference Correction
- Internal Standardisation
- Detection Limit Estimation
- Plasma Instrument Tuning
- Sample Introduction System Care
- Metals Data Review

## Why Attend This Course:

- Leave with an Elemental Analysis Method Sheet and QC Plan for an analyte suite your laboratory already runs, ready for supervisor sign-off
- Reduce reruns and lost plasma time by recognising a digestion, interference or hardware fault from the QC pattern it leaves
- Answer client and auditor questions on metals results with documented detection limits, recoveries and interference corrections
- Compare elemental analysis practice with analysts from refinery, utility, environmental, mining and food testing laboratories

## Conclusion:

Defensible metals results rest on the right atomic spectrometry technique, a complete digestion, corrected interferences, a stable calibration and a QC sequence that catches drift before it reaches a certificate. The course moves from absorption and emission principles through AAS, ICP-OES and ICP-MS hardware, then to digestion, calibration, internal standards and interference removal, before detection limits, QC samples and instrument upkeep. The final day turns this into an Elemental Analysis Method Sheet and QC Plan participants can use at their next batch review.