

Hands-on Training Programme

Report

# Inductively Coupled Plasma-Mass Spectrometer

10 January 2025



Patron

**Prof. Neelima Gupta**  
Hon'ble Vice Chancellor

Chief Coordinator  
**Prof. Shweta Yadav**

Course Coordinators  
**Prof. A. K. Singh**  
**Dr. Vivek Prakash Malviya**

Technical Officer  
**Dr. Vivek Kumar Pandey**

Technical Team:  
**Mr. Ramesh C. Prajapati**  
**Mr. Shivprakash Solanki**  
**Mr. Saurabh Sah**  
**Mr. Ashish Chadhar**  
**Mr. Aravind Chadhar**



# Centre for Advanced Research (CAR) Dr Harisingh Gour Vishwavidyalaya, Sagar

The Centre for Advanced Research (CAR) at Dr. Harisingh Gour Vishwavidyalaya hosted a successful one-day hands-on training program on Inductively Coupled Plasma-Mass Spectrometer (ICP-MS) on January 10, 2025. The program, attended by 33 enthusiastic participants across various disciplines of Applied Science, aimed to provide comprehensive training on the principles, operation, and applications of ICP-MS. The program included a balanced blend of theoretical lectures and hands-on practical sessions.

Inductively Coupled Plasma Mass Spectrometry (ICP-MS) is a powerful analytical technique used to measure the elemental composition of a sample. Here's a glimpse into the theoretical aspects that underpin its operation:

## 1. The Inductively Coupled Plasma (ICP)

- **Generation:** The heart of ICP-MS is the ICP, a high-temperature plasma generated by radiofrequency energy. An alternating current in a coil surrounding a quartz torch creates a magnetic field, which ionizes argon gas flowing through the torch, producing a plasma with temperatures reaching 6,000-10,000 K.
- **Ionization:** The high temperature of the ICP causes the sample introduced into it to vaporize and atomize. Further collisions with the plasma result in the ionization of these atoms, creating positively charged ions.

## 2. Ion Extraction and Focusing

- **Interface:** The ions formed in the ICP are extracted into the mass spectrometer through a series of cones, forming an interface between the high-pressure plasma and the vacuum of the mass spectrometer.
- **Ion Optics:** Ion lenses or guides are used to focus the ion beam and direct it into the mass analyzer.

## 3. Mass Analysis

- **Mass Analyzer:** The mass analyzer separates the ions based on their mass-to-charge ratio ( $m/z$ ). Different types of mass analyzers can be used, including:
  - **Quadrupole Mass Analyzer:** Uses electric fields to filter ions based on their  $m/z$ .
  - **Time-of-Flight (TOF) Mass Analyzer:** Measures the time it takes for ions to travel through a flight tube, separating them based on their  $m/z$ .
  - **Magnetic Sector Mass Analyzer:** Uses magnetic fields to bend the path of ions, separating them based on their  $m/z$ .

#### 4. Detection

- **Detector:** The detector measures the abundance of each ion reaching it. Common detectors include:
  - **Electron Multiplier:** Produces a cascade of electrons when struck by an ion, amplifying the signal.
  - **Faraday Cup:** Measures the current produced by ions striking it.

#### 5. Data Analysis

- **Data Processing:** The data collected by the detector is processed to determine the elemental composition and concentration of the sample.

#### Theoretical Considerations

- **Plasma Physics:** Understanding the physics of the ICP, including the processes of ionization, excitation, and recombination, is crucial for optimizing ICP-MS performance.
- **Ion Optics:** The design and operation of ion lenses and guides are critical for efficient ion transmission and minimizing background noise.
- **Mass Spectrometry:** A thorough understanding of mass analyzers and their principles of operation is essential for accurate mass determination and resolution.
- **Isotope Abundance:** ICP-MS can measure isotopic ratios, requiring knowledge of the natural abundance of isotopes for accurate quantification.
- **Interferences:** Isobaric interferences (ions with the same  $m/z$ ) can occur, requiring careful selection of isotopes and the use of interference correction methods.

#### Applications of ICP-MS

ICP-MS is a versatile technique with applications in various fields, including:

- **Environmental Monitoring:** Measuring trace elements in water, soil, and air.
- **Geochemistry:** Determining the age and composition of rocks and minerals.
- **Materials Science:** Analyzing the elemental composition of metals, alloys, and polymers.
- **Clinical Chemistry:** Measuring trace elements in biological fluids.
- **Food Science:** Analyzing the elemental composition of food products.

This is just a glimpse into the theoretical aspects of ICP-MS. A deeper understanding of these concepts is essential for effective operation and interpretation of results.

#### Program Highlights

- **Expert Guidance:** The training program was led by keynote speaker Prof. A. K. Singh & Dr. Vivek Prakash Malviya, Teacher In-charge of ICP-MS, and coordinated by Professor Shweta Yadav, Chief Coordinator of CAR. Professor Shweta Yadav, started the session with brief introduction of the Centre for Advanced Research and informed about the upcoming workshops to be conducted in the Vishwavidyalaya and wished the participants all the best for the training.



Researchers/scientists/students engaged in a lively discussion about the theoretical underpinnings of ICP-MS.

- Theoretical Sessions: The program included a balanced mix of theoretical lectures and hands-on practical sessions, ensuring a thorough understanding of ICP-MS. Prof. A. K. Singh & Dr. Vivek Prakash Malviya were the key note speakers during the session. In the Inductively Coupled Plasma- Mass Spectrometry (ICP-MS) lecture session, Dr. Vivek Prakash Malviya, Department of Applied Geology sensitized the participants from very basic to advance level regarding the general introduction of the ICP-MS, basic principle of ICP-MS technique, and its applications in the diverse field of Applied Sciences.
- Prof. A.K Singh, Department of Applied Geology explained to the participants how the ICP-MS can be utilized for rock sample and Geological sample. Briefly sample preparation protocols were also discussed and the queries of the participants were entertained to clear their doubts related to sample types and sample preparation.



A step-by-step demonstration of the ICP-MS workflow, from sample preparation to data interpretation.

- Practical Sessions: Demonstration and hands-on practice session on the ICP-MS and its peripherals started with a brief introduction of the hardware portion the ICP-MS instrument and its peripherals by Dr Vivek Kumar Pandey & Mr. Ramesh Prajapati, CAR.
- Hands-on session: In lab hands-on session, Dr. Vivek Kumar Pandey, CAR, briefed ICP-MS software part, instrument calibration, functioning and sample preparation methods with special emphasis on water sample collection, sampling & analysis. Method to collect a sample and sampling protocols were also discussed and the queries of the participants to their field of interest were entertained.



*Delving into the intricacies of the ICP-MS interface, where ions are extracted from the plasma and guided into the mass spectrometer.*

- Comprehensive Coverage: Participants were introduced to the history, principles, sample preparation techniques, and diverse applications of ICP-MS across various scientific disciplines. The complete process from the sample preparations, its analysis to data interpretation was provided to the participants.
- Interactive Sessions: The program encouraged active participation, with ample opportunities for questions and discussions to clarify doubts related to ICP-MS, sample types, and preparation methods. Participants were encouraged for using the ICP-MS facility for enhancing the quality of their research and publication



Observing the mass analyzer in action, separating ions based on their mass-to-charge ratio, revealing the elemental composition of the sample.

- Hands-on Experience: Participants gained practical experience in operating the ICP-MS instrument and its peripherals, including sample preparation, analysis, and data interpretation. 02 Group of participants were made to perform the experiment from scratch. Some of the participants performed the sample preparation and analysed their samples also.



A glimpse into the lab: Witnessing the dedication and precision required for accurate ICP-MS analysis.

- Technical Support: Technical support was provided by Mr. Ashish Chadar and dedicated technical team from CAR ensuring a smooth and enriching learning experience during entire session.



Enthusiastic learners at the ICP-MS training program, delving into the world of inductively coupled plasma mass spectrometry.

Participants were briefed with the online booking facility of CAR and official email id [car@dhsgsu.edu](mailto:car@dhsgsu.edu) provided for any query. Recently introduced On demand training facility for various sophisticated instrument facility available at Centre for Advanced Research (CAR) were also discussed.

### Feedback

The training concluded with a feedback session, allowing participants to share their suggestions for improving future training programs. Participants were briefed with the other sophisticated instrument facility available at Centre for Advanced Research (CAR).



Patron  
Prof. Neelima Gupta  
Hon'ble Vice Chancellor

## One Day Hands-on Training Programme

on

### Inductively Coupled Plasma-Mass Spectrometer (ICP-MS)

10<sup>th</sup> January, 2025



Centre for Advanced Research (CAR)

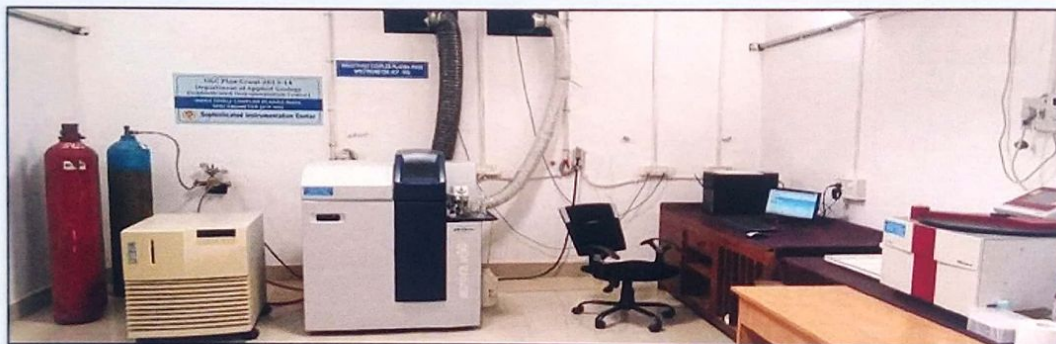
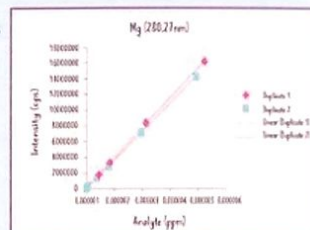
Dr. Harisingh Gour Vishwavidyalaya (A Central University) Sagar [M.P.]

### Inductively Coupled Plasma-Mass Spectrometer (ICP-MS)

One day demonstration on the Atomic determination of trace elements.

#### Training Highlights:

- Sample preparation.
- Elemental detection from water/soil samples.
- Heavy metals Cr, Mn, Co, Cu, Ag, Pb etc. quantification in environmental samples.
- ICP-MS Data Processing.
- Safety Protocols of ICP-MS.



Inductively Coupled Plasma-Mass Spectrometer Lab

#### Who can attend:

UG & PG Students/Research Scholars  
of all Applied Sciences

#### Registration fee

Internal (DHSGSU) Participants: Rs. 200/-

External Participants : Rs. 350/-

(Fee non-refundable)

#### Chief Coordinator

Prof. Shweta Yadav

#### Course Coordinator

Prof. A. K. Singh

Dr. Vivek Prakash Malviya

#### Technical Officer

Dr. Vivek Kumar Pandey

#### Bank Detail for paying Reg. Fees

|              |                              |
|--------------|------------------------------|
| Account name | Centre for Advanced Research |
| Account no.  | 41487942215                  |
| Bank name    | State Bank of India          |
| Branch       | Saugor University            |
| IFS Code     | SBIN0001143                  |

**Last Date of Registration:** 08<sup>th</sup> January, 2025

**Maximum No. of Participants:** 25

(Registrations will be closed once seats are filled)

Notification to selected participants on or before: 09<sup>th</sup> January, 2025

**Venue:** ICP-MS Lab, Department of Applied Geology,

DHSGSU, Sagar

**Note:** Only E-certificate will be provided to the registered participants.

Fooding & lodging will be the responsibility of the participants only.



Registration link:

<https://tinyurl.com/2jwbdajd>

For any query please write us: sic122015@gmail.com

## List of Participants

| S.N. | Name                  | Institute / Organisation Name      | Type of Participant |
|------|-----------------------|------------------------------------|---------------------|
| 1.   | SHASWAT KUMAR         | Dr. Harisingh Gour Vishwavidyalaya | Research Scholar    |
| 2.   | MANASWITA JHA         | Dr. Harisingh Gour Vishwavidyalaya | PG student          |
| 3.   | ANSHIKA RAJE          | Dr. Harisingh Gour Vishwavidyalaya | UG student          |
| 4.   | OM SHARMA             | Dr. Harisingh Gour Vishwavidyalaya | PG student          |
| 5.   | SHIV SHANAKAR MARKAM  | Dr. Harisingh Gour Vishwavidyalaya | Research Scholar    |
| 6.   | GURPREET SINGH        | Dr. Harisingh Gour Vishwavidyalaya | Research Scholar    |
| 7.   | SHIKHA PATHAK         | Dr. Harisingh Gour Vishwavidyalaya | Research Scholar    |
| 8.   | MAYANK PANDEY         | Banasthali Vidyapith               | Research Scholar    |
| 9.   | SRIJAN PANDEY         | Banasthali Vidyapith               | Research Scholar    |
| 10.  | KRIPALI BAGHEL        | Dr. Harisingh Gour Vishwavidyalaya | Research Scholar    |
| 11.  | SIDDHARTH RAJPUT      | Dr. Harisingh Gour Vishwavidyalaya | Research Scholar    |
| 12.  | ADARSH KUMAR          | Dr. Harisingh Gour Vishwavidyalaya | Research Scholar    |
| 13.  | RAKHI SAHU            | Dr. Harisingh Gour Vishwavidyalaya | Research Scholar    |
| 14.  | SANSKRITI TAMRAKAR    | Dr. Harisingh Gour Vishwavidyalaya | Research Scholar    |
| 15.  | DIVYA RAI             | Dr. Harisingh Gour Vishwavidyalaya | Research Scholar    |
| 16.  | DEVKINANDAN KURMI     | Bundelkhand medical college sagar  | Research Scholar    |
| 17.  | BALRAM JEE            | Dr. Harisingh Gour Vishwavidyalaya | Research Scholar    |
| 18.  | GIRJA AHIRWAR         | Dr. Harisingh Gour Vishwavidyalaya | Research Scholar    |
| 19.  | SHRUTI JAIN           | Dr. Harisingh Gour Vishwavidyalaya | Research Scholar    |
| 20.  | MR. SUNNY RATHEE      | Dr. Harisingh Gour Vishwavidyalaya | Research Scholar    |
| 21.  | GOURAB ROUT           | Dr. Harisingh Gour Vishwavidyalaya | PG student          |
| 22.  | SAKSHI                | Dr. Harisingh Gour Vishwavidyalaya | Research Scholar    |
| 23.  | SUPRITI MAHAPATRA     | Dr. Harisingh Gour Vishwavidyalaya | PG student          |
| 24.  | SAGAR SINGH SHEKHAWAT | Dr. Harisingh Gour Vishwavidyalaya | PG student          |
| 25.  | MADHURI SINGH MASHRAM | Dr. Harisingh Gour Vishwavidyalaya | PG student          |
| 26.  | LAXMI KURMI           | Dr. Harisingh Gour Vishwavidyalaya | Research Scholar    |
| 27.  | ANKESH AHIRWAR        | Dr. Harisingh Gour Vishwavidyalaya | Research Scholar    |
| 28.  | ANAMIKA TIWARI        | Dr. Harisingh Gour Vishwavidyalaya | PG student          |
| 29.  | DEVENDRA              | Dr. Harisingh Gour Vishwavidyalaya | PG student          |
| 30.  | SUMANA MURMU          | Dr. Harisingh Gour Vishwavidyalaya | Research Scholar    |
| 31.  | PREETI PATLE          | Dr. Harisingh Gour Vishwavidyalaya | PG student          |
| 32.  | JYOTI BIDOLYA         | Dr. Harisingh Gour Vishwavidyalaya | Research Scholar    |
| 33.  | AKSHYATA SAHOO        | Dr. Harisingh Gour Vishwavidyalaya | Research Scholar    |

## Media Coverage

## आचरण

## एक दिवसीय कार्यशाला का आयोजन



सागर,आचरणा। डॉ हरीसिंह गौर विश्वविद्यालय की कुलगुरु प्रो. नीलिमा गुप्ता के मार्गदर्शन में विश्वविद्यालय अलग-अलग परिष्कृत उपकरणों पर कार्यशाला आयोजित कर रहा है। इसी संदर्भ में विश्वविद्यालय के उन्नत अनुसंधान केंद्र में इंडिक्टिवली कपलड मास स्पेक्ट्रोमेट्री पर एक दिवसीय कार्यशाला का आयोजन किया गया, जिसमें कुल 33 प्रतिभागियों ने भाग लिया. उक्त कार्यशाला में मुख्य वक्ता डॉ. विवेक प्रकाश मालवीय एवं प्रो. ए.के. सिंह रहे जिन्होंने आईसीपीएमएस मशीन से हेवी मेटल डिटेक्शन एवं विभिन्न सैंपल में मेटलिक कंटेस्टेशन कैसे निकाला जाता है, इस बारे में बताया. कार्यशाला में विभिन्न शैक्षिक संस्थानों से आए प्रतिभागियों को आईसीपीएमएस मशीन पर हैड्स ऑन प्रशिक्षण दिया गया. कार्यक्रम की शुरुआत में उन्नत अनुसंधान केंद्र की मुख्य समन्वयक प्रो. श्वेता यादव द्वारा केंद्र के द्वारा संचालित विभिन्न प्रशिक्षण कार्यशालाओं के बारे में बताया गया एवं विश्वविद्यालय में संचालित होने वाली आगामी कार्यशालाओं के बारे में अवगत कराया गया एवं प्रशिक्षण हेतु प्रतिभागियों की शुभकामनाएं दी गई।

विवि के उन्नत अनुसंधान केंद्र  
में एक दिवसीय कार्यशाला



सागर. डॉ. हरिसिंह गौर विश्वविद्यालय के उन्नत अनुसंधान केंद्र में सोमवार को इंडिक्टवली कपल्ड मास स्पेक्ट्रोमेट्री पर एक दिवसीय कार्यशाला का आयोजन किया गया। कार्यशाला में 33 प्रतिभागियों ने भाग लिया। वक्ता डॉ. विवेक प्रकाश मालवीय, प्रो. एके सिंह ने आइसीपीएमएस मशीन से हेवी मेटल डिटेक्शन व विभिन्न सैंपल की जानकारी दी। कार्यशाला में विभिन्न शैक्षिक संस्थानों से आए प्रतिभागियों को आइसीपीएमएस मशीन पर हैंड्स ऑन प्रशिक्षण दिया गया। कार्यक्रम की शुरुआत में उन्नत अनुसंधान केंद्र की मुख्य समन्वयक प्रो. श्वेता यादव द्वारा केंद्र के द्वारा संचालित विभिन्न प्रशिक्षण कार्यशालाओं के बारे में बताया गया। विश्वविद्यालय में संचालित होने वाली आगामी कार्यशालाओं के बारे में अवगत कराया गया और प्रशिक्षण के लिए प्रतिभागियों को प्रोत्साहित किया।

इंडिकिवली कपल्ड मास स्पेक्ट्रोमेट्री पर एक  
दिवसीय कार्यशाला का हुआ आयोजन

**सागर, देशबन्धु।** डॉ. हर्षाभि गौरी  
विश्वि को कुलपति पुरो. नॉलिमा युवा के  
मार्गदर्शन में विश्व अल्प-अल्प परीक्षा  
उत्तरणों पर कार्यरता आयोगिक कर  
रहा है। इसी संदर्भ में विश्व के उत्त  
अनुसंधान केंद्र में इंस्टिट्यूट कएल  
नस स्कोमेड्रो पर एक दिवसीय  
कार्यरता का आयोजन किया गया,  
जिसमें कुल 33 प्रतिभागियों ने भाग  
लिया। उक्त कार्यरता में मुख्य वक्ता डॉ.  
ब्रिजेक प्रकाश मालवीय एवं पुरो. एके सिंह  
रहें जिनने आईआईएमएस मस्ती से  
हेबी मेडल डिटेकरा एवं विश्वि सैपल में  
कंसर्टेशन कैसे निकाला जाता है, इस बारे  
में विश्वि शैक्षिक समस्थानों  
प्रतिभागियों को आईआईएमएस मस्ती  
और प्रशिक्षण दिया गया। कार्यक्रम की र



श्री श्री मेडल डिस्टिक्शन एवं विभिन्न सैपार में मैट्रिकल  
कमंडरशिप कैसे निकाला जाता है, इस बारे में बताया।  
कार्यशाला में विभिन्न शैक्षिक संस्थानों से आये  
प्रतिभागियों को आईसीपीएमएस प्रभोग पर हैंड्स  
ऑन प्रशिक्षण दिया गया। कार्यक्रम को शुरुआत में

विवि में इंडक्टिवली कपल्ड  
मास स्पेक्ट्रोमेट्री पर हुआ  
कार्यशाला का आयोजन

**सागर।** डॉ. हरीसिंह गौर विश्वविद्यालय की कुलपति प्रो. नीलिमा गुप्ता के मार्गदर्शन में विवि अलग अलग परिष्कृत उपकरणों पर कार्यशाला आयोजित कर रहा है। इसी संदर्भ में विश्वविद्यालय के उन्नत अनुसंधान केंद्र में इंडिकटिवली कपल्ड मास स्पेक्ट्रोमैट्री पर एक दिवसीय कार्यशाला का आयोजन किया गया जिसमें कुल 33 प्रतिभागियों ने भाग लिया। उक्त कार्यशाला में मुख्य वक्ता डॉ. विवेक प्रकाश मालवीय एवं प्रो. एके सिंह रहे, जिन्होंने आईसीपीएमएस मशीन से हेवी मेटल डिटेक्शन एवं विभिन्न सैंपल में मेटेलिक कंसंट्रेशन कैसे निकाला जाता है, इस बारे में बताया। कार्यशाला में विभिन्न शैक्षिक संस्थानों से आए प्रतिभागियों को आईसीपीएमएस मशीन पर हैड्स ऑन प्रशिक्षण दिया गया। कार्यक्रम की शुरुआत में उन्नत अनुसंधान केंद्र की मुख्य समन्वयक प्रो. श्वेता यादव द्वारा केंद्र के द्वारा संचालित विभिन्न प्रशिक्षण कार्यशालाओं के बारे में बताया गया एवं विश्वविद्यालय में संचालित होने वाली आगामी कार्यशालाओं के बारे में अवगत कराया गया एवं प्रशिक्षण के लिए प्रतिभागियों को शुभकामनाएं दी गई।

## Technical Team



**Sh. Ramesh Chandra  
Prajapati**

Technical Officer



**Dr. Vivek Kumar Pandey**

Technical Officer



**Sh. Shivprakash Solanki**

Technical Officer



**Sh. Saurabh Sah**

Sr. Technical Assistant



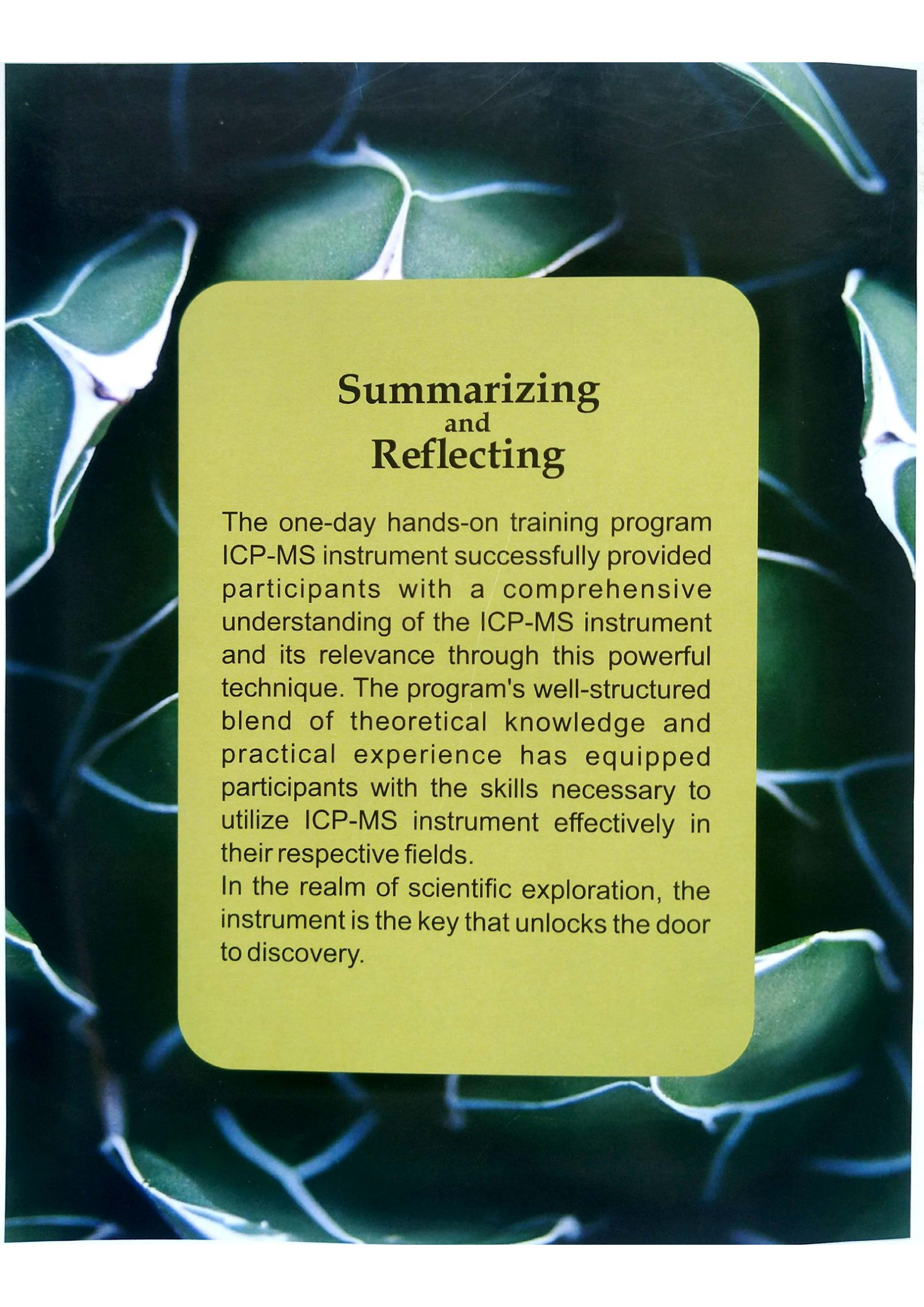
**Sh. Ashish Chadhar**

Technical Assistant



**Sh. Aravind Chadhar**

Laboratory Assistant



## Summarizing and Reflecting

The one-day hands-on training program ICP-MS instrument successfully provided participants with a comprehensive understanding of the ICP-MS instrument and its relevance through this powerful technique. The program's well-structured blend of theoretical knowledge and practical experience has equipped participants with the skills necessary to utilize ICP-MS instrument effectively in their respective fields.

In the realm of scientific exploration, the instrument is the key that unlocks the door to discovery.