

**HANDS ON TRAINING PROGRAM**  
**A COMPREHENSIVE APPROACH TO**  
**SPECTROSCOPY & CHROMATOGRAPHY**

**PROCEEDINGS**

**AUGUST 22<sup>nd</sup> - 28<sup>th</sup>, 2022**

*Organized by*

**Sophisticated Analytical Instrument Facility (DST-SAIF)**

**Mahatma Gandhi University, Kottayam**

*In Association with*

**Sophisticated Analytical Instrument Facility (DST-SAIF) Panjab University, Chandigarh**



**HANDS ON TRAINING PROGRAM**

**A COMPREHENSIVE APPROACH TO  
SPECTROSCOPY & CHROMATOGRAPHY**

[VAIGYANIK BHARAT, ATMANIRBHAR BHARAT]

**Synergistic Training Program Utilizing the Scientific and Technological  
Infrastructure (STUTI)**

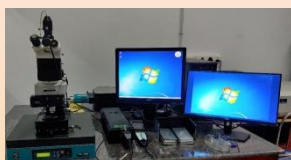
**AUGUST 22 - 28, 2022**

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**Professor Sabu Thomas**  
Vice Chancellor

**Mahatma Gandhi University**  
Kottayam



### **MESSAGE**

A warm welcome to all the participants of the Training program on “**A COMPREHENSIVE APPROACH TO SPECTROSCOPY & CHROMATOGRAPHY**” being organized under the aegis of Synergistic Training program Utilizing the Scientific and Technological Infrastructure (STUTI), an initiative of the Department of Science and Technology (DST) at Mahatma Gandhi University, Kottayam. This is truly a platform which aims at sensitizing the young generation on the state-of-the-art equipment through open access to Science and Technology infrastructure across the country. I congratulate the Sophisticated Analytical Facility (SAIF), Mahatma Gandhi University, Kottayam on organizing the STUTI program, the first of its kind in Kerala. This training program encourages the researchers and industry to provide suitable solutions and interface for future scientific ventures. This also provide tremendous opportunities for all the stakeholders to come together, collaborate and complement each other.

I congratulate the Coordinators and the Organizing Committee on the hard work put in by them to ensure the success of the 7 day training program at Mahatma Gandhi University campus.

I wish all success for the conference.

**Prof. (Dr.) Sabu Thomas**

## DEPARTMENT OF SCIENCE AND TECHNOLOGY

Department of Science & Technology (DST) was established in May 1971, with the objective of promoting new areas of Science & Technology (S&T) and to play the role of a nodal department for organizing, coordinating and promoting S&T activities in the country. The Department has major responsibilities for specific projects and programmes such as Formulation of policies relating to Science and Technology, Matters relating to the Scientific Advisory Committee of the Cabinet (SACC), Promotion of new areas of Science and Technology with special emphasis on emerging areas, Coordination and integration of areas of Science & Technology having cross-sectoral linkages in which a number of institutions and departments have interest and capabilities, Undertaking or financially sponsoring scientific and technological surveys, research design and development, where necessary and Support and Grants-in-aid to Scientific Research Institutions, Scientific Associations and Bodies.



DST has many scientific and engineering programmes that are aimed to promote research in science. It includes creation of Mega Science facilities and launch Mega Science projects in and out of the country to improve access to such state-of-the-art facilities for the Indian scientific community, especially from the academic sector. Because of technical complexities and requirement of large resources, such projects are manifestly multi-agency, multi-institutional and, quite often, international in character. DST and the Department of Atomic Energy (DAE) have been jointly promoting most of such projects in the country. Another innovative program is, Innovation of Science Pursuit for Inspire Research (INSPIRE) for attracting of young talent to science. The R&D Infrastructure Division of the Department aims to strengthen the S&T infrastructure of the country by fostering well-equipped R&D labs in the academic/research institutes/universities as well as a strong culture of research collaboration between institutions and across disciplines. It has four schemes viz. Fund for Improvement of S&T Infrastructure in Universities and Higher Educational Institutions (FIST), Promotion of University Research and Scientific Excellence (PURSE), Sophisticated Analytical Instrument Facilities (SAIF), Sophisticated Analytical & Technical Help Institutes (SATHI) and Synergistic Training Program Utilizing the Scientific and Technological Infrastructure (STUTI). The objectives of these program, at large, are establishment of R&D labs, centers, upgradation of research facilities orienting towards creating a self-reliant India.

### SYNERGISTIC TRAINING PROGRAM UTILIZING THE SCIENTIFIC AND TECHNOLOGICAL INFRASTRUCTURE (STUTI)

The program has been designed to cater to human resource and its capacity building through open access to S&T Infrastructure across the country by organizing short term courses/workshops on the awareness, use and application of various instruments and analytical techniques.

## **MAHATMA GANDHI UNIVERSITY, KOTTAYAM, KERALA**

Mahatma Gandhi University, one of the major Universities in Kerala, is a premier education institution that strives to fulfil the higher educational needs of the people from Central part of Kerala. The University was established on 2<sup>nd</sup> October 1983 and has a jurisdiction over the revenue districts of Kottayam, Ernakulam and parts of Pathanamthitta and Alappuzha. It offers a large number of programs through its 17 University departments, 18 Centres, around 300 affiliated Colleges and 199 recognised Research Centres. It imparts education in the interdisciplinary as well as conventional disciplines of Science, Social Science and Humanities. The University is a member of the AIU (Association of Indian Universities) and the ACU (Association of Commonwealth Universities).

Mahatma Gandhi University holds 30<sup>th</sup> position among University category and 51<sup>st</sup> position in overall category of NIRF 2022. Also, M.G.U holds 702<sup>nd</sup> position in Times Higher Education World University Ranking.





## SAIF, MAHATMA GANDHI UNIVERSITY, KOTTAYAM



Sophisticated analytical instruments are vital for pursuing research in many areas of modern science and technology. Many institutions in the country do not have such instruments. These instruments are expensive and cannot be provided through individual project mechanism. The Department of Science & Technology has set up Sophisticated Analytical Instrument Facilities (SAIFs) in different parts of the country to provide the facilities of sophisticated analytical instruments to the research workers in general and especially to the institutions which do not have access to such instruments. DST-SAIF centre at Mahatma Gandhi University is operational since 2013. Confocal Raman Microscope with AFM, Fluorescence Spectrometer with Lifetime Detector, LC-MS/MS and FESEM are the available instruments in the SAIF centre.



LC-MS/MS



Confocal Raman Microscope with AFM



Fluorescence Spectrometer with Lifetime Detector



FESEM

## PANJAB UNIVERSITY, CHANDIGARH

Since its inception in 1882 at Lahore (now in Pakistan), the magnificent traditions of the Panjab University have been a source of inspiration for the current generations of the faculty and students to accomplish and stand out in their academic endeavours. This University now ranks 1<sup>st</sup> among Universities of India and 38<sup>th</sup> in Asia according to Times Higher Education Asian University rankings 2015. It has been ranked number one university in India and in the bracket 276-300 internationally in the Times Higher Education World University Rankings, 2014-2015 powered by Thomson Reuters and it is also ranked 39<sup>th</sup> by the Times Higher Education among BRICS & Emerging Economies.

The Panjab University Campus at Chandigarh accommodates 73 teaching and research departments/institutes/centres besides four independent Chairs for research. Furthermore, the university has 189 affiliated/constituent colleges spread over Punjab and Chandigarh besides Regional Centres at Muktsar, Ludhiana, Hoshiarpur and Kauni. In addition, there is the Vishveshvaranand Vishwa Bandhu Institute of Sanskrit and Indological Studies at Hoshiarpur. Panjab University is located in Sector 14 and Sector 25 of Chandigarh, spreading across an area of almost 550 acres.





## SAIF/CIL

Sophisticated Analytical Instrumentation Facility (SAIF)/Central Instrumentation Laboratory (CIL) formerly known as RSIC at Panjab University, Chandigarh was incepted in the earlier years of the 6<sup>th</sup> plan. The complete facilities of USIC, CIL, SAIF and RSIC are working in unison in the service of research and also for imparting practical training to the students through workshops. The Centre also undertakes the design, fabrication and repair of electronic instruments required by students and teachers from the University and the colleges around. It also runs training programmes in technical skills for the benefit of scientific community and associated laboratory staff from different institution.



The Centre houses the following Sophisticated Instruments: Transmission Electron Microscope (TEM) Hitachi (H-7500), Scanning Transmission Electron Microscope (SEM) Model JSM6100 (Jeol) with Image Analyser, Elemental Analyser for CHN (Thermo Scientific), FT-NMR Cryomagnet Spectrometer 400 MHz (Bruker), X-ray Diffractometer (Powder Method). Panalytical.s X. Pert Pro, LC-MS Spectrometer Model Q-ToF (Micro Waters), Liquid Nitrogen Plant Stirling (StirLIN-1), FTIR Spectrophotometer Model RZX (Perkin Elmer), UV-VISNIR Spectrophotometer Model Lambda 750 (Perkin Elmer), WD-XRF Spectrometer ModelS8 (TIGER Bruker).





## **HIGHLIGHTS PROGRAM OF THE TRAINING**

To get the insights and hands on training on LC-MS/MS, ICP-MS, LC-QToF, HPLC, FESEM, UV-Vis Spectrophotometer, Fluorescence Spectrometer with Lifetime Detector and Confocal Raman Microscope with AFM. During the training program the participants will get the opportunity to visit SAIF and field visit to get glimpse of state-of-the-art instrumentation. The participants will get the golden opportunity to interact with eminent researchers from different fields.

## **LEARNING OUTCOMES OF THE PROGRAM**

The up gradation of knowledge and hands on expertise of students, researchers and faculty members on the variety of characterisation techniques to gain deeper understanding of sophisticated techniques, develop data analysis, interpretation skills and gain the ability to apply their theoretical knowledge to practice.

## EMINENT SPEAKERS/RESOURCE PERSONS



**Prof. Chandan Srivastava**

Professor  
Department of Materials Engineering  
Indian Institute of Science, Bangalore



**Dr. Ramesh K Sharma**

Assistant Professor  
Central Instrumentation Laboratory (CIL)  
Panjab University, Chandigarh



**Prof. Ashok Misra**

Professor  
Department of Chemistry  
IIT Madras



**Dr. A. Ranjith**

Scientist C, Quality Evaluation  
Laboratory, Spices Board (Govt. of India)  
Chennai



**Prof. Ganga Ram Chaudhary**

Professor (Physical Chemistry)  
Dept. of Chemistry  
Director (SAIF/CIL/UCIM)  
Panjab University, Chandigarh



**Prof. P. Venugopalan**

Professor  
Dept. of Chemistry  
Panjab University, Chandigarh



**Dilshad Pullancheri**  
Manager-Marketing, Southern Region,  
Waters India  
Pvt. Ltd.



**Mr. N. R. Vishnu**  
Workflow Specialist  
Spinco Biotech



**Dr. Devendiran.m**  
Field Application Specialist,  
Perkin Elmer



**Dr. C. S. Rajesh**  
Application Scientist, Horiba



**S. Dinesh**  
Field Application Specialist, Spinco  
Biotech, Chennai



**Satheesh Kumar**  
Manager – Applications & Aftersales  
Support, India & Middle East Oxford  
WITec

**DST-STUTI  
HANDS ON TRAINING PROGRAM  
A COMPREHENSIVE APPROACH TO SPECTROSCOPY &  
CHROMATOGRAPHY**

**PROGRAM SCHEDULE**

Venue	Main Seminar Hall, School of Environmental Sciences, Mahatma Gandhi University, Kottayam
<b><u>INAUGURAL FUNCTION</u></b>	
<b>22<sup>nd</sup> August 2022 10am -11am</b>	<b>Welcome speech and introduction</b> <b>Ms. Shiny Thomas</b> , Training Convener
	<b>Lighting of Lamp &amp; Inaugural address</b> <b>Prof. C.T. Aravindakumar</b> Hon. Pro-Vice Chancellor, (Coordinator, SAIF-MGU), Mahatma Gandhi University, Kottayam
	<b>Unveiling of Training Manual &amp; Felicitation</b> <b>Dr. B. Keralavarma</b> Member Syndicate, Mahatma Gandhi University, Kottayam
	<b>Introduction-DST STUTI Scheme by Guest of Honor</b> <b>Prof. G. R. Chaudhary</b> Director, SAIF/CIL,STUTI Program Coordinator-PMU Panjab University, Chandigarh
	<b>Felicitation message</b> <b>Prof. E.V. Ramasamy</b> Dean, School of Environmental Sciences, Mahatma Gandhi University, Kottayam
	<b>Felicitation message</b> <b>Dr. K.R.Baiju,</b> Director, School of Environmental Sciences, Mahatma Gandhi University, Kottayam
	<b>Vote of Thanks</b> <b>Ms. Anu Mathew</b> Organizing member, SAIF, Mahatma Gandhi University, Kottayam
11am – 11.25am	<b>TEA BREAK</b>
<b>INVITED TALKS</b>	
11.30am-12.15 pm <b>IT 1</b>	Dr. Chandan Srivastava, Professor, IISc, Bangalore <i>“Fundamentals of Electron Microscopy”</i>
12.15 pm-1:00 pm <b>IT 2</b>	Prof. P. Venugopalan, Professor, Panjab University, Chandigarh <i>“Supramolecular Synthons In Crystal Engineering: A Structural Outlook”</i>
1:00pm-2:00pm	Lunch Break
2:15 pm-3:15 pm <b>IT 3</b>	Lecture 3: Dr. Ranjith Arimboor, Scientist C, Spices Board, Chennai <i>“Application of modern analytical techniques for ensuring the safety and quality of spices”</i>
3.15 pm-4.15 pm <b>IT 4</b>	Lecture 4: Dr. Ramesh K Sharma, Assistant Professor Central Instrumentation Laboratory Panjab University <i>“Basics and advances in Mass spectrometry”</i>
4.15 pm-4.30 pm	<b>TEA BREAK</b>
4.30pm-5.30pm <b>IT 5</b>	Lecture 5: Dr. Ashok Kumar Mishra, Professor, Department of Chemistry, IIT Madras <i>“Basic concepts and applications of Fluorescence Spectroscopy”</i>



## PHOTOS



Welcome speech by Ms. Shiny Thomas, Training Convenor



Lamp lighting & Inaugural address by Hon. Pro-Vice Chancellor,  
(Coordinator, SAIF-MGU) Mahatma Gandhi University, Kottayam



**Introduction-DST STUTI Scheme by  
Guest of Honor-Prof. G. R. Chaudhary**  
Director, SAIF/CIL, STUTI Program Coordinator-PMU Panjab University, Chandigarh



**Unveiling of Training Manual & Felicitation**  
Dr. B. Keralavarma, Member Syndicate, Mahatma Gandhi University, Kottayam



**Felicitation Message**  
Prof. E. V. Ramasamy  
Dean, School of Environmental Sciences, Mahatma Gandhi University, Kottayam





**Felicitation message**

**Dr. K. R. Baiju**

Director, School of Environmental Sciences, Mahatma Gandhi University, Kottayam



**Vote Of Thanks**

**Ms. Anu Mathew**

Organizing member, SAIF, Mahatma Gandhi University, Kottayam



Group Photograph



## DAY 1 INVITED TALKS

### 1. **Fundamentals of Electron Microscopy**

***Dr. Chandan Srivastava, Professor, Department of Materials Engineering  
IISc Bangalore***

Fundamentals of electron-material interactions (elastic and inelastic scattering), construction of an electron microscope, essential concepts in optics (resolution, magnification, depth of field, and lens-related aberrations), image formation in electron microscopes, fundamentals of electron diffraction and fundamentals of spectroscopy using electrons were detailed in this session



### 2. **Supramolecular Synthons in crystal engineering: a structural outlook**

***Dr. P. Venugopalan, Department of Chemistry & Centre of Advanced  
Studies in Chemistry, Panjab University, Chandigarh***

Crystal engineering, one of the prolific areas in solid-state chemistry, has developed special and specific strategies to design crystalline materials with desired chemical and physical properties. That is, the field is maturing with its own 'nuts and bolts', enabling deep understanding of interactions that are essential for the assembly of molecules in the crystalline state. Detailed understanding of such interactions has led to the concept of supramolecular synthons, which are structural units within

supermolecules that convey the essential features of a crystal structure and are crucial for their structural stability. Based on the supramolecular synthon concept, rational molecular design for multi-component guest inclusion with differential binding ability can be realized in a variety of host molecules. Such approaches can also be extended to the design of organometallic architectures.



### 3. Application of modern analytical techniques for ensuring the safety and quality of spices

*Dr. Ranjith A., Scientist C, Quality Evaluation Laboratory, Spices Board, Chennai*

The safety and quality of spices have been monitored in the domestic and international trades through stringent quality regulations. Mycotoxins, agrochemical residues, heavy metals, etc are the major chemical contaminants in spices and spices products. Analytical methods based on chromatographic and spectroscopic techniques are being extensively used for the monitoring of chemical contaminants in spices. Among mycotoxins, aflatoxins being mutagenic are considered a major safety hazard in spices. Immunoaffinity-based separation of aflatoxins from the spice matrix, followed by HPLC-FD analysis is practiced for the estimation of aflatoxins in spices. Pesticide residues in spices are estimated by

LC-MS/MS and/or GC-MS/MS analysis of samples cleaned through the QuChERS method.



#### 4. Basics and advances in Mass spectrometry

*Dr. Ramesh K. Sharma, Assistant Professor, Panjab University, Chandigarh*

Mass spectrometry is an art of measuring the weights of atoms and molecules. It has emerged as a powerful micro analytical technique not only in determining the molecular weight but also in structural elucidation. Mass spectrum of a compound is its “chemical fingerprint” as each class of compound possesses its own characteristic spectrum. The complete process involves the conversion of the sample into gaseous ions, with or without fragmentation, which are then characterized by their mass to charge ratios ( $m/z$ ) and relative abundances. Mass spectrometry is applicable across diverse fields, including forensic toxicology, metabolomics, proteomics, pharma/biopharma, and clinical research. Specific applications of mass spectrometry include drug testing and discovery, food contamination detection, pesticide residue analysis, isotope ratio determination, protein identification, and carbon dating.



## 5. Basic concepts and applications of Fluorescence Spectroscopy

*Dr. Ashok Kumar Mishra, Professor, Department of Chemistry, IIT Madras*

Fluorescence Spectroscopy deals with the study of photons emitted from the photo-excited singlet electronic states of molecules and materials. Properties of fluorescence emission strongly reflect the photo physical processes that the molecules/materials undergo during the lifetime of their excited singlet state. Interactions of certain molecules/materials in their photo-excited state and the consequent changes in the fluorescence parameters enable fluorescence based molecular level probing/sensing/imaging applications. The fluorescence parameters monitored include emission wavelength, emission intensity, fluorescence anisotropy, and the time-dependent changes of these parameters at nanosecond time scale. This talk will explain the basic concepts of Fluorescence, outlines of instrumentation, different experimental/analytical parameters involving fluorescence and their applications in studying the photo physics of molecules/material in solutions as well as the sensing and probing an electron microscope, essential concepts in optics (resolution, magnification, depth of field, and lens-related aberrations), image formation in electron microscopes, fundamentals of electron diffraction and fundamentals of spectroscopy using electrons.





**Day 2: Lecture 1**

**UV-Visible Spectroscopy**

***Dr. Devendiran M., Field Application Specialist, Perkin Elmer***



Second day of the training started with theoretical session of UV-Visible spectroscopy by Dr. Devendiran M., Field Application Specialist, Perkin Elmer. The session covered of all the basics of UV-Visible spectroscopy along with

principle and various research and industrial applications. Different types of spectrophotometers depending on the nature of analysis were discussed.

The hands-on session included detailed explanation on different components of spectrophotometer, sample preparation methods, and familiarisation of software. All these was demonstrated by phenol and methyl orange.



## Day 2: Lecture 2

### Fluorescence Spectroscopy

*Dr. C. S. Rajesh, Application Scientist, Horiba*



Second theoretical session was on Fluorescence Spectroscopy by Dr. C. S. Rajesh, Application Scientist, Horiba. The basics of steady state measurement were detailed. Main components of the instruments were familiarized. Detailed about sample preparation and applications of fluorescence measurements.

In the hands on session calibration of fluorescence instrument was demonstrated. In vivo measurements, emission- excitation matrix (EEM) analysis is also demonstrated. Analysis were performed using Rhodamine 6G and Eu doped glass.





## Day 3: Lecture 1

### High Pressure Liquid Chromatography

*Mr. N.R. Vishnu, Workflow Specialist, Spinco Biotech*



Day 3 of the training program started with theory class of HPLC by Mr. N.R. Vishnu, Workflow Specialist, Spinco Biotech. The session started from the basics of Chromatography and detailed the different chromatographic techniques and its advancements. During the practical session, explained each parts of HPLC system, types of columns used and selection criteria for mobile phase. Analysis details using the detectors (PDA and RID) were explained. Discussed and differentiated quaternary and binary pump used in HPLC and its applications. Explained about the normal phase and reversed phase analysis.

Equipment hands on was demonstrated using caffeine standard. The change in retention time with respect to the different composition of isocratic elution of the same mobile phase was also demonstrated.





**Day 3: Lecture 2**

**Liquid Chromatography Tandem Mass Spectrometry**

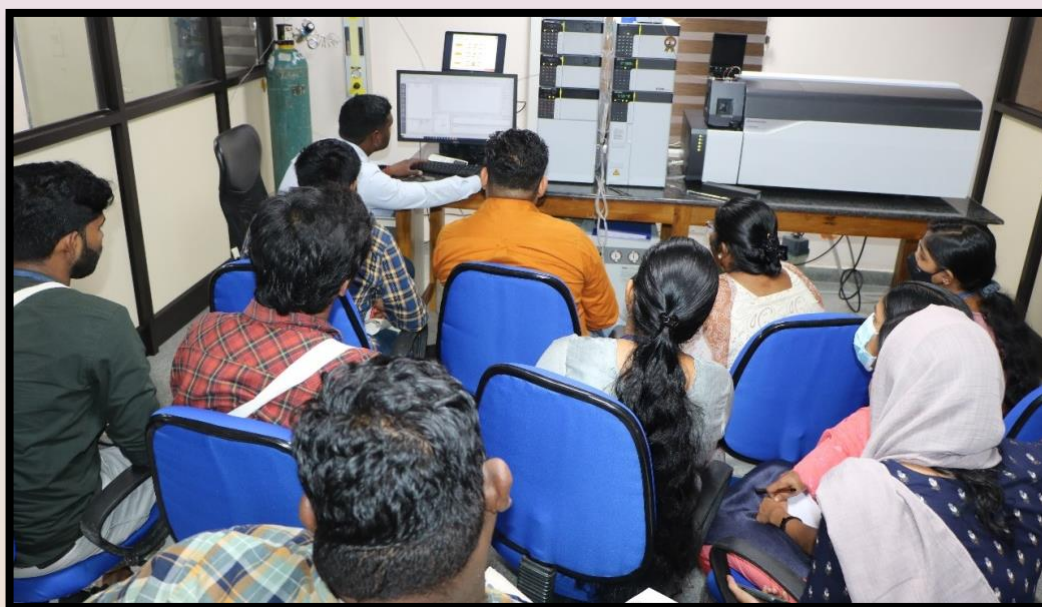
***Mr. S. Dinesh, Field Application Specialist, Spinco Biotech***



Second session of Day 3 was the theory of Liquid Chromatography tandem mass spectrometer by Mr. S. Dinesh, Field Application Specialist, Spinco Biotech. The theoretical session covered all the basics of mass spectrometry and in-depth details of triple quadrupole mass spectrometer. Different kinds of ionization techniques (ESI, APCI, MALDI etc.) were discussed. Different modes of analysis like Scan,

SIM, MRM were explained. Details of application of the equipment in research and industry were shared.

In the practical session the front end and mass part were shown and each part was explained in detail. Selection and preparation of mobile phase, column selection were explained. Scan, SIM, MRM modes were demonstrated by injecting drug standard (Lenvatinib). Method development for new compounds were detailed. Instrument trouble shooting and remedies were also discussed.



#### **Day 4: Field visit**

### **SEALAB & SEAFOOD PARK, AROOR, ALAPUZHA**







## Day 5: Lecture 1

# Liquid Chromatography Mass Spectrometry with Time of Flight Mass Analyzer

*Ms. Dilshad Punnacheril, Manager-Marketing, Waters India Pvt. Ltd*



Day 5 of the training program started with theoretical talk on LC-QTOF MS by Ms. Dilshad Punnacheril, Manager-Marketing, Waters India Pvt. Ltd. Details of High-Resolution mass spec instruments were discussed and explained the scope of non-target analysis using the HRMS. In the practical session, detailed and demonstrated each part of HPLC and mass spectrometer of LC-Q-TOF ms. Differentiated the high pressure and low pressure gradient pump and its applications. Detailed about the resolution of  $m/z$  ratio, isotopic pattern and its importance in non-target analysis. Explained and showed the importance of tuning the instrument using the internal standard leucine enkephalin before doing analysis. Done full scan analysis and  $ms/ms$  analysis of the standard caffeine. Assigning of elemental composition, structures of fragments of the parent ion using masslynx and mass fragment software was also explained in the session.





**Day 5: Lecture 2**

**Inductively Coupled Plasma Mass Spectrometry**

*Mr. Chandragiri Rambabu, Application Manager, Thermo Fisher Scientific*



Second theoretical session of Day 5 was about Inductively Coupled Plasma Mass Spectrometry by Mr. Chandragiri Rambabu, Application Manager, Thermo Fisher Scientific. The session on ICPMS covered basics of ICPMS and metal analysis, instrumentation, sample preparation and data interpretation.

During the practical demonstration and hands-on training was given to the participants on plasma ignition, tuning of the instrument, calibration curve plotting and monitoring different metals in a given water sample. Explained the software and trouble shooting.



**Day 6: Lecture 1**

**Fild Emission Scanning Electron Microscopy**

***Mr.A. Rajagopal, Senior Product Manager, LABINDIA***





First lecture of Day 6 was on FESEM by Mr. A. Rajagopal, Senior Product Manager, LABINDIA. He explained the basic principle, working and analysis methods along with the relevance of this highly equipped instrument for high-end research. New advancements in this field were also discussed.

The hands on session covered the functioning of different parts of FESEM. Imaging procedures at different modes with different voltages explained using both conducting sample Ag<sub>3</sub>PO<sub>4</sub> and non-conducting (gold coated samples) like polymer fibres and bone bio char.



**Day 6: Lecture 2**  
**Life time Analysis**

*Dr. C. S. Rajesh, Application Scientist, Horiba*



Second lecture of Day 6 was by Dr. C. S. Rajesh, Application Scientist, Horiba on Life time Analysis. Use of lifetime analysis in various research fields were discussed along with the new advancements in the area.

In the hands on session the different components of the PL instrument for decay measurement is narrated and monitored both nano scale and milli scale lifetime of Rhodamine 6G and Eu doped glass respectively. Also explained how to fit the decay data in DAS6 software.





**Day 7: Lecture**

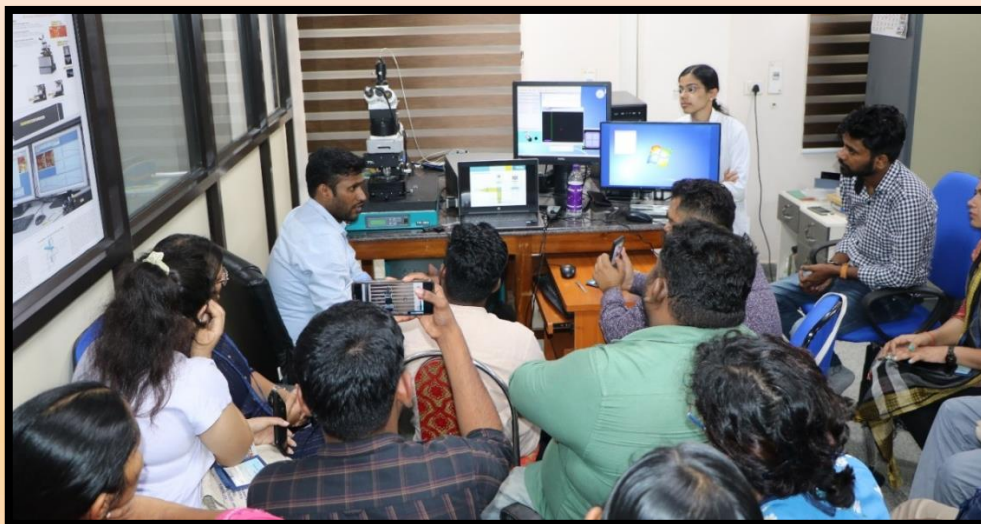
## **Confocal Raman Spectroscopy & AFM**

*Mr. Satheesh Kumar, Country Manager & Aftersales Support, WITec*



The forenoon session of the last day of training consisted of detailed theory classes on Raman spectroscopy and Atomic Force Microscopy and its applications by Mr. Satheesh Kumar, Country Manager & Aftersales Support, WITec.

In the hands-on session the technical expert explains different parts of a Raman spectrometer i.e.; laser, detector, spectrometer etc. Collected one Raman spectra of graphite sample and explained different properties of the sample like crystallinity and peak shift from the collected Raman spectra. For AFM analysis a standard polysulfone membrane was used. From image obtained, surface properties like roughness, particle size were explained.



## **VALEDICTORY SESSION**

Valedictory Session started by 4pm at the Main Seminar Hall of School of Environmental Sciences, M. G. University, Kottayam. Hon. Pro-Vice Chancellor Prof. C. T. Aravindakumar presided over the meeting. Candidates expressed their gratitude for selecting them for the training and shared their one week experience during the training. All the delegates gave good feedback about the training program and were really enthusiastic to participate in further workshops at Mahatma Gandhi University, Kottayam. Hon. Vice Chancellor gave his message and the session was concluded by distributing training certificates to the delegates.



## List of Participants

Sl. No.	Name	Designation	Institute/Department
1	Ms. Mary Theresa	Research scholar	School of Biosciences, Mahatma Gandhi University, Kottayam
2	Ms. Linda Maria Varghese	Research scholar	School of chemical Sciences, Mahatma Gandhi University, Kottayam
3	Ms. Gopika N V	Technical Assistant	ACCESSD, Mahatma Gandhi University, Kottayam
4	Ms. Susmy Jose	R&D Chemist	Arjuna Natural Extracts Pvt Ltd
5	Ms. Shamna K	Project fellow	Kerala forest research institute, Peechi
6	Mr. Manoj Kumar Mallick	Project Associate-I	CIPET: SARP-LARPM, Odisha
7	Mr. Nibu B. Thomas	Assistant Professor	Baselius College, Kottayam
8	Ms. Sajna Peediyakkathodi	Research Assistant	CUSAT, Kochi
9	Mr. Muhammed Mubashir P V	M.Sc. Chemistry	Central University of Tamil Nadu
10	Dr. Abhithaj J	Research Associate	ICMR, Kannur University
11	Ms. Anjana E. I.	Research Scholar	CSIR-NIIST, Thiruvananthapuram
12	Dr. V. Gopalakrishnan	Assistant Professor	Dept chemistry, R.K.M. Vivekananda College, Tamil Nadu
13	Dr. P. Maheswari	Assistant Professor,	Department of Physics, Sri Sairam Engineering College, Chennai
14	Dr. Vijaytha Vijayakumar	Assistant Professor	Sree Narayana Guru College, Kozhikode
15	Dr. K. Rama Swami	PDF	IIT, Madras

16	Mr. Unnikrishnan T G	Research Scholar	NIT Trichy Tamilnadu
17	Ms. Reshmi John	Research scholar	S B College, Changanassery
18	Mr. Prathap. H.M	Research scholar	Davanagere University, Karnataka
19	Mr. Sanuvel Shajan	R&D Chemist	Govt. Engineering College, Trissur
20	Mr. Harpreet Singh	Research Scholar	Department of Physics, Punjabi University, Patiala
21	Mr. M. Sudharsan	Research scholar	Department of Biochemistry and Biotechnology, Annamalai University, Chidambaram
22	Ms. Sini K S	Research scholar	St. Joseph's College (Autonomous), Devagiri, Calicut
23	Mr. Deepak Kumar	Research Scholar	Chaudhary Charan Singh University, Meerut
24	Mr. Rishi	Research Scholar	Guru Jambheshwar University of Science & Technology, Hisar
25	Ms. Jaishree Sharma	Research Scholar	Department of Applied Science, UPES Bidholi Campus, Dehradun
26	Ms. Aiswarya Robert Antony	Research Scholar	Department of Environmental Science, Central University of Kerala, Kasaragod
27	Mr. Rajeev Rajendran	Research scholar	CUSAT, Kochi
28	Mr. Baljinder Kaur	Research Scholar	Department of Chemistry, Panjab University, Chandigarh
29	Mr. Rajiv Kashyap	Research Scholar	Dept of chemistry Chandigarh, Panjab University, Chandigarh
30	Ms. Purna Bansal	Research Scholar	Dept. of Biomedical Science ACBR, University of Delhi
31	Ms. Purna	Research Scholar	Dept of chemistry Chandigarh, Panjab University, Chandigarh



# PARTICIPANTS' DISTRIBUTION

