
Training Programme on
Advance Instrumental Analytical Techniques
(AAS, ICP-OES, GC, GC-MS, HPLC, and TOC)
September 18-20, 2019
Venue
CSIR-NEERI, Nagpur
Target Group
• Scientists • Scientific / Technical / Research Officers • Environmental Analysts
• Chemists • Scientific/Technical/Laboratory Assistants • Researchers • NGOs
Sponsored by
CENTRAL POLLUTION CONTROL BOARD
(Ministry of Environment, Forests and Climate Change)
NEW DELHI-110032
Organized by
CSIR-National Environmental Engineering Research Institute
(Council of Scientific and Industrial Research)
Nehru Marg, Nagpur-440020, Maharashtra, INDIA
NEERI

केंद्रीय प्रदूषण नियंत्रण बोर्ड

CENTRAL POLLUTION CONTROL BOARD

REGIONAL DIRECTORATE, BHOPAL

"प्रशिक्षण प्रतिवेदन"

Three Day Training Programme on

"Advance Instrumental Analytical Techniques and Preventive Maintenance - Hands on Training"

CSIR-NEERI, Nagpur / September 18-20, 2019

द्वारा प्रस्तुत -
Submitted by –

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Executive Summary

A Central Pollution control Board (CPCB) sponsored three day training programme on "**Advance Instrumental Analytical Techniques and Preventive Maintenance - Hands on Training"** was organized by CSIR-NEERI, Nagpur from September 18- 20, 2019. The undersigned was nominated as a participant from CPCB (Central), Regional Directorate, Bhopal along with Smt. Rashmi Thakur, SSA. The participant of various State Pollution Control Boards like West Bengal, Maharashtra, Karnataka, Assam, Bihar, Himachal Pradesh and officials from CPCB Regional Directorates had participated in this training programme. Some faculty members from Government College and self sponsored business professional were also registered for the training programme.

It was a comprehensive training module designed including principle, working and applications of various sophisticated instruments used in laboratory and research like Direct Mercury Analyser (DMA), Absorption Atomic Spectroscope (AAS), Gas Chromatography with Mass Spectroscope (GC-MS), High Performance Liquid chromatography (HPLC), Total Organic Analyser (TOC), Inductively Coupled Plasma with Optic Emission Spectroscope (ICP-OES), Inductively Coupled Plasma with Mass Spectroscope (ICP-MS).

Some basic topics along with instrumentation and related to analysis were also included in the training module which were worth listening like Skill Development and Awareness for Climate Change and Environment Sustainability, Trends in Online Instrumentations for Environmental Monitoring, Quality Assurance and Quality Control in Environment analysis etc. Discussion on trouble shooting and maintenance of instruments while operating them were also includes in the talk and was very informative.

Besides these, Hands-on training sessions were also done for the same instruments. However, a very good mixture of theoretical and practical training was defined in the programme module as the number of the instruments is more Hands-on sessions were found a little short of time in three days to practice by ourselves.

The entire training programme was full of knowledge and significant practical experience required relevant to my work profile at CPCB and motivated us to work on sophisticated instruments with confidence. Handout material provided during the training was also very good and there is lot of related information was covered in that. All power point presentations were also very descriptive and are in conjunction with the handouts.

All the lectures were delivered by Senior Scientists and Sr. Technicians having work experience over 15 years for handling the instruments and are expertise in their fields. Moreover, all the required arrangement for the training like training room, refreshments during training hours, pick-up and drop vehicle, accommodation, food, internet facility etc. were also made at their best in the large green NEERI campus, made the entire atmosphere serene for the training.

In the nutshell, the training was a good mixture of theoretical and practical sessions with well defined objectives which were clearly stated from the beginning and achieved at the last to their best.

(Dr. Ranu Chouksey Verma)
Scientist 'B'
Central Pollution Conttrol Board (Central)
Regional Directorate, Bhopal

First Day (18/09/2019)

The programme started with registration on 18 September, 2019 at 9.30 am followed by inauguration of the Training Programme between 10:00 am and 10:30 am. The session was started with the welcome address by **Dr. J.S. Pandey**, Chief Scientist & Scientist Secretary, CSIR-NEERI, Nagpur. In his address, he also focussed on the need and importance of this training module for the participants. Training Programme overview was given by **Dr. G.L. Bodhe**, Chief Scientist, CSIR-NEERI. The inaugural session also included introduction by all the participants with perspective of attending this training. At the last vote of thanks was given by **Er. G.S. Kanade**, Sr. Principal Scientist, CSIR-NEERI and co-ordinator for this training programme. The session was ended up with an interactive mode at High-Tea and Group Photo.

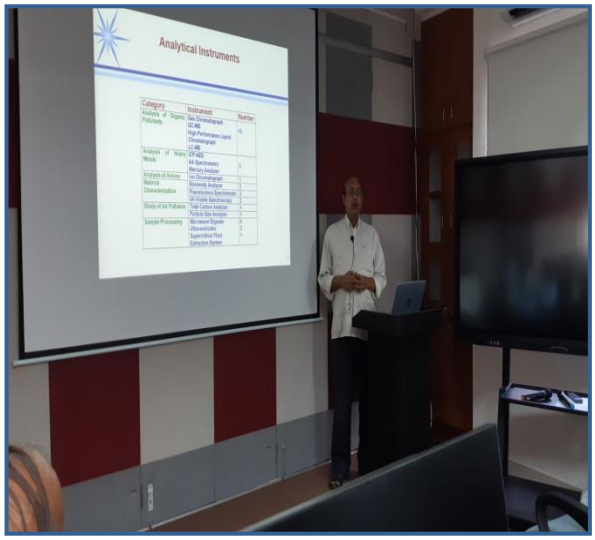
On the first day, the theoretical session was started at 11:00 am with the lecture of **Dr. J.S. Pandey** on "**Skill Development and Awareness for Climate & Environmental sustainability"**. The lecture was the most interactive one including suggestions from all the participants to improve the contribution from different organizations to evolve better awareness among the mass for climate change and sustainability. He focussed more on the importance of imparting environmental education from the very childhood to work on the root causes. He also added how the ancient people were aware about the environmental importance and they explained it in various religious books also. He said "the root problems are somewhere else and we exactly need to focus on their only to sustain a clean environment for our future".

Second lecture was arranged by **Dr. G.L. Bodhe** on **"Trends in Online Instrumentation for Environmental Monitoring"**. He discussed about the various technologies being evolved during the years for online monitoring making it easy to

keep a check on pollution emission from different sources. However, he also focussed on the importance of manual sampling and analysis to verify these results.

Sr. Principal Scientist, **Er. G.S. Kanade** also presented before lunch on **"Principle and Applications of Gas Chromatography"**. That was a well elaborated technical presentation comprised of all important points about gas chromatography, itspractical utility and maintenance also.The lecture highlighted on classification of chromatography method, principle involved, components of GC, theory of operation etc.

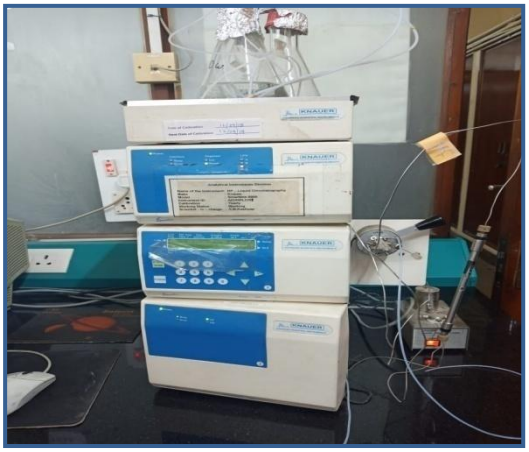
The lunch break was from 1: 00 pm to 2: 00 pm, after that the lecture **"High Performance Liquid Chromatography (HPLC)- Principle and Applications"** was delivered by **Er. K.S. Kashyap**, Principal Scientist, CSIR-NEERI, having an experience of 22 years in the field. The presentation was well acquainted with basics of liquid chromatography to interpretation of a Chromatogram along with construction of and working of HPLC. He also explained about the types of chemical components that can be determined with this instrument's application.



The first day training was ended up with two sessions of hands-on training scheduled in the module for which all the participants were divided into two batches for the alternate instrument. The two sessions were: **"Analysis of environmental gasses by GC-TCD"** and **"Analysis of Poly aromatic hydrocarbons (PAHs) by HPLC"**.

Hands-on GC was taken by **Er. G.S. Kanade** and **Er. V.M. Shinde**, explained in a very detailed manner. He also opened the instrument to show important components of GC like oven, column, detectors etc. to understand the working of it. The operation in-charge also focussed on operation theory, different detectors involved and importance of using FID detector for organic compounds detection. Uses of mass spectroscopy in GC, working principle of it were also discussed.

Hand-on HPLC was taken by **Er. S.M. Kashyap** and **Er. S.K. Lokhande**. The instrument was of older version of Make- ***Knauer***. He explained about the column used, stationary and mobile phase, calibration of instrument and the software used to run it. He also discussed the importance of purging the solvent for about 8 hours to enhance the life of column.



On the first day at evening time on 8:00 PM a common gathering and dinner was arranged for all the training faculties, organising committee and participants where many important research areas and awareness ideas were discussed on the table. This provided the opportunity to all participants from different places to interact and exchange their views

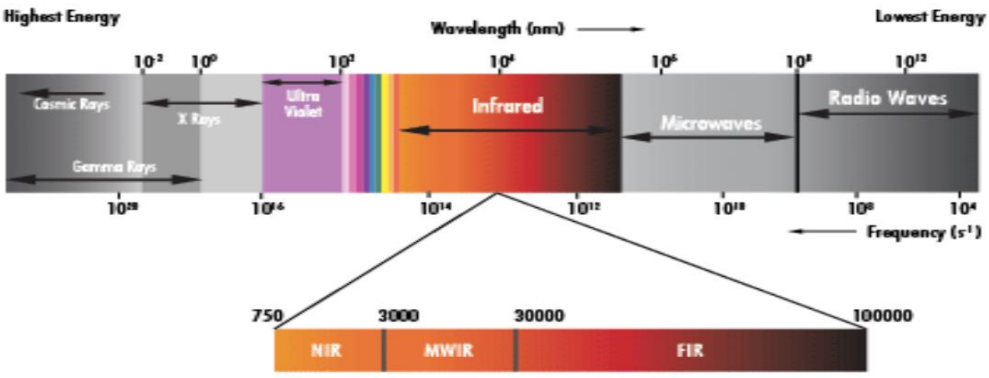
Second Day (19/09/2019)

Theoretical Session (9:30 am to 1:30 pm)

On the Second day dated 19th September, 2019, the morning session was startedby the lecture of **Er. G.S. Kanade** on the topic **"Calibration and Preventive Maintenance"**. In his slides he included about the two important attributes of measurement by any instrument: *Accuracy* & *Precision;* types of analysis, instruments used for analysis in laboratory and sample preparation; common parameters analysed for water and air monitoring etc. he descriptively explained about the importance of calibration and maintenance to reduce the uncertainty in results and to improve the quality of measurement and analysis.

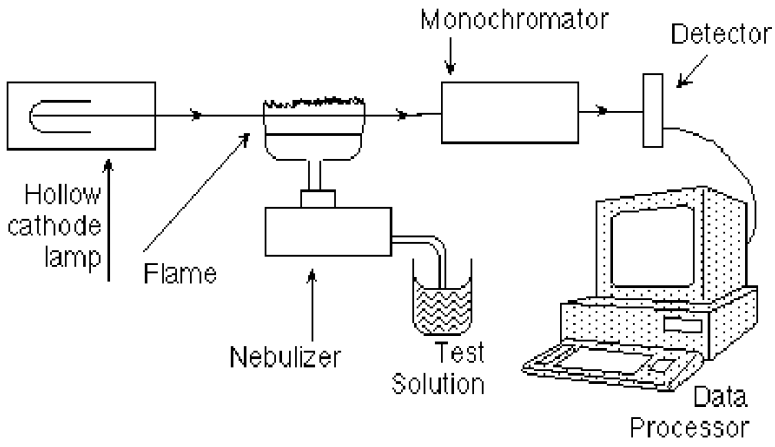
Second lecture was delivered by **Er. Sera Das** on the topic **"Principle and application of Fourier Transform Infra-Red (FTIR) Spectroscopy"**

She started with the introduction of IR spectroscopy and covered all the important parts viz. principle, construction and working, condition for IR active molecules, fundamental modes-stretching and bending, and interpretation of IR spectrum.

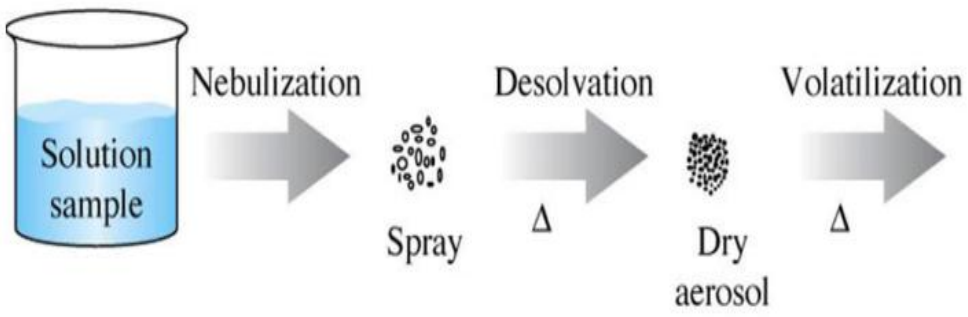


After tea break, from 11:15 am to 12:00 noon there was a lecture on the topic **"Principle and Applications of Atomic Adsorption Spectroscopy (AAS)"**.by **Mr. Sagar Nimsadkar,** Sr. Tech. Officer, NEERI. He started with the first research paper published in this regard entitled ***"The application of atomic absorption spectroscopy to chemical analysis; A.Walsh, Spectrochimica Acta, 1955, 7, 108-117."*** He spoke about AAS as an important technique for detecting metals and metalloids in an analyte. AAS is based on the same principle as the flame test used in qualitative analysis. If light of resonance wavelength is passed through a flame containing the free atoms, then part of the light will be absorbed. The absorption will be proportional to the number of respective atoms present in the flame.It is based on the Bear-Lambert law.

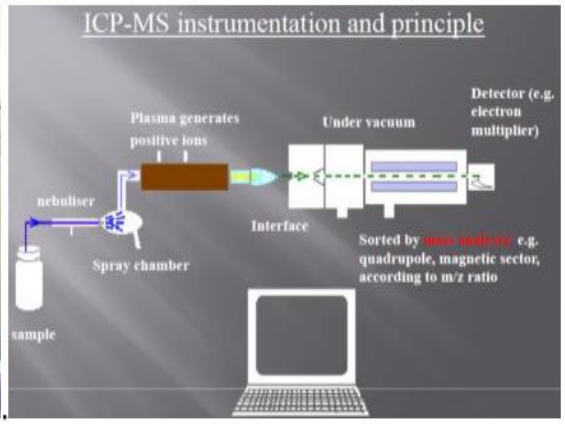
He added about the types of light source used- Hollow cathode Tube (HCT) and Electrode less Discharge Lamp (EDL) and principle of spurting. He also discussed about the Graphite Furnace and Hydride generation technique.



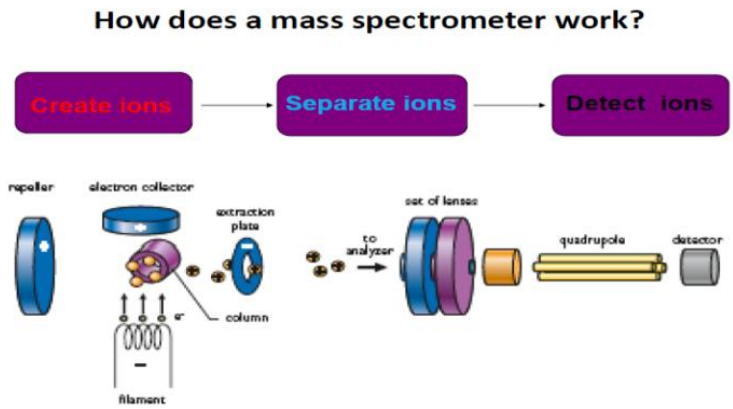
He also shared on process of atomization in flame which includes- Desolvation (solvent evaporates), Volatilization (gaseous vapours form), Dissociation (molecules break into atoms) and Excitation.



Er. V.M. Shinde gave presentation on another important instrument having many applications i.e **"Principle and Application of Inductively Coupled Plasma Optical Emission Spectrometer (ICP-OES)"**. While the topic **"Principles and Applications of Inductively Coupled Plasma and Mass Spectroscope (ICP-MS)"** were explained by **Dr. Amit Bansiwal** in his presentation.



ICP-OES **ICP-MS**



After the lunch break, Hands-on training session was there where all participants divided in two batches were made familiar with the instruments: AAS and ICP-OES & ICP-MS. The laboratory session on "**Trace metal analysis by AAS"** was taken by **Mr. Sagar Nimsadkar and Er. Piyush Kokate**.

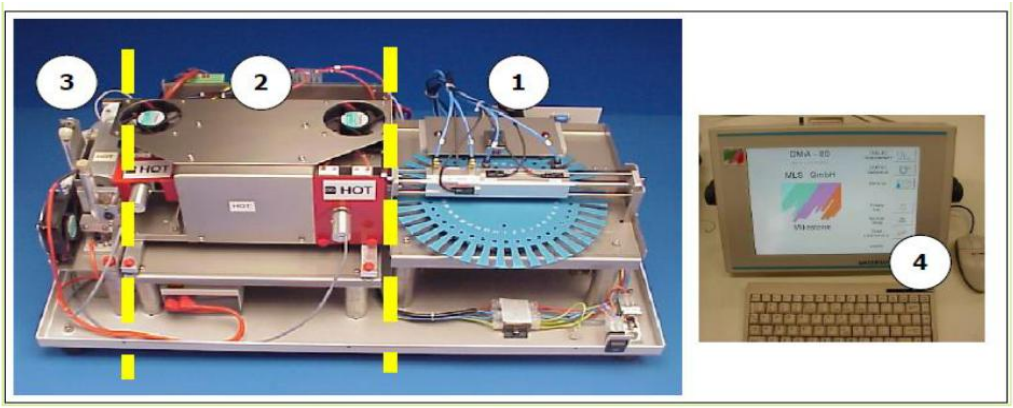

Er. V.M. Shinde and Dr. Amit Bansiwal highlighted **"Multi-elemental analysis by ICP-OES and ICP-MS".** They explained about the need and concept of elemental analysis, the different components of respective instruments, principle and methodology followed. They also briefed about mass analysers for ICP-MS along with sample collection, preparation and analysis. Typical application areas for ICP-MS and ICP-OES were explained.


ICP-MS (Make: *Perkin Elmer,* Model: *NexiON 300X*)

Third Day (20 September, 2019)

On the Day 3, dated 20th September, 2019 four lectures were arranged in the morning session before lunch. **Er. Naresh Bokade**, Operation in-charge, Direct Mercury Analyser (DMA) presented on **"Mercury analysis by DMA"**. He explained the analysis of mercury by DMA Unit 80 includes three simple steps- Thermal decomposition of mercury followed by catalytic (Co-Mn oxide)

decomposition, Absorption of mercury vapours on gold amalgamator and its determination by atomic absorption at 254 nm. He also briefed advantages of the instrument as the instrument can be used directly for both solid and liquid sample analysis and the amount of sample required is very less: Liquid (500 µml) and Solid (500 mg), no pre-treatment of sample, less time consumption (6 min./ sample), low cost, high confidence level of results etc.

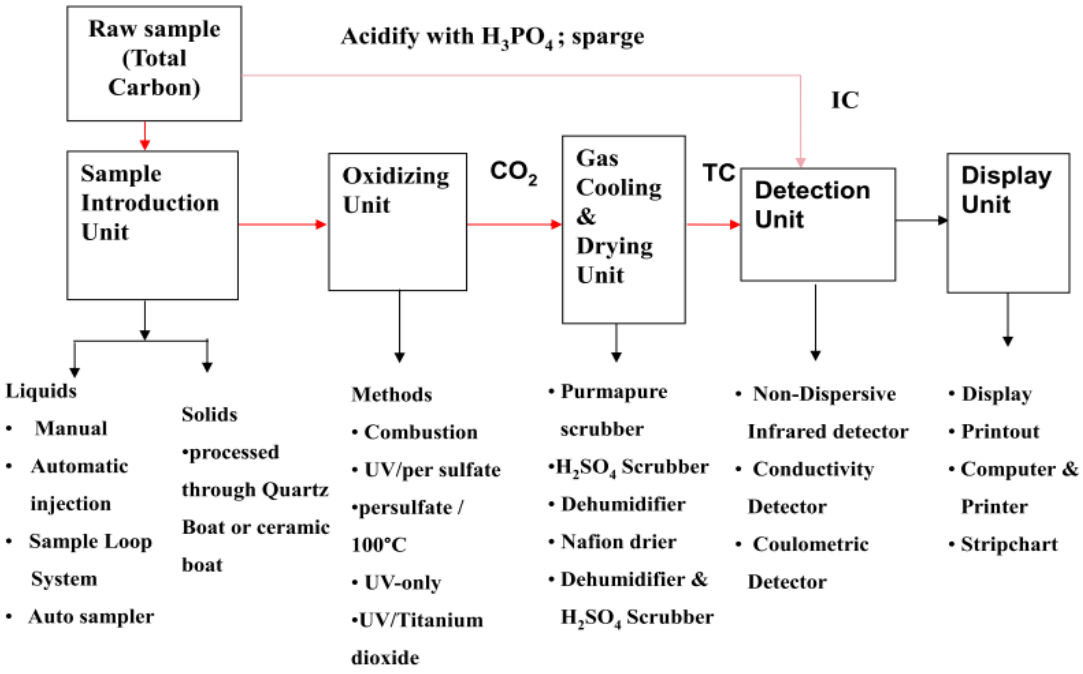


Direct Mercury Analyser (DMA Unit 80)
[1. *Autosampler*, 2. *Thermal Process Furnaces*, 3. *Atomic Absorption Spectrophotometer*, 4. *Desktop PC with Software*]

Lecture on **"Theory and Principle of Total Organic Carbon (TOC) analyser"** was delivered by **Er. S.K. Lokhande**. He explained the terms Total Carbon (TC), Inorganic Carbon (IC), Total Organic Carbon (TOC), Non-Purgeable Organic carbon (NPOC) and Purgeable Organic Carbon (POC) and relation between them.

TOC = TC – IC **&TOC = NPOC + POC**

He also discussed about the auto dilution function in TOC analyser which reduces the effects of acidic, alkaline, high Total Dissolved Solids (TDS) contents and salt samples which enhances the life of catalyst, combustion tube etc. The precautions to be taken include organic free apparatus, preservation with H_3PO_3 (pH < 2), analysis within 7 days of preservation etc.



Basic Units of Total Organic Carbon (TOC) analyser

The most informative lectures of the training module **"Analytical Method Development and Validation"** and **"Quality Assurance and Quality Control in Environmental analysis"** were delivered by **Dr. A. Ramesh Kumar** and **Dr. G.S. Khadse** respectively.

Dr. Ramesh Kumar gave information about different types of validation viz. Equipment, Method, Cleaning and Method Validation. The important attributes of method validation include Accuracy, Precision, Specificity, Linearity, Range, Detection limits, Quantification limits, Robustness and Ruggedness.

On the other hand **Dr. G.S. Khadse** in his lecture revealed important facts about data validation and importance of conditional checks that are to be performed during any analysis. He elaborately explained all the important

relations between water analysis parameters to be studied while producing results. Different types of graphical representations and there importance in data presentation was also presented by him. He also covered topics like Analytical Quality Control (AQC), Errors and types, Quality assurance, NABL, Uncertainty in measurements, ISO guide and some statistical methods for uncertainty evaluation.

For the Hands-on training session we divided into batches and moved on to Laboratory for the instruments like **DMA, TOC** and **FTIR** between 2: 00 PM and 5: 00 PM.

There was valedictory function at the end of the training programme chaired by **Dr. J.S. Pandey**, Chief Scientist & Science Secretary; **Dr. G.L. Bodhe**, Chief Scientist**; Er. G.S. Kanade**, Principal Scientist, Trainer faculty and other organizing committee members. The function started with the motivational words of **Dr. J.S. Pandey**. He spoke on how important it is to work on environment management and organising such training programmes for students, faculties, researcher and other groups of people also. Balance between environment and economics is very important for sustainability.

In the next segment feedback about the training module was given by all the participants including critical suggestion for the scope of improvement. All the facilities arranged by the training institute were very good. At last, certificates were distributed to the participant followed by vote of thanks by **Shri. G.S. Kanade** and High Tea.

Future Utilization of this Training Programme: This training module is very significant for operation and maintenance of advanced and sophisticated instruments used in Laboratory that will help in analysing samples, calibration and data interpretation more efficiently.

Glimpses….


CENTER FOR SKILL DEVELOPMENT & TRAINING (CSDT)
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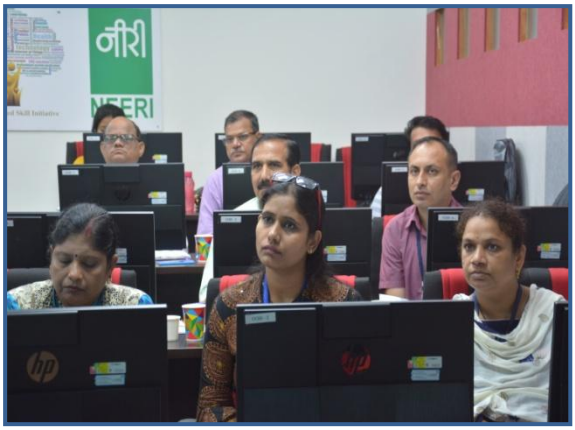
पर्यावरण प्रौद्योगिकी में नवप्रवर्तन हेतु नीरी
NEERI FOR INNOVATIONS IN ENVIRONMENTAL TECHNOLOGY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