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IISER/PUR/0295/AP/FAA/SEESS /25-26

Date: 2.07.2025

CORRIGENDUM

No: IISER/PUR/0295/AP/FAA/SEESS /25-26

Sub: Supply, Installation, and commissioning of Inductively Coupled Plasma Mass Spectrometer (ICP-MS) with Microwave Digestion System: reg

Ref: Tender ID: 2025_IISRT_866523_1

1. The technical specification is attached to the above mentioned tender document at Annexure 1.

2. All other Terms and Conditions remain the same. Bidders may quote accordingly

Thanking You,

Yours Faithfully

Anwar Sadath
2/7/25

Assistant Registrar (P&S)

Annexure I: List of the NIST calibration standards

ANNEXURE-1

NIST calibration standards 20/21 elements (1000 ppm, 125 ml).

Aluminum (Al)	1,000 µg/mL	Lead (Pb)	1,000 µg/mL
Barium (Ba)	1,000 µg/mL	Lithium (Li)	1,000 µg/mL
Bismuth (Bi)	1,000 µg/mL	Magnesium (Mg)	1,000 µg/mL
Boron (B)	1,000 µg/mL	Manganese (Mn)	1,000 µg/mL
Cadmium (Cd)	1,000 µg/mL	Nickel (Ni)	1,000 µg/mL
Calcium (Ca)	1,000 µg/mL	Potassium (K)	1,000 µg/mL
Chromium (Cr)	1,000 µg/mL	Silver (Ag)	1,000 µg/mL
Cobalt (Co)	1,000 µg/mL	Sodium (Na)	1,000 µg/mL
Copper (Cu)	1,000 µg/mL	Strontium (Sr)	1,000 µg/mL
Gallium (Ga)	1,000 µg/mL	Thallium (Tl)	1,000 µg/mL
Indium (In)		Zinc (Zn)	1,000 µg/mL
Iron (Fe)			

NIST calibration standards 22/23 elements (125 ppm, 100 ml)

Aluminum (Al)	100 µg/mL	Lead (Pb)	100 µg/mL
Barium (Ba)	100 µg/mL	Lithium (Li)	100 µg/mL
Beryllium (Be)	100 µg/mL	Magnesium (Mg)	1,000 µg/mL
Bismuth (Bi)	100 µg/mL	Manganese (Mn)	100 µg/mL
Boron (B)	100 µg/mL	Nickel (Ni)	100 µg/mL
Cadmium (Cd)	100 µg/mL	Potassium (K)	100 µg/mL
Calcium (Ca)	100 µg/mL	Selenium (Se)	100 µg/mL
Chromium (Cr)	100 µg/mL	Sodium (Na)	100 µg/mL
Cobalt (Co)	100 µg/mL	Strontium (Sr)	100 µg/mL
Copper (Cu)	100 µg/mL	Tellurium (Te)	100 µg/mL
Gallium (Ga)		Thallium (Tl)	100 µg/mL
Iron (Fe)		Zinc (Zn)	100 µg/mL

NIST calibration standards 21/22 elements including U & Th (10 ppm, 100 ml).

Aluminum (Al)	10 µg/mL	Lithium (Li)	10 µg/mL
Arsenic (As) Barium (Ba)	10 µg/mL	Magnesium (Mg)	10 µg/mL
Beryllium (Be)	10 µg/mL	Manganese (Mn) Nickel (Ni)	10 µg/mL
Bismuth (Bi)	10 µg/mL	Potassium (K)	10 µg/mL
Cadmium (Cd)	10 µg/mL	Rubidium (Rb)	10 µg/mL
Calcium (Ca)	10 µg/mL	Selenium (Se)	10 µg/mL
Cesium (Cs)	10 µg/mL	Silver (Ag)	10 µg/mL
Chromium (Cr)	10 µg/mL	Sodium (Na)	10 µg/mL
Cobalt (Co)	10 µg/mL	Strontium (Sr)	10 µg/mL
Copper (Cu)	10 µg/mL	Thallium (Tl)	10 µg/mL
Gallium (Ga)	10 µg/mL	Uranium (U)	10 µg/mL
Indium (In)	10 µg/mL	Vanadium (V)	10 µg/mL
Iron (Fe)	10 µg/mL	Zinc (Zn)	10 µg/mL
Lead (Pb)	10 µg/mL		10 µg/m

Technical specifications and general conditions for Inductively Coupled Plasma Mass Spectrometer (ICP-MS) with Microwave Digestion System (MDS)

A. Technical specifications of ICP-MS

Application: Accurate and precise measurement of trace elements (including common, rare, toxic, etc.) at ppm, ppb, and ppt levels in various types of samples such as water, rocks, minerals, ores, sediments, soils, waste extracts, sludges, food, pharmaceutical samples, etc. for basic and applied aspects of Earth and Environmental Sciences.

Sl. No.	*Main component*	*Required specifications*
1	Basic design	Space-saving, compact bench-top model so that it can fit in the allocated lab space with all its components and accessories with corrosion-resistant exteriors. The system should be capable of working in a standard laboratory environment even without class-100/1000 clean rooms.
2	Sample Introduction System a. All components should be positioned in a way such that users can access, remove, and fit them easily on a regular basis. b. Open architecture design for sample introduction system having capability to connect in future to suitable Ion Chromatography (IC) or Liquid Chromatography (LC) or Laser Ablation (LA) systems. c. The sample introduction should be both manual and auto-controlled. d. Capable of handling aqueous solutions with high dissolved solids of the order of 20% or better.	
2.1	Nebulizer	Glass concentric nebulizer with constant flow rate. It should be able to connect to an autosampler and port for Argon dilution.

2.2	Spray chamber	1. Peltier-cooled, high-purity quartz, spray chamber with high sensitivity, greater stability and repeatability. 2. The chamber should efficiently filter large aerosol droplets for efficient plasma stability. 3. Controlled temperature range: -5°C to +20°C or better.
2.3	Additional kits	1. For the samples digested with HF (rock samples and other silicates), an HF kit (PFA) should be quoted as an additional component. The HF kit should include a nebulizer, spray chamber, plasma torch, injector, and all other necessary components. 2. A separate sample introduction system should be quoted for running organic samples directly along with Peltier cooler.
2.4	Peristaltic pump	1. Low-pulsation, high precision, multi-channel (minimum 3 channels), at least 10 roller pumps with precise computer-controlled pumping of the sample, internal standards and spray chamber drain. 2. The pump speed should be computer-controlled, with the range and speed aligned to the instrument and software specifications.
3	Inductively Coupled Plasma (Robust plasma ion source suitable to handle the variable and challenging matrices such as aqueous and organic matrices, highly volatile organic solvents, geological samples, etc.)	
3.1	Torch	1. Push-fit, demountable, single-piece quartz torch. 2. Torch movement should be completely computer-controlled and auto-tunable in x-y-z directions.

		3. Provision of auto-alignment of the torch after routine maintenance with reproducibility better than 0.1 mm in x-y-z directions. 4. Torch should have the capability for variable sampling depth with small incremental steps. 5. At least 4 active mass flow controllers (MFC) or an equivalent electronic/pressure-based flow controllers should be available to control plasma, auxiliary makeup, carrier gas and makeup/dilution gas.
3.2	RF generator and load coil	1. 27 to 40 MHz solid-state RF generator with dynamic frequency impedance 2. The RF generator should be able to operate in cold and hot plasma mode in a single sample acquisition and should be able to rapidly change between these modes. 3. The power range should be variable from near 500 to 1600 W or wider. 4. Water/Air/Gas-cooled load coil for an improved lifetime and reliable plasma ignition should be provided at an accessible height for maintenance.
3.3	Interface	1. Double or triple cone interface involving sample and skinner cones to accomplish ion extraction from plasma. The interface should be easy to remove and clean for routine maintenance without disturbing the vacuum. The cones should be resistant to clogging and stable for a longer time period. 2. Standard sample and skimmer cones with orifice diameters suitable for all applications and to prevent clogging and minimize signal drift. Should have minimal matrix condensation and good tolerance to high-matrix samples.

		3. Ni sampling core orifice diameter should be 1 mm or more. 4. Platinum cones should be quoted. 5. The skimmer cone orifice should have 0.9 mm diameter or less for minimal matrix condensation and good tolerance to high-matrix samples.
3.4	Ion optics and focusing systems	1. Well-designed suitable extraction lenses that can operate at low voltages allowing proper ion extraction and focusing into the ion optics should be provided. or 2. An off-axis lens system to reduce the background noise should be provided outside the high vacuum region for easy maintenance. 3. Maintenance-free ion optics system with no or minimal maintenance.
4	Collision/Reaction cell	1. Collision/reaction cells should be available with kinetic energy discrimination (KED) for eliminating polyatomic interfering species, isobaric species through chemical and collision reaction technology. 2. The system should be capable of analyzing all elements in the analytes (entire mass range: 2-260 amu or wider) in a single measurement mode with a very short stabilization time between different modes. 3. Helium gas cell configured with a low mass cut-off/ or a suitable mechanism for removing polyatomic interference should be included. 4. The facility of fully automated and software-controlled changeover between standard mode and collision/reaction mode without any manual intervention should be available.

		5. Two or more dedicated gas channels with active mass flow controllers for He and other pure reactive gases like ammonia should be present to allow the reaction of gases. The instrument must have separate MFC for reaction and collision gases.
5	Vacuum system and turbo pump	1. Three or four-stage differential vacuum system should be present. 2. The vacuum should be maintained in the event of power and argon gas supply failure. 3. Single split-flow or triple-inlet turbomolecular pump capable of maintaining vacuum 10^{-5} Torr or less during the operation. 4. Operating vacuum should be capable of achieving within minimum pumping time. 5. The turbo pump should be corrosion-resistant. 6. A single external high-performance rotary pump for fast pump down and simple maintenance should be provided. The pump should be provided with standard temperature-resistant and chemically stable pump oil.
6	Mass analyzer (Quadrupole)	1. Quadrupole should be made of gold-coated ceramic or molybdenum or SS for a low coefficient of thermal expansion. 2. The scan speed should be better than 3000 amu per second. 3. Mass range of 2-260 amu or wider. 4. Mass resolution of less than 1 amu in the entire mass range. 5. The quadrupole should have a frequency of 2 MHz or more to ensure low abundance sensitivity and mass stability 6. Mass stability should be less than ± 0.05 amu per day or better.

		7. Abundance sensitivity should be less than or equal to 5×10^{-7} (low-mass side) and less than or equal to 1×10^{-7} (high-mass side).
7	Detector	1. Dual-stage, long-life discrete dynode detector. 2. Minimum dwell time: 100 µs or less in both analog and pulse counting detection modes. 3. Automated optimization of operating voltages and cross-calibration between pulse counting and analog modes. 4. Linear dynamic detection ranges up to 10 orders of magnitude or better. 5. The dynamic range should be able to cover all measurable elements and their isotopes.
8	Specific analytical requirements	
8.1	Detection limit	Detection limit (ng/L) should be lesser than or equal to the reference values provided below: $^{9}Be \leq 0.5$ $^{115}In \leq 0.1$ $^{209}Bi \leq 0.1$
8.2	Sensitivity	Sensitivity (Mcps/ppm) should be more than or equal to the reference values provided below: $^{7}Li = 50$ $^{89}Y = 160$ or $^{115}In = 250$ $^{205}Tl = 80$ or $^{238}U = 300$ The sensitivity value mentioned above should be factory specification and should be demonstrated during installation.

8.3	Elements	1. Should be able to analyze the following elements: Cd, Pb, Hg, As, Cu, Zn, Se, Sn, Be, Ca, Co, Ag, Al, Mn, Ti, Cr, Ni, Pt, Au at a concentration of 0.05 ppb with RSD of 5% at standard conditions. 2. Calibration curves of the above elements in the concentrations of 0.05 ppb, 0.1 ppb, 0.5 ppb, 1 ppb and 2 ppb with r^2 of 0.99 should be possible. A copy of the calibration curves for these elements should be submitted in the tender documents.
8.4	Oxides (e.g., CeO/Ce)	Should be less than 2.5%
8.5	Double charged (e.g., Ce^{2+}/Ce)	Should be less than 3%
8.6	Stability	1. Short term: less than 3% RSD 2. Long-term: less than 4% RSD
8.7	Isotope ratio precision	Should be less than 0.1% RSD
9	Software and operating system	1. Original licensed software (perpetual) compatible with the latest version of Windows OS must be provided. 2. The software shall support the following calibration curve fit modes for quantitative analyses: A. linear least squares, B. weighted linear least squares, C. linear forced through zero least squares, D. real-time graphics with the ability to display transient and continuous signal profiles,

		E. quantitative analysis including external calibration, standard additions, isotope ratios and isotope dilutions and semi-quantitative analysis. F. On-line help with quick steps to refer to the entire instrument user manual. A hard copy of the user manual should also be provided. G. Data reprocessing on stored data without re-running analyses for changes of calibration points, internal standard points or curve fit mode. H. The software package should have the option to control the plasma, autosampler and other accessories of the instrument. I. The software must have inbuilt methods available for routine samples to enable fast turnaround time after installation and commissioning. J. Exporting data to Excel sheets for processing should happen easily K. The software should have method templates. L. Timely updates in the software (if any) should be free of cost. 3. A branded PC with the following minimum specifications: Latest version of Windows 11 OS, core i7 processor, 3.6 GHz and above CPU speed, integrated 2 GB graphic card, 24 inches monitor, 16 GB RAM, 1 TB SSD storage, multiple memory slots, Wi-Fi and Bluetooth loaded with the above-mentioned software. 4. A branded laserjet or inkjet printer should be provided along with the PC.
10	Autosampler	1. An autosampler should be provided with more than 100 vials capacity or more along with 7 ml to 50 ml capacity tube racks.

		2. The autosampler should have an enclosure and connecting duct to exhaust systems.
11	Chiller	A high-performance, closed-loop, low-noise chiller unit (including the ultrapure ICP-MS grade coolant chemicals) should be provided for the instrument. The chiller should be able to maintain 18-22°C continuously.
12	Power supply	The power input is 220/440 VAC, 50-60 Hz, with a BIS-certified plug (ISI mark). The system is to be installed at IISER, Thiruvananthapuram. The supplier should verify the power requirements to ensure compatibility.
13	Other accessories and consumables	
13.1	Gas cylinders and associated accessories	1. 10 argon gas cylinders (~10 cubic meter capacity) (≥ 99.995% purity) should be provided along with the branded/certified regulator system and gas panel as per requirement. 2. 2 helium gas cylinders (~10 cubic meter capacity) (≥ 99.999% purity) should be provided along with the regular system and gas panel as per requirement. 3. 2 oxygen or hydrogen or any other reactive gas cylinders with pure or pre-mix form for reaction mode operation to remove interference effectively. 4. Automatic changeover manifold, cylinder cage, spanner/spindle/wrench, etc. (tool kit) should be provided.
13.2	Exhaust unit	A suitable exhaust assembly should be provided for the ICP-MS and autosampler.
13.3	Standards	The following standards should be provided (see the list provided in Annexure I): 1. NIST calibration standards 20/21 elements (1000 ppm, 125 ml). 2. NIST calibration standards 22/23 elements (125 ppm, 100 ml).

		3. NIST calibration standards 22/23 elements including U and Th (10 ppm, 100 ml). 4. Single element standards (100/10 ppm, 125 ml) for Hg, Os, Au stock solution. 5. Rare earth elements multi-element standards (including Zr, Hf, W, Nb, Ta) (100 ppm, 125 ml). 6. Precious elements (Ir, Ag, Au, Pt, Pd, Rh, Ru), 125 ml.
13.4	Certified Reference Materials	1. NIST SRM water 1640 2. Rock and sediment certified reference materials: i. Igneous rocks: Andesite (e.g., AGV-1 or AGV-2), basalts (e.g., BCR-1 or BCR-2, BHVO-1 or BHVO-2), granites (e.g., G-2 or G-3), peridotite (e.g., PCC-1), and syenite (e.g., SY-5 or SY-2 or SY-3) ii. Sedimentary rocks and sediments: Slate (e.g., OU-6), marine sediment (e.g., SDO), and limestone (e.g., NIST SRM 1d) 3. NIST SRM 1573a tomato leaves
13.5	Spares	The following spare items should be quoted with the quantity specified in the brackets with OEM part numbers in addition to one standard set supplied along with instrument: 1. Spray chamber (1 qty) 2. Nebulizer (1 qty) 3. Ni and Pt cones with O rings (1 complete set – sampler and skimmer) 4. Injector and plasma torch (4 sets)

		5. Sample uptake tubing (5 sets) 6. Peristaltic pump tubing for drain (2 sets) 7. Peristaltic pump tubing for samples (4 sets) 8. Tool kit with all standard tools (1 set) 9. Autosampler tubes (2 sets) 10. Instrument calibration and validation solution (1 set) 11. Instrument performance check solution (1 set) 12. Tuning solutions (2 sets) 13. PVC waste tubing for autosampler (2 sets) 14. PFA sample and rinse tubing (3 sets) 15. Oil element (2 sets) 16. Graphite gasket for sampling cone (1 set) 17. Tubing for spray chamber drain (3 meter) 18. Pump oil (1 liter – 3 sets) 19. Load coil (1 set) 20. Fluid for chiller (5 liters) 21. Gas cylinder regulators for all different gases (1 set) 22. Cone cleaning solvent with high purity (3 liters) 23. Autosampler vials (200 7 ml vials, 400 10 ml vials, 200 15 ml vials and 200 20 ml vials) 24. Gas clean filter for carrier gas (1 set)

B. Technical specifications for Microwave Digestion System (MDS)

Application: For acid digestion applications for a diverse range of sample types, including sediments, silicate and carbonate rocks, ores, soil, environmental samples, natural products, and plant materials, to prepare samples for subsequent analysis using ICP-MS techniques.

Sl. No.	*Description*	*Specifications*
1	Cavity chamber	1. Constructed from highly corrosion-resistant stainless steel with a multilayer fluoropolymer coating. 2. The coating provides both physical protection against external factors and enhances chemical resistance. 3. Volume exceeding 60 liters to accommodate larger sample batches and facilitate efficient processing.
2	Microwave power	1. Power output of 1800 watts or higher. 2. Controlled by a microprocessor with a single or dual magnetron system. 3. Allows adjustments in 1-watt increments for precise control, ensuring optimal conditions for sample digestion and enhancing reproducibility and accuracy.
3	Vessels	1. Fully closed and resistant to corrosion from any acid and gases. Vessels should be capable of handling chemicals such as HNO_3, HCl, H_2O_2, HF, H_2SO_4 and their mixtures. 2. The vessels must be designed to prevent cracking, breaking, or explosion in case of overpressure from unknown sample reactions. The vessels must have controlled release of overpressure to avoid explosions in case of any sudden exothermic reactions over entire temperature and pressure range. 3 Made from microwave-transparent and reagent-resistant inert polymeric materials such as PTFE or PTFE-TFM. 4. Vessel volume of at least 80 ml or more with a minimum filling volume of 5 ml.

		5. Designed for a sample weight of at least 1 gram to accommodate inhomogeneous samples and trace-level analysis. 6. Vessel design parameters should allow for temperatures up to 300°C or more and pressures up to 100 bars or more. 7. Vessels should have minimum hold time of 45 minutes or more at maximum operating temperature.
4	Controller	1. Integrated colour touchscreen display of at least 4 inches or wider. 2. Displays a real-time graphical representation of reaction parameters and internal temperature of each individual reaction vessel. 3. Must be built-in/ detachable/ external controllers. 4. Includes standard programs like EPA and ASTM methods and allows for user-defined program creation. 5. Onboard storage to save and run a virtually unlimited number of methods, and web-based app for an extensive library of information, such as parts list, technical notes, user manuals, video tutorials, updated application notes, a complete library of relevant scientific articles and an online help section for user training and support. 6. Features automatic power adjustment based on sample load, number of vessels, and pre-programmed control settings.
5	Safety features	1. Equipped with temperature sensors on the magnetron to protect against overheating from back-reflected microwave energy. 2. Includes an advanced temperature sensor to monitor and display the internal temperature of all reaction vessels. 3. No electronic plugs or sockets inside the cavity to prevent corrosion.

		4. Pressure control with a vent and reseal technology, avoiding the use of plastic or polymer springs due to temperature dependency.
6	Rotor	1. The rotor should accommodate 15 or more high-pressure vessels simultaneously, constructed from Teflon coated aluminum or ceramic. 2. Designed to withstand pressures up to 150 bar or higher, ensuring maximum safety and facilitating ultrafast cooling. 3. Rotor should have minimum hold time of 45 minutes or more at maximum operating temperature. 4. Comes with a lid to protect the cavity coating from acid vapors and fumes, prolonging system longevity.
7	Temperature and Pressure specifications	1. Maximum operating temperature of 240°C or more for complete digestion of even the most difficult samples (including the silicate rocks and ores with zircon, apatite, chromite, spinel, corundum, rutile and garnet). 2. Maximum operating pressure of 80 bar or more for complete digestion of even the most difficult samples (including the silicate rocks and ores with zircon, apatite, chromite, spinel, corundum, rutile and garnet). Note: The supplier will have to demonstrate complete digestion of these tough minerals during the time of installation.
8	Exhaust system	1. Integrated high-performance exhaust system to remove fumes from the cavity chamber. 2. Vessels must be cooled inside the oven.
9	Accessories	1. Must include necessary accessories for system operation. 2. Should have options for future upgrades, such as microwave-assisted synthesis, high-pressure parallel synthesis from the same manufacturer. 3. System should be supplied with a minimum of 20 vessels.

10	Power requirements	1. 220-240 V and 50 Hz

C. General conditions for ICP-MS and MDS

Sl. No.	*Condition*	*Description*
1	Warranty	1. 2 years warranty + 3 years AMC from the date of installation. The warranty should cover all the components of the instruments (including ICP-MS and MDS). 2. In case of any breakdown in software and hardware, routine queries should be resolved within 24 hours and in person queries should be resolved within 72 hours.
2	Safety features (ICP-MS)	1. Safety interlocks for the plasma compartment door, water flow and exhaust airflow should be available. 2. The window to see the plasma position should be well-shielded (UV shielding).
3	Documentation required while quoting	1. Published brochures of all the components should be provided. 2. Details (including POs) of a minimum of 4 installations of the offered or previous model in the last five years at other academic or research institutions in India should be provided. 3. Two performance satisfactory certificates from the laboratories where the offered or previous model has been installed should be provided for the last two years.

		4. Copies of research publications within the field of Earth and Environmental Sciences from the offered or previous model in peer-reviewed scientific journals should be provided. 5. Contact details of the service engineers should be provided.
4	Documents required during the time of installation	1. Both soft and hard copies of the user manual should be provided. 2. A certificate of calibration and inspection should be provided. 3. List of important spare parts and accessories with their part number to be provided.
5	Installation and training	1. The vendor must provide and enclose the complete pre-requirements for the successful installation of the instrument. 2. The instrument with all its components should be installed and full functionality should be demonstrated at IISER Thiruvananthapuram. 3. The mentioned accuracy and precision of the instrument must be demonstrated at the time of installation at IISER Thiruvananthapuram. 4. A minimum of 5 days of on-site training should be provided to the users (lab staff and members) during the installation.
6	A trained operator with relevant expertise/experience in analytical chemistry/geochemistry should be provided for two years.	
7	The IISER-appointed committee reserves the right to conduct site visits for demonstration of the quoted specifications on an existing instrument installed in India at any point in time during the tendering process/before the placement of the purchase order.	
8	Vendors must provide pre-installation requisites along with the tender clearly citing the space requirement/dimension of the individual modules.	

9	The vendor should have an ISO 9001 certification.
10	Only the OEMs should participate in the tender or else their authorized dealers or representatives with an authorization letter or proof of supply from OEM should be included in the tender.
11	The components of the offered model should be guaranteed to be made available for at least the next 10 years.
12	An undertaking from OEM is required stating that they would facilitate the bidder regularly with technology/product updates and extend support for the warranty as well.