

A training session report on
Advanced Analytical Techniques

Under STUTI program funded by DST



In association with
Indian Institute of Technology, Gandhinagar
(Project Management Unit)



Coordinated by

Prof. Anita Lakhani

Department of Chemistry,
Dayalbagh Educational Institute, Agra

Uttar Pradesh, India

24th to 30th September 2022

Acknowledgement

We convey gratitude for the encouragement and support received from multiple sources during the execution of this training since its beginning. First and foremost, we want to express our sincere appreciation to the IIT Gandhinagar (PMU) and Department of Science and Technology (DST) for entrusting us with this project. The workshop was coordinated by **Dr. Anita Lakhani**. The workshop was conducted on the '*Advanced Analytical Techniques*' on the instrument funded by the FIST program (Sanction No.: SR/FST/CS-II/2017/38(C)). Organizing team acknowledge the contributions of the committee, in the implementation and the execution of the program to achieve the objectives of the project, particularly, **Prof. Ajay Taneja** (Pro-Vice Chancellor, Dr B R Ambedkar University, Agra), **Prof. A K Saxena** (Dean, Faculty of Engineering, DEI), **Dr. A M Khan** (Director, National Jalma Institute, Agra) and **Prof. S P Singh** (Principal, St. John's College, Agra) for serving as Chief Guest and Guests of Honour during Inaugural and Valedictory Sessions. Their kind presence graced the occasion. Our special thanks to the DEI administration, especially the **Prof. P K Kalra** (Director), **Prof. Anand Mohan** (Registrar) and **Ms. Sneh Bijlani** (Treasurer), who have helped us in providing the necessary administrative support for the programme.

We also acknowledge the most significant contributions of all invited speakers, the staff members and the research scholars of the Department of Chemistry, DEI. Their kind support and help has been the key in successfully organizing the training program to achieve its objectives.

Dr. Anita Lakhani

Coordinator

Summary

The goal of this training programme was to acquaint and popularize the use of sophisticated instruments and characterization tools among students, faculty, scientists and industry professionals through a week-long training program. The workshop was conducted at department of Chemistry Dayalbagh Educational Institute (DEI), Dayalbagh, Agra from 24th to 30th September, 2022. It comprised of lectures and hands on training sessions. The programme was funded by Department of Science & Technology, Govt. of India, under the program STUTI (*Synergistic Training Program Utilizing the Scientific and Technological Infrastructure*). It aimed to provide the participants an insight into the principles and operation of various analytical instruments and techniques, viz. Field Emission Scanning Electron Microscope (FE-SEM), X-ray Diffractometer (XRD), Inductively Coupled Plasma Optical Emission Spectrometer (ICP-OES), Gas Chromatograph – Mass Spectrometer (GC-MS), Thermogravimetric Analyzer (TGA), Differential Scanning Calorimeter (DSC) and Ion Chromatograph (IC). The participants were introduced to the basic concepts of instrumentation, troubleshooting and the advanced modes of operation of these instruments. The focus of this workshop was to have “a balance between theory and practical training on the equipment. Greater emphasis was laid on *hands-on training to the participants on use of equipment, through laboratory demonstration sessions and by encouraging participants to analyze their own samples.*

Introduction

Department of Chemistry, Dayalbagh Educational Institute, Agra, conducted 7-day long hands-on training program on ‘*Advanced Analytical Techniques*’ organized by IIT Gandhinagar, (PMU). The participants from various backgrounds such as Post Graduate, Professors, Scientists, Post-Doc Fellows, Ph.D. Fellows and Industry persons participated in this workshop (**Annex-1**). The training program was organized during 24th to 30th September, 2022, the activities of which are as mentioned in (**Annex-2** and **3**). This report provides a quick overview of both the lecture and technical sessions.

- Lecture Sessions:

Dr. Aparna Satsangi (Assistant Professor, Department of Chemistry, DEI) delivered a talk on ‘Ion Exchange Chromatography: Principle and Application’ and **Prof. Anita Lakhani** (Department of Chemistry, DEI) delivered a talk on Quantitative analysis dealing with numbers. Few talks delivered by **Prof. Will H Cantrell** (Associate Provost and Dean of the Graduate School at Michigan Technological University, USA) delivered a talk on ‘Interactions between Turbulence and Cloud Microphysics: Insights from the Lab; **Dr. Pankaj Kumar** (Scientist, Inter University Accelerator Centre, New Delhi) delivered a talk on ‘Plasma Source Based Low Energy Mass Spectrometer: Basics and Research’ and **Dr. Barun Gosh** (Technical Specialist, Agilent Technologies India Pvt. Ltd) delivered a talk on ‘Training on ICP OES Principles, Operation and General Application’. Next session were held with a talk delivered by **Mr Praveen Arya** (Product Specialist, Agilent Technologies India Pvt. Ltd.,) delivered a talk on ‘Fundamentals, operation and general applications of Gas Chromatography-Mass Spectrometry (GC-MS)’. It was followed by talk from **Mr. Anshuman Mahato** (Senior Application Specialist, Agilent Technologies India Pvt. Ltd. On ‘Overview of fundamentals, applications and sample preparation techniques of High Performance Liquid Chromatography’. Following this, **Prof. S K Gupta** (Head, School of Studies in Chemical Sciences, Jiwaji University, Gwalior) spoke on “X-ray diffraction techniques for research and teaching”. **Mr. Ananta K Chowdhury** (Regional Sales Manager (North) – AXS Division, Bruker) delivered his talk on ‘Lab Basics of X-ray Diffractometer and how to get a good diffraction data’. A talk delivered by **Mr. Saurabh**

Jain (Senior Product Specialist, Perkin Elmer) on ‘Thermal Analysis and its Applications’. It was followed by **Dr. Sudhir Kumar Verma** (Assistant Professor, DEI) who spoke on principle and applications of ‘Thermogravimetric Analysis and Differential Scanning Calorimetry’. Following this **Mr. Sachin Gangwar** (Product Specialist, Agilent technologies India Pvt. Ltd.) delivered talk on fundamentals and general applications of ‘Liquid Chromatography Mass Spectrometry (LC-MS)’. **Dr. Manju Srivastava** (Assistant Professor, DEI) explained the ‘Basics of Field-Emission Scanning Electron Microscope (FE-SEM)’.

- Technical Session

On the **first** day participants were given demonstration and hands-on training on Ion Chromatograph by **Dr. Aparna Satsangi**. On the **second** day, scientific/cultural excursion tour of Dayalbagh way of life and local heritage sites was organized. On the **third and fourth** day participants were given demonstration and hands-on training on Inductively Coupled Plasma-Optical Emission Spectrophotometer by **Prof. Anita Lakhani**. She was assisted by **Dr. Ranjit Kumar, Dr. Aparna Satsangi, Dr. Vipin Singh** (Project Scientist), and PhD students namely, **Ms. Isha Goyal, Ms. Gunjan Goswami, Ms. Simran Bamola** and **Ms. Muskan Agarwal**. On the **fifth and sixth** day, laboratory sessions were conducted wherein participants were given demonstration and hands-on-training on TGA and DSC by **Dr. Sudhir Kumar Verma** (Assistant Professor, DEI). Research students, **Mr. Rajat Sengar, Mr. Virendra Upadhyay, Ms. Simran Bamola** and **Ms. Kirti Singh** assisted in this session. On the **seventh** day, laboratory sessions were conducted by **Dr. Ranjit Kumar** (Assistant Professor, DEI) and **Dr. Anupam Srivastava** (Assistant Professor, DEI). Participants were given demonstration and hands-on-training on the Film Deposition Techniques, viz. Spray14 pyrolysis and Spin Coating.

- Types of samples tested

During the technical session, all of the participants expressed an interest in learning from the workshop and characterized samples like Acid digested samples, microwave digestion vessel, Sugar, aerosol and soil samples were also tested.

Outcomes of the Workshop

The STUTI workshop attracted participants from 20 different institutes (Figure 1). About 30 participants enrolled and attended the “Advanced Analytical Techniques”. The goal of this training event was to provide a general overview on the practical aspects of various sophisticated techniques over instruments, along with the hands-on practical knowledge using sophisticated instrumentation techniques. To bring together participants from many disciplines and raise awareness of the institute's advanced facilities. Throughout the workshop, participants actively involved in the session and developed expertise's, asked major questions regarding theoretical and practical aspects of drug screening. This hands-on training program collaborations from many small institutions and national level institutes. Finally, the feedback from the participants was considered in the evaluation of the workshop. The majority of the participants were pleased with the training session and suggested that more workshops should be held in the future. Few participants suggested organizing such a workshop/training session on more regarding full instrumental technique workshop and regulatory needs.



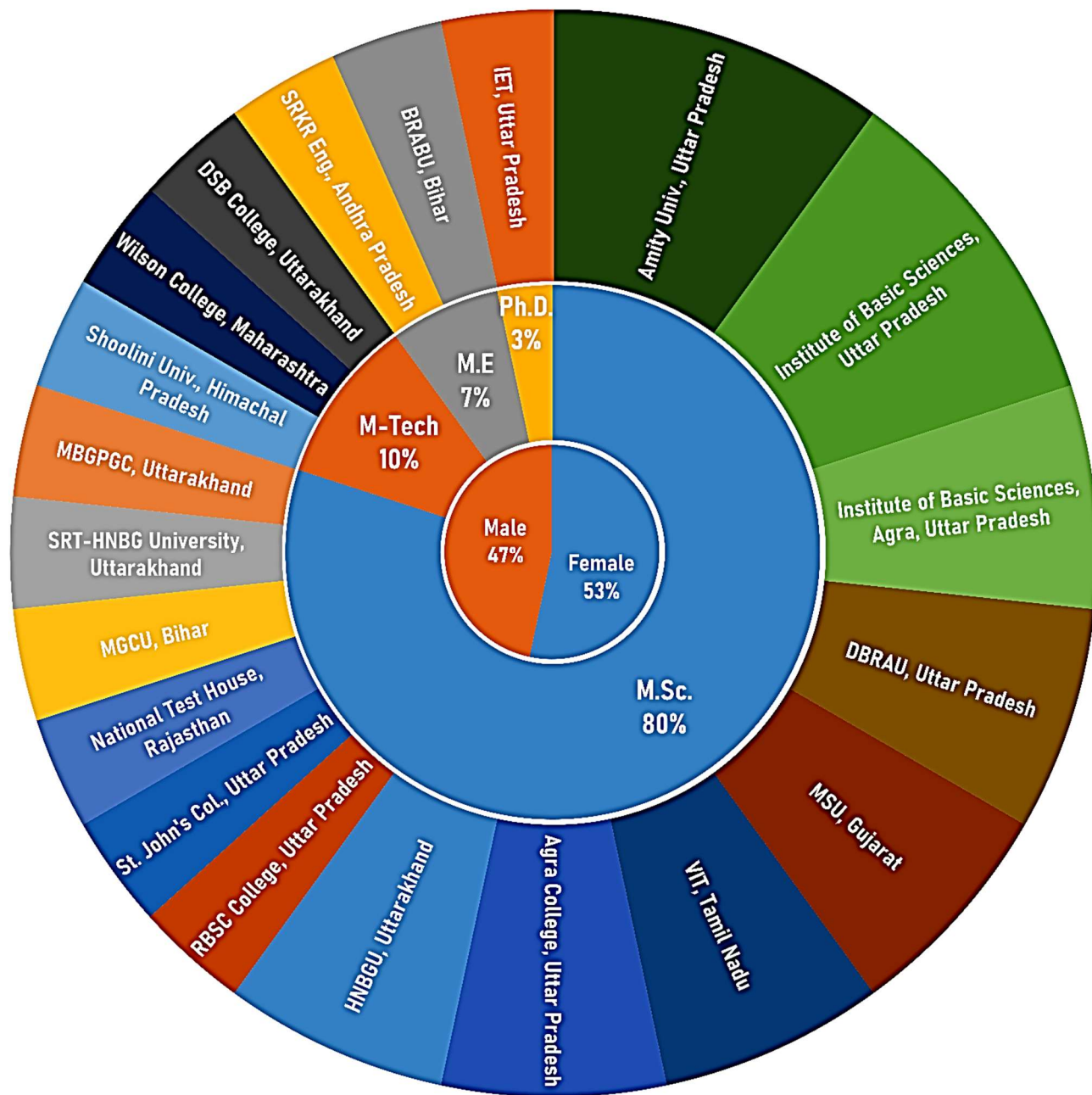


Figure 1. Participants registered workshop from different institutes

Annexure 1: Brochure for the program



Dayalbagh Educational Institute (DEI), Dayalbagh, Agra

Organizes
Training Program on Advanced Analytical Techniques
Sponsored by
Indian Institute of Technology, Gandhi Nagar
Under 'Synergistic Training program Utilizing the Scientific and Technological Infrastructure'
(STUTI)
An Initiative of Department of Science & Technology (DST), Govt. of India
(24 – 30 September, 2022)



About Dayalbagh Educational Institute (DEI)
Established in 1915, Dayalbagh Educational Institute (DEI) is today a 'Deemed to be University', known world over for its unique academic programmes, starting from kindergarten to doctoral research. The Institute enjoys a high national and international reputation for its quality teaching, research and outreach programmes. It is located amidst the tranquil environs of Dayalbagh, on the outskirts of the historic city of Agra. With a vibrant, active and diverse scientific community, DEI is a leading centre for dissemination and application of knowledge in the natural sciences and technology. Additionally, the Institute has been making relentless efforts in providing employment-oriented education to women, other weaker sections of society and the tribal populace, by providing vocational training-based education. Department of Chemistry in the Faculty of Science at DEI works with the objective of imparting up-to-date knowledge in modern cutting edge areas of Chemistry, with imbedded inter-disciplinary and social elements.

About the Training Programme
Chemical analysis and characterization of prepared samples on sophisticated and high-end equipment is one of the prerequisites for quality research in Chemical Sciences. The Department of Chemistry (DST - FIST Sponsored) at DEI is equipped with a wide range of sophisticated instruments/systems, viz. Field Emission Scanning Electron Microscope, X-ray Diffractometer, Gas Chromatograph - Mass Spectrometer (coupled with Thermal Desorption Unit), Inductively Coupled Plasma Optical Emission Spectrometer, Thermo-gravimetric Analyzer & Differential Scanning Calorimeter, Gas Chromatograph, Online Analyzers for atmospheric O₃ and NO_x, Ion Chromatograph, and Zeta Sizer, for qualitative and quantitative analysis and characterization of samples. The Department has a long tradition of quality research in emerging and socially relevant areas of Chemical Sciences. One week Training Program on Advanced Analytical Techniques' is being organized in the offline mode by the Department of Chemistry (DEI), at DEI, in collaboration with IIT-Gandhi Nagar, under the 'Synergistic Training program Utilizing the Scientific and Technological Infrastructure (STUTI)' Scheme of Department of Science & Technology (DST), Govt. of India, from September 24-29, 2022. It aims to impart training cum hands-on experience to young researchers and faculties on sophisticated equipment used in chemical analysis.

Instrumental Techniques to be covered

- Field Emission Scanning Electron Microscope (FESEM)
- X-ray Diffractometer
- Inductively Coupled Plasma Optical Emission Spectrometer
- Gas Chromatograph - Mass Spectrometer
- Thermogravimetric Analyzer & Differential Scanning Calorimeter
- Ion Chromatograph

Programme Faculty
Lectures/Laboratory Sessions will be conducted by eminent researchers, experts and faculty members.

Objective
To familiarize the participants with better understanding and acquaintance on principles, operations and applications of listed instruments in cutting-edge researches in the fields of materials science, atmospheric science, surface chemistry, biofuel studies and drug designing.

Eligibility
Indian nationals, working as Assistant/Associate Professors/Professors/Scientists/Post-Doc. Fellows/Ph.D. scholars and M. Tech. Students actively involved in the field of Basic/Applied Sciences or Engineering are eligible to apply.

Award of Certificate
On successful completion of the training programme, participants will be awarded with participation Certificate.

Registration
Interested candidates need to apply to the Programme Coordinator, before September 18, 2022, on the Google Form with link given below:
<https://forms.gle/R5JH4Aw2oRp8kov9l>
All selected candidates will be intimated through email latest by September 20, 2022.

Patron
Prof. P K Kalra
Director
Dayalbagh Educational Institute
Dayalbagh, Agra - 282 005, India

Convener
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Important
Number of participants is limited to 30. Selection will be based on screening of applications from the viewpoint of candidates' areas of research matching with the theme and objectives of the training program. Participation of women and from disadvantaged sections would be encouraged. Selections made by the organizers will be final and cannot be challenged.

Participants will be offered local hospitality. Out-station participants will be provided modest accommodation. On demand basis, limited number of out-station participants may be offered to-and-fro train fare (AC 3 Tier) by shortest route from their workplace.

For any further query contact at:
tpaatstuti@gmail.com



आज़ादी का
अमृत महोत्सव



Annexure 2: List of registered participants for the workshop

Sr. No.	Candidate Name	Gender	Educational Qualification	University/Institute
1	Aditi Kandari	Female	M.Sc. (Organic Chemistry)	Hemvati Nandan Bahuguna Garhwal University, Srinagar, Uttarakhand
2	Rita	Female	M.Sc. (General Chemistry)	
3	Ayush Dutta	Male	M-Tech (Mechanical Engineering)	Inst. of Engg. & Technology, Lucknow, Uttar Pradesh
4	Chandra Kant	Male	MSc. (Organic Chemistry)	Babasaheb Bhimrao Ambedkar University, Muzaffarpur, Bihar
5	Dr. Chandra Sekhar D.	Male	Ph.D. (Industrial Chemistry)	Sagi Ramakrishnam Raju Engineering College, Andhra Pradesh
6	Shalini Singh	Female	M.Sc. (Physical Chemistry)	Agra College, Agra, Uttar Pradesh
7	Neha Verma	Female	M.Sc. (Organic Chemistry)	
8	Chetan Gautam	Male	MSc. (General Chemistry)	
9	Shailendra Pratap Singh	Male	M.Sc. (Organic Chemistry)	Institute of Basic Sciences, Agra, Uttar Pradesh
10	Mohit Kumar	Male	M.Sc. (Organic Chemistry)	
11	Deepa Sharma	Female	MSc. (Organic Chemistry)	
12	Onkar Jaywant Kewate	Male	M-Tech (Nanotechnology)	
13	Gunjan Mittal	Female	M-Tech (General Chemistry)	Vellore Institute of Technology, Vellore, Tamil Nadu
14	Patel Shivani P	Female	M.E (Applied Physics)	Maharaja Sayajirao Univ. of Baroda, Gujarat
15	Harsh D Patel	Male	M.E (Applied Physics)	
16	Iram	Female	M.Sc. (Organic Chemistry)	Dev Singh Bisht College, Nainital, Uttarakhand
17	Rini John	Female	M.Sc. (In-Organic Chemistry)	Dr Bhimrao Ambedkar University, Agra, Uttar Pradesh
18	Kavita Singh	Female	M.Sc. (Organic Chemistry)	
19	Lorraine Edwin Tellis	Male	M.Sc. (Organic Chemistry)	Wilson College, Mumbai, Maharashtra
20	Pankaj Kumar	Male	M.Sc. (Organic Chemistry)	Shoolini University, Solan, Himachal Pradesh
21	Palak Sharma	Female	M.Sc. (Forensic, Toxicology)	Amity University, Noida, Uttar Pradesh
22	Shweta Singh	Female	M.Sc. (Forensic Science)	
23	Priyanka Gopi	Female	M.Sc. (Forensic, Toxicology)	
24	Reema Chand	Female	M.Sc. (Organic Chemistry)	M.B.G.P.G.C, Kathgodam, Haldwani, Uttarakhand
25	Shyam Narayan Nautiyal	Male	M.Sc. (Organic Chemistry)	SRT Campus Tehri, HNBBG University, Uttarakhand
26	Sumit Singh	Male	M.Sc. (Organic Chemistry)	Mahatma Gandhi Central Univ. Motihari Bihar
27	Tarun Rai	Male	M.Sc. (Organic Chemistry)	Ministry of Consumer Affairs, National Test House, Jaipur, Rajasthan
28	Tulika Tripathi	Female	M.Sc. (Organic Chemistry)	Institute of Basic Sciences, Agra, Uttar Pradesh
29	Sonam Sandal	Famale	M.Sc. (Organic Chemistry)	St. John's College, Agra, Uttar Pradesh
30	Shilendra Kumar	Male	M.Sc. (General Chemistry)	Raja Balwant Singh Degree College , Agra, Uttar Pradesh

Annexure 3: Schedule date and activities during the workshop

Sept. 24	Registration Inauguration Prayer Welcome Departmental Movie Show About the Program - Prof. Anita Lakhani, DEI & Mr. Partha Patel, IIT Gandhinagar Address by Chief Guest Presidential Remarks Vote of Thanks <i>HIGH TEA</i>	09:30-10:30 10:30-11:15	
	Talk 1 Ion Exchange Chromatography: Principle and Applications – Dr. Aparna Satsangi, DEI	11:15-11:30 11:30-12:30	
	Talk 2 Quantitative analysis dealing with numbers – Professor Anita Lakhani, DEI	12:30-13:30	
	<i>LUNCH</i>	13:30-14:30	
	Lab. Session 1 Hands-on Training on Ion Chromatograph	14:30-16:30	
	Sept. 25	Scientific/Cultural Excursion of Dayalbagh Way of Life and Local Heritage Sites – Dr. Sudhir Kumar Verma & Student Volunteers	10:30-16:30
	Sept. 26	Prayer Talk 3 Interactions Between Turbulence And Cloud Microphysics: Insights from the Lab. – Dr. W. H. Cantrell, Associate Provost & Dean of the Graduate School, Michigan Technological University, USA	10:25-10:30 10:30-11:30
Talk 4 Plasma Source Based Low Energy Mass Spectrometer: Basics & Research – Dr. Pankaj Kumar, Scientist, IUAC, New Delhi		11:30-12:30	
Talk 5 Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES): Principle, Operation and General Applications – Dr. Barun Gosh - Technical Specialist, Agilent Technologies India Pvt. Ltd.		12:30-13:30	
<i>LUNCH</i>		13:30-14:30	
Lab. Session 2 Hands-on Training on ICP-OES		14:30-16:30	
Sept. 27	Prayer Talk 6 Gas Chromatography-Mass Spectrometry (GC-MS): Fundamentals, Operation and General Applications – Mr. Praveen Arya, Product Specialist, Agilent Technologies India Pvt. Ltd.	10:25-10:30 10:30-11:30	
	Talk 7 High Performance Liquid Chromatography: Fundamentals, Applications and Sample Preparation Techniques: A complete overview – Mr. Anshuman Mahato, Senior Application Specialist, Agilent Technologies India Pvt. Ltd.	11:30-12:30	
	Talk 8 X-ray Diffraction Techniques for Research and Teaching – Prof. S. K. Gupta, Head, School of Studies in Chemistry, Jiwaji University, Gwalior	12:30-13:15	
	<i>LUNCH</i>	13:15-14:00	
	Talk 9 Basics of X-ray Diffractometer and How to get a Good Diffraction Data – Mr. Ananta K Chowdhury, Regional Sales Manager (North) – AXS Division, Bruker	14:00-15:00	
Sept. 28	Lab. Session 3 Hands-on Training on GC-MS and XRD	15:00-17:00	
	Prayer Talk 10 Thermal Analysis and its Applications – Mr. Saurabh Jain, Senior Product Specialist, Perkin Elmer	10:25-10:30 10:30-11:15	
	Talk 11 LC-MS/MS Fundamentals and General Application – Mr. Sachin Gangwar, Agilent Technologies India Pvt. Ltd.	11:15-12:00	
	Talk 12 Principle and Applications of Thermogravimetric Analysis/Differential Scanning Calorimetry – Dr Sudhir Kumar Verma, DEI	12:00-12:45	
	Talk 13 Fundamentals and General Applications of Liquid Chromatography Mass Spectrometry (LC-MS) – Mr. Sachin Gangwar, Product Specialist, Agilent Technologies India Pvt. Ltd.	12:45-13:30	
Sept. 29	<i>LUNCH</i>	13:30-14:30	
	Lab. Session 4 Hands-on Training on TGA and DSC	14:30-16:30	
	Prayer Talk 14 Field Emission-Scanning Electron Microscopy: Basics – Dr. Manju Srivastava, DEI	10:25-10:30 10:30-11:30	
	Talk 15 Applications of Field Emission-Scanning Electron Microscopy – Dr. Shyama Prasad, Former Chief Scientist, NIO, Goa	11:30-12:30	
	Talk 16 Computational Chemistry – Dr. Nazia Siddiqui, DEI	12:30-13:30	
Sept. 30	<i>LUNCH</i>	13:30-14:30	
	Lab. Session 5 Hands-on Training on Field Emission –Scanning Electron Microscope	14:30-16:30	
	Prayer Talk 17 Biomedical Applications of Electronic Chips – Dr. Aatmesh Shrivastava, North Eastern University, USA	10:25-10:30 10:30-11:30	
	Talk 18 Air Sampling and Analysis – Ms. Kruti Davda, Environment Lead, Oizom Instruments Pvt. Ltd.	11:30-12:30	
	Lab. Session 6 Hands-on Training on Film Deposition Techniques and Air Sampling	12:30-13:30	
Sept. 30	<i>LUNCH</i>	13:30-14:30	
	Valedictory Session Report of the Program – Prof. Anita Lakhani, Program Co-ordinator Feedback from participants Certificate distribution Remarks from the Chief Guest Vote of thanks <i>HIGH TEA</i>	14:30-15:30	

Annexure 4: Feedback summary

Sr. No	Content	% Rating
1	Overall grading of the program with reference to relevance of course, module/ content etc.	98% Rated on or above 8 points
2	Overall grading of the facilities provided by the institute, i.e., Hostel, Mess, Classrooms, Transport/infrastructure etc.	98% Rated on or above 8 points
3	Overall grading of the faculty members conducting the training	97% Rated on or above 8 points
4	How do you rate the overall training methodology	98% Rated on or above 8 points
5	How far the field visit is relevant and related to your research study	99% Rated on or above 8 points
6	Usefulness of this training in your current role	98% Rated on or above 8 points
7	Usefulness of this training in future work/job you may handle	97% Rated on or above 8 points
8	How far have you benefitted from interaction with the fellow participants of the training	98% Rated on or above 8 points
9	How far the course material supplied relevant and related to the training curriculum	96% Rated on or above 8 points
10	Overall grading of the process of training	94% Rated on or above 8 points
11	Your recommendation to your peers/ colleagues for the training Program	97% Rated on or above 8 points