

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)



Co-ordinated by

Prof. Hareshkumar Keharia

Post Graduate Department of Biosciences

Sardar Patel University

Vallabh Vidyanagar, Gujarat

19th to 25th September 2022

Acknowledgement

The workshop on Advanced Analytical Techniques was organized using sophisticated analytical Instruments procured from DST-FIST support (Project No.: HPLC-(SR/FIST/LSI-376/2008 December 01, 2009); Flash Chromatography-(SR/FST/LS-I/2017/50 January 16, 2018); Fluorescence Microscope-(SR/FIST/LSI-376/2008 December 01, 2009); DIC Microscope with Fluorescence and Phase contrast facility-(SR/FST/LS-I/2017/50 January 16, 2018)) mainly to create awareness regarding the fundamentals and applications of the instruments in research and development. We sincerely acknowledge the financial support that department has received from Department of Science and Technology to organize STUTI workshop.

During the workshop, training was imparted on FTIR, Ion Chromatography, HPLC, HPTLC, Flash Chromatography and Fluorescence as well as DIC Microscopy. I acknowledge the contributions of all the resource persons, who spared their valuable time and delivered lectures as well as demonstrated the analytical applications of these instruments. The department acknowledges the contributions of the team of Ph. D. scholars and Assistant Professors for interacting with participants on one to one basis and helping them in the analysis of their samples during the entire workshop. I acknowledge the services of Dr. Kunal Jain who has worked tirelessly right from the design of flyer to communication with participants and assisting me in every aspect for organizing this workshop. I also acknowledge the support and contributions of my colleagues as well as our Head of the Department for this event.

I express my deep sense of gratitude towards the project staff and STUTI team from IIT Gandhinagar for their contributions and all support, without which this workshop would not have been possible.

Co-ordinator

Prof. Hareshkumar Keharia

Summary

The objective of organizing this training is to create awareness regarding the applications of sophisticated analytical instruments among students, faculty, scientists and industry professionals through a week-long workshop. The workshop was organized at Post Graduate Department of Biosciences, Sardar Patel University, Bakrol from 19th to 25th September 2022 and consisted of lectures and practical training sessions. This initiative is funded by Department of Science and Technology under the program STUTI (Synergistic Training Program Utilizing the Scientific and Technological Infrastructure). During this workshop, training was provided on working and applications of Fourier Transformed Infrared Spectroscopy, Ion chromatography, High Performance Thin Layer Chromatography, Flash Chromatography, High Performance Liquid Chromatography, Fluorescence and Differential Interference Microscopy including sample preparation and data interpretation as well as statistical analysis. The participants were introduced to basis concepts of techniques, instrumentation, sample preparation and analysis, trouble shooting, data interpretation and report generation. The focus of this workshop was to provide balanced training on theory and practical aspects of handling the equipment and to enable them to use these techniques for seeking the required information. The participants performed the analysis of their samples, that was followed by discussion with experts on the results and interpretation.

Introduction

The Post Graduate Department of Biosciences, Sardar Patel University conducted 7-day workshop on DST-FIST funded instruments in its central Instruments Facility for which participants from various backgrounds such as Post Graduate, Faculty, Ph. D. Fellows, Post-Doctoral Fellows were invited (**Annex-1**). The following workshop's activities took place from 19th to 25th September 2022 (**Annex-2 and 3**). This report provides a quick overview of both the lecture and technical sessions:

- *Lecture sessions*

An inaugural address by **Prof. Ujjwal Trivedi** (Head, PG Department of Biosciences, Sardar Patel University). He welcomed the resource persons and attendees and gave a brief introduction to the department and the university. **Prof. Hareshkumar Keharia** introduced about DST-STUTI to the participants. **Mr. Bharat Phatak** (LabIndia Instruments Pvt. Ltd., Vadodara) discussed the basics of instrumentation and modes of operation of FTIR. **Mr. Achyut Kodollikar** (Metrohm, Mumbai) delivered a lecture on the basics of Ion Chromatography, its different modes of operation. **Dr. Brijesh Parikh** (CEO and Owner of Rasayan Laboratories, Anand) delivered a lecture on the topic “Understanding of ISO/IEC 17025: 2017 version” and gave a detailed explanation of the various types of requirements for running and maintaining a testing laboratory. He also gave details about maintaining the standards of equipment, development of standard operating procedures (SOP) for equipment and utilizing pre-existing SOP for well-defined applications. The lecture was followed by an online quiz using Kahoot conducted by **Prof. Haresh Keharia** and **Prof. Hetalkumar Panchal** to test the learning outcomes of participants on technical sessions of the workshop. A lecture on the Fundamentals of HPLC, HPLC Instrumentation and its applications, delivered by **Mr. Sarojkumar Katara** (SPINCOTECH, Vadodara). He explained various theoretical considerations and importance of experimental design while using HPLC. A lecture on the fundamentals of Microscopy was delivered by **Dr. M Nataraj** (P.G. Department of Biosciences, SPU). He discussed the optics, instrumentation and theory behind the different forms of microscopy. **Mr. Mohit Upadhyay** (Anchrom Enterprise Pvt. Ltd., Mumbai) delivered a lecture on HPTLC basics, instrumentation and detection techniques with an emphasis on the user interface of the instrumentation. **Prof. Vasudev Thakkar** (P.G. Department of Biosciences, SPU) discussed the theory behind separation chromatography

techniques with an emphasis on improving the resolution of samples for better quantification and qualification of the samples. **Dr. Jayati Banerjee** (Team Lead, Peptide Workflow, Biotage India Pvt. Ltd, New Delhi) delivered a lecture on Flash Chromatography and its applications, and its comparison to other separation techniques. Session on statistical analysis and interpretation of data was conducted by **Mr. Hiren Kakkad** (CEO & Founder, Stat Modeller, Vadodara). **Prof. Arun** (Department of Physics, SPU) gave a lecture on Holographic imaging, DIC and Fluorescence Microscopy in addition to basics of microscopy. A lecture on the application of Fluorescence Microscopy was conducted by **Dr. Bijaya Haobam** (DBT-BioCare Scientist, Dr. Vikram Sarabhai Institute of Cell and Molecular Biology, The M.S University of Baroda). She also discussed the theory and applications of DIC (Differential Interference Contrast) microscopy.

- *Technical Session*

On the day **one**, Operational demonstration and an hands-on session on FTIR-ATR Spectroscopy was showed by **Mr. Sandeep Patel** (LabIndia Instruments Pvt. Ltd., Vadodara), during which participants worked on sample preparation and recording of spectra. Demonstration and an interaction on the working principle of Ion Chromatography instrument was guided by Mr. Achyut Kodollikar. On the day **two**, **Mr. Viral Shah, Mr. Dinesh Varu** and **Mr. Sankalp Rami** (Metrohm) took a session on practical application of instruments used in the Ion Chromatography system. Also present from Metrohm were Mr. Dinesh Varu and Mr. Sankalp Rami. The session also included the details about the software applications. On the day **three**, practical demonstration of the HPLC system was guided by **Mr. Sarojkumar Katara and Mr. Apurv Naik**. They helped the participants in hands-on session, by giving introduction about various components of the system and the handling of software while operating the HPLC system. During this session, HPLC analysis of samples brought by the participants was performed and interaction over the results were discussed. On the **fourth** day, **Mr. Mohit Upadhyay** in coordination with **Prof. Vasudev Thakkar** showed demonstration on the Applicator, Developer and detector system of HPTLC. In addition to they also showed demonstration on software applications for data analysis and standards used to investigate an 'unknown' mixture while using HPTLC. On the **fifth** day, **Mr. Sarang Pinjarkar** in coordination with **Dr. Jayati Banerjee** (Biotage India) demonstrated the flash chromatography and method development, trouble shooting and report generation.

Participants were taken for a field visit to the CALF Laboratory, NDDB, Anand, a sample testing laboratory that deals with various samples of dairy products, animal products, other food products, genetics testing for paternity and disease testing. It is one of the first testing laboratories in India to have a specific setup for testing Honey for adulteration. Participants visited to the labs of Microbiology, Chemical Analysis, Genetics, Honey and general parameter testing sections of the organisation. On the **sixth** day, in coordination to **Prof. Arun** a session on microscopy was demonstrated by **Dr. M. Nataraj**. Participants offered hand-on knowledge on the basic operation of microscopes and precautions to be practised while using a microscope of any type. On the **seventh** day, Dr. Bijaya Haobam showed demonstration on the operation of DIC and inverted fluorescence microscopes, along with sample analysis of the participants.

- *Valedictory session*

Prof. Ujjwal Trivedi (Head, Post Graduate Department of Biosciences, SPU was invited as a chief guest for the session. **Prof. Datta Madamwar** (Chief Scientific Advisor, CHARUSAT University, Changa and a former Head of the Bioscience Department, SPU). **Prof. Haresh Keharia** then summarized the proceedings of the workshop and acknowledged financial support from DST as well as IIT-Gandhinagar (Nodal Agency of DST), Sardar Patel University administration, Department Faculty, and support staff and the numerous volunteers who helped run the workshop smoothly. He also thanked **Mr. Nitin Solanki** and **Dr. Hitesh Patel** for their efforts in maintaining the instruments in good working condition. **Prof. Madamwar** and **Dr. Bijaya** both addressed the audience, emphasizing the importance of good practices in research. This was followed by the presentation of certificates to the attendees.

Types of samples tested

During the practical sessions, the participants enthusiastically learned the analysis and all participants who had got their samples performed the analysis. For FTIR, 22 samples that included plant based extract, anti-hypertensive drug, cresol degradation metabolites, pigments, were brought by 5 participants and all of them were analyzed. In addition, three participants analyzed their plant extract samples by HPTLC, two participants analyzed their 6 samples by HPLC, two participants analyzed their 6 samples (nematodes and bacterial cells) by fluorescence microscopy

Outcome of the workshop

The STUTI workshop attracted the participants from 21 different institutes (Figure 1). Amongst 120 registered applicants, 32 were allowed to attend the workshop. The goal of this training programme was to bring participants together from diverse disciplines and institutions from different parts of Gujarat as well as country and create awareness of the analytical facility available at Post Graduate Department of Biosciences, Sardar Patel University as well as in the vicinity. The participants took interest and actively interacted with resource persons, Ph. D. scholars and Faculty members of the department regarding the use of Instruments and their applications. This workshop led to development of a network amongst participants and with the faculty members of the department. Each day, a quiz was organized to assess the learning outcomes in which participants participated enthusiastically. The best three participants based on their cumulative score were felicitated in the valedictory session. Finally feedback of the participants was used to evaluate the workshop (Annexure-4). The majority of the participants were highly satisfied with the workshop. Very few participants suggested to give more emphasis of application development aspect and to include statistical analysis as one of the component in such workshops.



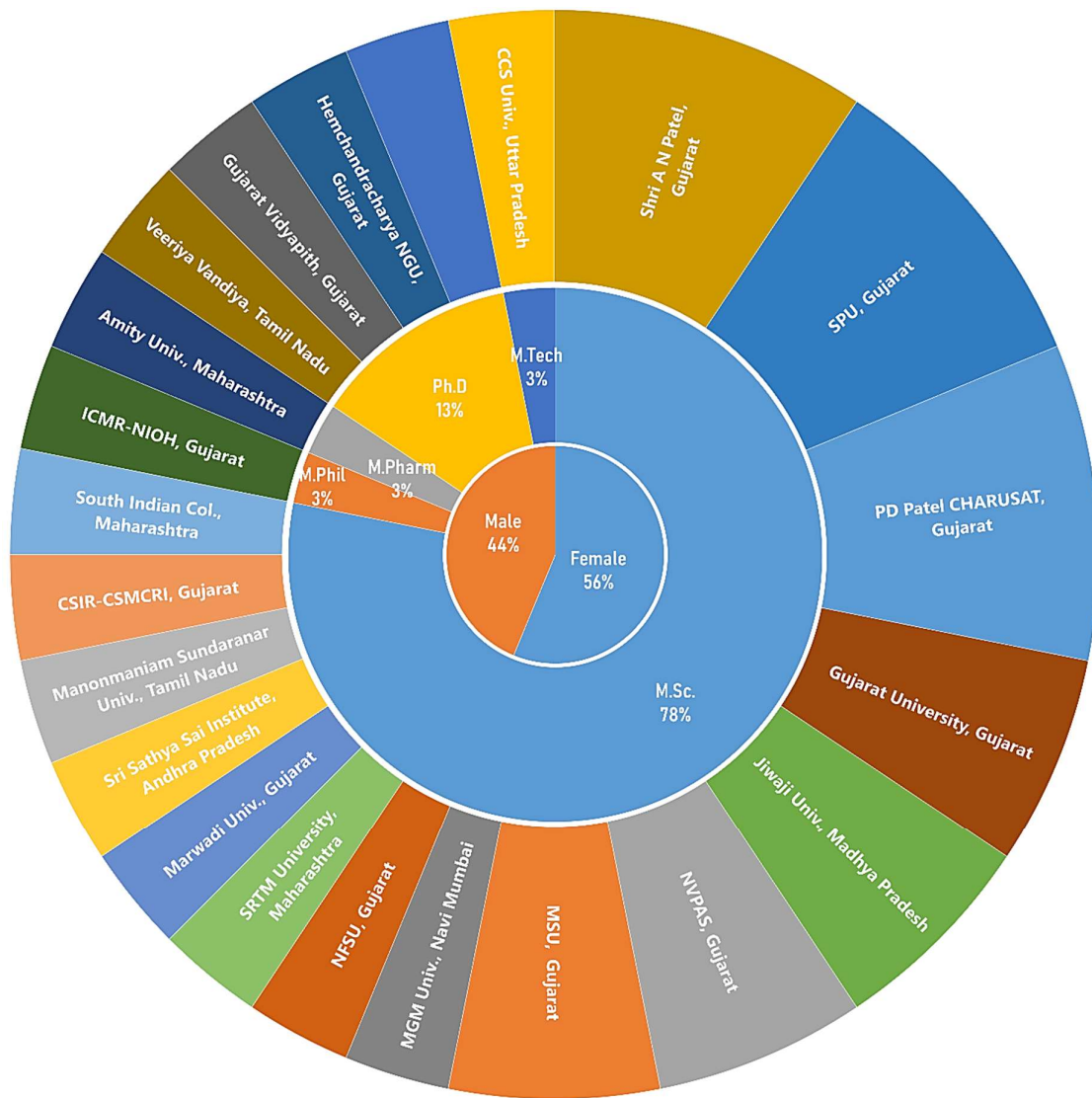


Figure 1: Participants registered for the workshop on Advanced Analytical Techniques from 21 different institutes

Annex 1: Brochure for the program.

Content of the Workshop

Session 1A-B
Inauguration and Welcome Address
Introduction of the Participants and the Host
Overview of various DST sponsored Programmes

Session 2A-B
Overview of Analytical Chromatography
Fundamentals, instrumentation and applications of HPLC
Method optimization
Preventative maintenance and troubleshooting (Advancement in HPLC: HPLC-MS)

Session 3A-B
Fundamentals, instrumentation and applications of HPLC
Method development and optimization of different parameters for HPLC
Preventative maintenance and troubleshooting

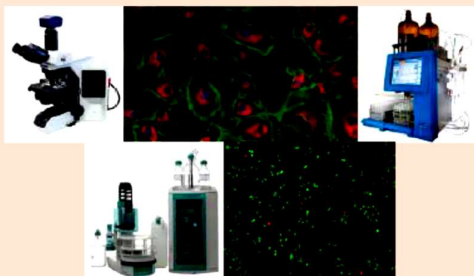

Session 4A-B
Fundamentals, instrumentation and applications of Ion Chromatography
Sample preparation in ion chromatography
Method Optimization
Preventative maintenance and troubleshooting

Session 5A-B
Fundamentals, instrumentation and applications of Flash Chromatography
Purification of sample, Sample preparation and method optimization
Preventative maintenance and troubleshooting

Session 6A-B
Overview of Fluorescence Microscopy and DIC
Fundamentals, instrumentation and applications of Fluorescence Microscopy
Understanding specific applications, precautions, maintenance and troubleshooting

Session 7A
FTIR

Seven Day Workshop
On
ADVANCED ANALYTICAL TECHNIQUES
(Synergistic Training Programme Utilizing the Scientific and Technological Infrastructure)
DST - STUI
September 19, 2022 to September 25, 2022

Department of Biosciences
Sardar Patel University
Satellite Campus Vadtal Road
Bakrol – 388 315, (Anand), Gujarat

Schedule of the Workshop

Day 1 (September 19, 2022)		Day 2 (September 20, 2022)		Day 3 (September 21, 2022)	
0830	Registration	0900	Session 2A	0900	Session 3A
0900	Inaugural Session	1100	Break	1100	Break
0930	Session 1A	1130	Session 2B	1130	Session 3B
1000	Session 1B	1200	Lunch	1200	Lunch
1200	Lunch	1400	Lab Session 1	1400	Lab Session 2
1300	Department of Biosciences Lab Visit	1730	Coffee Break	1730	Coffee Break
1530	User requirement of precipitations				
1600	Coffee Break				

Day 4 (September 22, 2022)		Day 5 (September 23, 2022)		Day 6 (September 24, 2022)	
0900	Session 4A	0900	Session 5A	0900	Session 6A
1100	Break	1100	Break	1100	Break
1130	Session 4B	1130	Session 5B	1130	Session 6B
1200	Lunch	1200	Lunch	1200	Lunch
1400	Lab Session 3	1400	Lab Session 4	1400	Lab Session 5
1730	Coffee Break	1730	Coffee Break	1730	Coffee Break

Day 7 (September 25, 2022)	
1000	Session 7A
1200	Lunch
1400	Site Visit

Annex 2: List of participants registered and their attendance for the “Advances in Characterization of Materials” workshop

Sr. No.	Candidate Name	Gender	Educational Qualification	University/Institute
1	Nidhi Soni	Female	M.Sc. (Microbiology)	PD Patel Institute of Applied Sciences, CHARUSAT, Changa, Gujarat
2	Harsh Samirbhai Patel	Male	M.Sc. (Biochemistry)	
3	Nishita Gaurang Master	Female	M.Sc. (Microbiology)	
4	Saif Saleh Mohsen Ali	Male	M.Sc. (Biochemistry)	
5	Anjali Trivedi	Female	M.Sc. (Botany)	M.S University of Baroda, Vadodara, Gujarat
6	Apurva Kadia	Female	M.Sc. (Microbiology)	NVPAS, The Charutar Vidyamandal University, Vallabh Vidyaangar, Gujarat
7	Shreya Pandya	Female	M.Sc. (Microbiology)	
8	Beby Panwar	Female	M.Sc. (Botany)	CCS University, Meerut Campus, Uttar Pradesh
9	Mitra Patel	Female	M.Sc. (Microbiology)	Anand Agriculture University, Anand, Gujarat
10	Vikas Narvariya	Male	M.Sc. (Biotechnology)	Jiwaji University, Gwalior, Madhya Pradesh
11	Bhoomi Joshi	Female	M.Phil (Botany)	Hemchandracharya North Gujarat University, Patan, Gujarat
12	Shweta Prakashkumar Thakar	Female	M.Sc. (Zoology)	Gujarat University, Gujarat
13	Hitesh Chauhan	Male	M.Sc. (Zoology)	
14	Jahnvi Sanjay Padhiar	Female	M.Sc. (Microbiology)	
15	Vasantkumar Rabari	Male	M.Sc. (Zoology)	Hemchandracharya North Gujarat University, Patan, Gujarat
16	Amalraj S.	Male	M.Sc. (Botany)	A Veeriyai Vandiya Memorial Sri Pushpam College, Poondi, Tamil Nadu
17	Sinchan Hait	Male	M.Tech (Biotechnology)	Amity University, Mumbai, Maharashtra
18	Ashish Kumar	Male	M.S (Pharmacy)	ICMR-NIOH, Ahmedabad, Gujarat
19	Shweta V. Humbarwadi	Female	M.Sc. (Microbiology)	South Indian Degree College of Arts, Science and Commerce, Mumbai, Maharashtra
20	Mohamed Abd El-Maboud	Male	Ph.D. (Botany)	CSIR-CSMCRI, Bhavnagar, Gujarat
21	Rajkumar Thamarai	Male	Ph.D (Zoology)	UGC, Manonmaniam Sundaranar University, Tamil Nadu
22	B. Anusha	Female	M.Sc. (Biosciences)	Sri Sathya Sai Institute of Higher Learning, Anantapur Campus, Andhra Pradesh
23	Reena Govindbhai Korat	Female	M.Pharm (Quality Assurance)	Marwadi University Rajkot, Gujarat
24	Vivek Nanasahab Dhabadga	Male	Ph.D (Botany)	SRTM University Nanded, Maharashtra
25	Kalpeshkumar B. Ishnava	Male	Ph.D. (Botany)	Sardar Patel University, Vallabh Vidyanagar, Gujarat
26	Harsh Joshi	Male	M.Sc. (Industrial Biotechnology)	
27	Manoj Bhandari	Male	M.Sc. (Biochemistry)	
28	Prashsti Pradeep Chadha	Female	M.Sc. (Forensic Science)	National Forensic Science University, Gandhinagar, Gujarat
29	Dolly Patel	Female	M.Sc. (Genetics)	MGM Institute of Health Sciences, MGM University, Navi Mumbai.
30	Priya Rajkumar Sagar	Female	M.Sc. (Microbiology)	Shri A N Patel P G Institute of Science and Research, Anand, Gujarat
31	Bhavya Dilipkumar Kiri	Female	M.Sc. (Microbiology)	
32	Zuhour Hussein Wardah	Female	M.Sc. (Microbiology)	

Annex 3: Schedule date and activities during the workshop.

Day I		
Monday, 19-09-2022	9:00	Registration
	9:30	Inauguration
	9:45	Session IA: Lecture on FTIR-ATR Spectroscopy Mr. Bharat Pathak, LabIndia, Vadodara
	11:00	Tea
	11:15	Session IB: Demonstration of FTIR-ATR Spectroscopy
	13:00	Lunch
	14:00	Session IIA: Lecture on Ion Chromatography Mr. Achyut Kodollikar, Metrohm, Mumbai
	15:30	Tea
	15:45	Session IIB: Demonstration of Ion Chromatography
	17:00	Interaction with Participants
Day II		
Tuesday, 20-09-2022	9:30	Session III: Practical Session 1 on Ion Chromatography
	11:00	Tea
	11:15	Session III: Practical Session 2 on Ion Chromatography
	13:00	Lunch
	14:00	Session IV: Lecture on Laboratory Management System according to ISO 10725 (2017) Dr. Brijesh Parikh, Rasayan Laboratories, Anand
	15:30	Tea
	15:45	Session IV: Discussion with participants
Day III		
Wednesday, 21-09-2022	9:30	Session V: Lecture on Fundamentals of HPLC-Instrumentation and Applications Mr. Sarojkumar Katara, SPINCOTECH, Vadodara
	11:00	Tea
	11:15	Session V: Practical Session-3: HPLC
	13:00	Lunch
	14:00	Session VI: Practical Session-4: HPLC
	15:30	Tea
	15:45	Session VIB: Lecture on Fundamentals of Microscopy Dr. M. Nataraj, PG Department of Biosciences, Sardar Patel University, Vallabh Vidyanagar

Day IV		
Thursday, 22-09-2022	9:30	Session VIIA: Lecture on TLC and HPTLC Mr. Mohit Upadhyay, Anchrom Enterprise Pvt. Ltd., Mumbai
	11:00	Tea
	11:15	Session VIIB: Practical Session-5: HPTLC
	13:00	Lunch
	14:00	Session VIIIA: Lecture on Method development in HPTLC Prof. Vasudev Thakkar, PG Department of Biosciences, Sardar Patel University, Vallabh Vidyanagar
	15:30	Tea
	15:45	Session VIIB: Practical Session-6: HPTLC
Day V		
Friday, 23-09-2022	9:30	Session IXA: Lecture on Flash Chromatography-Instrumentation and Applications Dr. Jayati Banerjee, Team Lead, Peptide Workflow, Biotage India Pvt. Ltd., New Delhi
	11:00	Tea
	11:15	Session IXB: Practical Session-7: Flash Chromatography
	13:00	Lunch
	14:00	Site Visit: Calf Laboratory, NDDDB, Anand
	19:00	Session IXC: Lecture and Practical Session on Statistical Analysis by SPSS (3 h)
Day VI		
Saturday, 24-09-2022	9:30	Session X: Lecture on DIC and Fluorescence Microscopy Prof. Arun Anand, Department of Physics, Sardar Patel University, Vallabh Vidyanagar
	11:00	Tea
	11:15	Session XB: Practical Session-8: DIC Microscopy
	13:00	Lunch
	14:00	Session XIA: Practical Session-9: Fluorescence Microscopy
	15:30	Tea
15:45	Session XIB: Practical Session-10: Fluorescence Microscopy	
Day VII		
Sunday, 25-09-2022	9:30	Session XIIA: Lecture on Application of Fluorescence Microscopy Dr. Bijaya Haobam, DBT-BioCare Scientist, Dr. Vikram Sarabhai Institute of Cell and Molecular Biology, The M. S. University of Baroda, Vadodara
	11:00	Tea
	11:15	Session XIIB: Practical Session-11: Fluorescence Microscopy
	13:00	Lunch
	14:00	Discussion with participants and their Feedback
	15:00	Valedictory Session
	15:30	High Tea

Annex 4: Feedback

Sr. No.	Content	Rating (%)
1	Overall grading of the Programme with reference to relevance of course, module/ content etc.	94 % rated above 8 points
2	Overall grading of the facilities provided by the institute, i.e., Hostel, Mess, Class Rooms, Transport/infrastructure etc.	97 % rated above 8 points
3	Overall grading of the faculty members conducting the training	100 % rated above 8 points
4	How do you rate the overall training methodology	97 % rated above 8 points
5	How far the field visit is relevant and related to your research study	94 % rated above 8 points
6	Usefulness of this training in your current role	91 % rated above 8 points
7	Usefulness of this training in future work/job you may handle	97 % rated above 8 points
8	How far have you benefitted from interaction with the fellow participants of the training	88 % rated above 8 points
9	How far the course material supplied relevant and related to the training curriculum	94 % rated above 8 points
10	Overall grading of the process of training	100 % rated above 8 points
11	Your recommendation to your peers/ colleagues for the training Programme	100 % rated above 8 points