CAPACITY BUILDING PROGRAM FOR PGT CHEMISTRY OF DOE

at IIT Mandi, Himachal Pradesh

organized by SCERT, Delhi

Details of the Training

Name of the Programme

Five days Capacity Building Programme for PGT Chemistry of DOE, GNCTD

Dates

13 October 2025 to 17 October 2025

Venue

Indian Institute of Technology (IIT), Mandi, Himachal Pradesh

No. of Participants

34 PGTs + 02 Coordinators

Coordinators

Ms. Anchal Aggarwal & Mr. Mandeep

Report prepared by

Ms. Anchal Aggarwal, Mr. Mandeep & PGT Chemistry of DoE

The five-day Capacity Building Program (CBP) organized by SCERT Delhi for PGT Chemistry teachers of Delhi Government schools commenced on 13th October 2025 at the Indian Institute of Technology (IIT) Mandi. The program was coordinated by the Department of Chemical Sciences (SCS), IIT Mandi. It aims to enrich conceptual clarity, upgrade pedagogical skills and integrate modern ICT practices in teaching Chemistry.

Day 1 (13th October 2025)

Inaugural Session

The opening ceremony began with the Deep Prajwalan (lighting of the lamp) accompanied by Vedic Mantra Ucharan invoking the blessings of Goddess Saraswati.

The dignitaries present were:

- Prof. Lakshmidhar Behra, Director, IIT Mandi
- Prof. Subarto Ghosh, Chairperson, School of Chemical Sciences (SCS)
- Dr. Himanshu Pathak, Associate Dean
- Prof. Venkatesh Chimburlu, Dean (Academics)
- Mr. Amit Guleria, ADM, IIT Mandi

Prof. Subarto Ghosh delivered an inspiring thought:
"Even computers can teach theories, but practicals where teachers' role comes in make all the difference."
Director Prof. Lakshmi Dhar Behra emphasized the essence of self-realization, stating that "the idea of knowing yourself is the true motive of education, and for Viksit Bharat, we must build human potential."

Session 1 – Chemical Kinetics by Prof. Indu Bala

The first academic session was taken by Prof. Indu Bala on Chemical Kinetics. Her teaching style includes subject expertise with innovative multimedia pedagogy.

Highlights:

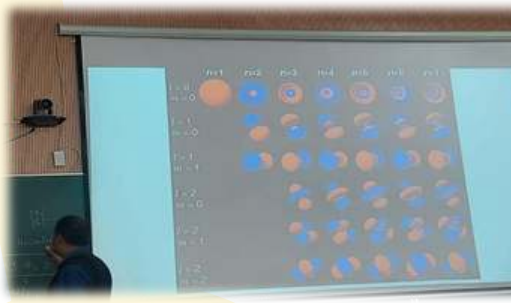
- Topic introduction linked to real-life situations, encouraging active participation.
- Effective use of animations, 3D models, and graphical simulations to explain collision theory, surface area, and catalysis.
- Concepts of rate law, reaction mechanism, order of reaction, and Arrhenius equation explained through ICT-based methods.
- Demonstration of the Iodine Clock Reaction showcased the idea of a chemical stopwatch.
- Session reflected her excellent communication, enthusiasm and strong pedagogical design.

Pedagogical Learning Outcomes & Applications:

- Inquiry-Based Learning:Learned to frame lessons starting with real-world questions (e.g., "Why does food spoil faster in summer?") to spark curiosity before introducing theory.
- Visualization Tools:Gained strategies to use simulations and animations to make abstract concepts like collision theory and activation energy tangible and memorable for students.
- Demonstration Technique: The Iodine Clock Reaction is a ready-to-adopt classroom demonstration that visually and dramatically illustrates how reaction rate can be measured and how it depends on concentration.

Session 2 – Structure of Atom by Prof. Chayan K Nandi

The second session focused on Structure of Atom, delivered by Prof. Chayan K Nandi. He skillfully merged traditional and modern teaching tools.



Highlights:

- Covered evolution from classical atomic models to the Quantum Mechanical Model (1925).
- Used 3-D visualizations, animations and chalk-ICT integration.
- Simplified wave-particle duality, quantum postulates, operators, wave functions, and eigenvalues.
- Visualized Double Slit Experiment, radial, angular, and total nodes clearly.
- His calm approach and willingness to clarify every doubt made the session highly effective.

Pedagogical Learning Outcomes & Applications:

- Historical Context: Understood the effectiveness of teaching the evolution of atomic models to show science as a process of discovery, helping students appreciate how theories are refined over time.
- Simplifying Abstraction: Learned to use 3D visualizations and analogies to demystify complex quantum concepts (e.g., orbitals as "probability clouds") that are traditionally challenging for learners.
- Doubt Resolution: Emphasized the importance of a patient, approachable demeanor and creating a classroom environment where students feel comfortable asking questions to clarify fundamental doubts.

Session 3 – Periodic Properties of Elements by Prof. Pradeep C. Parameswaran

The third session, conducted by Prof. Pradeep C. Parameswaran, dealt with Periodic Properties of Elements. He adopted a learner-centric, inquiry-based approach.

Highlights:

- Connected periodicity from middle-school to senior-secondary levels, reinforcing continuity in concepts.
- Linked quantum mechanical theories with periodic trends.
- Explained atomic size, ionization enthalpy, electron gain enthalpy, and electronegativity with reasoning and visual data.
- Stressed the role of effective nuclear charge and conceptual inter-linkages.
- Used resources from NCERT, Royal Society of Chemistry, and interactive ICT tools.

Pedagogical Learning Outcomes & Applications:

- Vertical Alignment: Learned to consciously map and link curriculum from lower to higher grades, showing students how their knowledge is building progressively, which strengthens long-term retention.
- Cause-and-Effect Teaching:Adopted the method of always explaining the "why" behind a trend (e.g.atomic radius decreases across a period because of increasing effective nuclear charge) instead of just stating the trend, promoting deeper conceptual understanding.
- Resource Integration: Identified reliable online repositories (like RSC) for interactive periodic tables and data sets that can be used to create more engaging and data-driven lessons.

Day 2 (14th October 2025)

Session 4 – Integration of theory topics with practical approaches by Prof. Aniruddha Chakraborty

In this session Quantum Mechanics was explained with the examples of day to day life and dual nature of light was explained in quite simple way that the students can easily relate with the topic.

Highlights:

1.Covered difference between classical and Quantum Mechanics
Explain Dual nature of light- wave and Particle nature.

Pedagogical Learning Outcomes & Applications:

1.Understood the concept of quantum mechanics.
2.Relate the concept with daily life.
3.Can distinguish the classical and quantum mechanics easily Using simple examples.
Can teach the students easily.

Session 5 – General Introduction: Importance and Scope of Chemistry by Professor Subrata Ghosh

In this session General introduction of chemistry was given and explain what is the importance of chemistry in our daily life and how a student can relate or make chemistry it's profession in future.

Highlights:

Importance:

1. Driving Human Welfare and Progress.
2. Health and Medicine 3
3. Food Security.
4. Energy and sustainability
5. Daily life comfort
6. Environmental Stewardship

Scope: Spanning All Fields of Science

1. The Central Science
2. Industrial engine
3. Material innovations
4. Analytical Science

Specialised Science

Pedagogical Learning Outcomes & Applications:

1. Ability to relate macroscopic properties of matter (e.g., hardness, colour, melting point) to the sub-microscopic behaviour of atoms, molecules, and ions.
2. Understanding how chemical knowledge is generated—formulating testable hypotheses, designing experiments, and drawing evidence-based conclusions
3. Proficiency in experimental techniques (synthesis, separation, purification, instrumentation), adherence to safety protocols, and maintaining accurate record.

Session 6 – Organic Chemistry- Some Basic Principles and Techniques By Dr Amit Pawari

In this Session some basic concepts like inductive effect, Resonance, hyper conjugation effect, formation of intermediates were explained quite well with new examples.

Highlights:

1.Tetra Valency of carbon
2.IUPAC Nomenclature of organic compounds
3.Isomerism
4.Nucleophiles and elctrophiles
5.Reactive intermediates
6.Purification techniques

Chromatography

Pedagogical Learning Outcomes & Applications:

1.The student can differentiate between structural and stereoisomers.
2.Students can name the organic compounds and can draw the structure of the molecules.
3.Students can identify and distinguish between nueleophile and electrophile.
4.The student can: Predict the relative strengths of organic acids and bases based on inductive effects and resonance stabilization of the conjugate base/acid.

The student can: Relate functional groups and molecular size to physical properties like boiling point, solubility, and polarity.

Practical Session 1 – Analysis of Functional Groups: Dr Amit B Pawar

In this session teachers learn and perform the test of some important funtional groups of organic chemistry like aldehyde, alcohols,unsaturation etc. All the teachers performs the test itself. It was basically learning by doing.

Highlights:

Following test were performed

1.Tollens test for aldehyde
2.Bromine water test for unsaturationkoi
3.Ceric ammonium nitrate test for alcohols
4.2,4- DNP test for aldehyde/Ketone
5.Schiff test for aldehyde
6.Bayers test
7. Azo dye test

Pedagogical Learning Outcomes & Applications:

1. Participants must be able to recognise and correctly name the common functional groups
2. Participants must be able to design and interpret qualitative chemical tests (like Tollen's test or the 2,4-DNP test) to distinguish between different functional group classes (e.g., aldehyde vs. ketone).
3. Participants should be able to apply IUPAC rules to name compounds, using the functional group priority to determine the parent chain and the primary suffix (e.g., butanol for an alcohol).
4. Participants learn to treat the rest of the molecule as an inert 'R' group and focus their analysis on the functional group, a powerful tool for simplifying complex molecules into manageable reactive sites.
5. Participants learn a system of prioritisation (e.g., IUPAC naming rules, relative reactivity) that is essential for problem-solving in any complex system.

Day 3 (15th October 2025)

Practical Session 2 – Pre-lab Discussion and Practical on Chemical Kinetics by Dr. Bhaskar Mondal

The day began with a pre-lab discussion conducted by Dr. Bhaskar Mondal, who introduced participants to the concepts of rate of reaction, effect of temperature and concentration on reaction rate, and the Arrhenius equation. The session emphasized the importance of practical learning in strengthening conceptual understanding. Dr. Mondal highlighted how simple experiments can bring abstract kinetic concepts to life for students.

Participants performed an experiment to study the effect of temperature and concentration on the rate of reaction using sodium thiosulphate and hydrochloric acid. Observations were taken carefully to determine how the reaction rate changes with varying conditions. A demonstration of the Iodine Clock Reaction was also presented, illustrating the sudden appearance of color after a time delay. This reaction helped participants understand how reaction kinetics can be visually represented and applied in classroom demonstrations to make learning more engaging.

Pedagogical Learning Outcomes & Applications:

·Gained experiential understanding of how experimental data supports theoretical kinetic models.
·Learned techniques to demonstrate abstract ideas like rate law and activation energy through visually engaging experiments.
·Enhanced laboratory skills, safety awareness, and ability to guide students in inquiry-based learning.
Recognized the value of linking experiments to real-world applications (e.g., food preservation, catalysis).

Practical Session 3- Demonstrations and Tinkering Lab Visit by Prof. Rahul Vaish

Participants were shown simple, innovative school-level experiments that demonstrated modern science concepts using everyday materials. Examples included ionization of water using an anti-mosquito racquet and glowing an LED using a KitKat wrapper, which generates voltage. These demonstrations illustrated how scientific principles can be taught creatively with minimal resources.

Following the demonstrations, participants visited the Tinkering Lab, where state-of-the-art equipment and instruments were showcased, including 3D printers, microcontrollers, sensors and laser cutters. Prof. Rahul Vaish explained the applications of such instruments in promoting STEM-based learning and innovation among students. Participants explored how tinkering-based activities could be incorporated into school curricula to enhance creativity and scientific inquiry.

Pedagogical Learning Outcomes & Applications:

·Understood the significance of experiential learning and problem-based pedagogy.

·Learned ways to link classroom science with real-world technology and innovation.

Observed opportunities to incorporate tinkering activities that foster creativity, collaboration, and scientific temper among students.

Day 4 (16th October 2025)

Session 7 – d and f Block Elements by Prof. Venkat Krishnan

Learning Outcomes:

After the session, the participants were able to have a better understanding of the electronic configuration, metallic & non-metallic character, IUPAC definition of transition and inner transition elements. The participants can explain in more better way about the variation of the various physical and chemical properties with respect to the trend observed in the periodic table. Some of the discussed properties were as follows: atomic size, ionization enthalpy, electronegativity, metallic and non-metallic properties, and nuclear charge, etc.

How to Implement Learning in the Classroom:

The interactive manner through which the topic was introduced was one of the skillsthatall the participants learned. How to connect the daily life experience with the topics was also one of the learnings. All this learning will enhance classroom teaching effectively.

Session 8 - Coordination Compounds by Dr. Narayan Sinha

Learning Outcomes:

The participants were able to understand the Crystal Field Theory effectively. A lot of exceptional cases, along with the oxidizing and reducing properties, shapes of the metal 'd' orbitals were also learned by the participants. The interactive session maintains involvement effectively. The participants learned about the effect of the ligand on the crystal field. Splitting of the various complexes. The participant also learned about the various Valence Bond Theory concepts for various transition metal ions (eg, $[Cu(NH_3)_4]Cl_2$

How to Implement Learning in the Classroom:

The participants learned about how to connect the various key concepts holistically. How to connect the exceptional cases with the size, charge density, lanthanoid contraction, types of 'd' orbitals, etc., in a specific manner will really help in the classroom teaching.

Session 9 - Haloalkanes & Haloarenes by Dr. Abhishek Dewanji

Learning Outcomes:

The participants are now able to distinguish between the transition state and intermediate in the various organic chemical reactions. The participants were also able to explain the factors affecting the SN^1& SN^2 Reaction based on the nature of the alkyl group, presence of conjugation, size of substituents, effect of the leaving group, effect of the solvent, stability of the transition state, stability of the intermediates, substitution vs. elimination reaction, nucleophilicity vs basicity of the species.

How to Implement Learning in the Classroom:

The learning from the session will really enhance the classroom teaching. The conceptual clarity gained through the session will enhance the knowledge base of the participant effectively. The participant will surely feel well-equipped with learning conceptual clarity to take the classroom doubts effectively.

Lab Visits -

i. AMRC VISIT (The Advanced Materials Research Center) by Dr. Garima Agrawal

Learning Outcomes:

The participants were able to understand the working procedure of the various instruments present at the AMRC, like Transmission Electron Microscopy (TEM),Scanning Electron Microscopy (SEM), and Nuclear Magnetic Resonance Spectroscopy (NMR). The participants were able to understand the application part of these instruments.

How to Implement Learning in the Classroom:

The knowledge gained through the AMRC visit surely provides a lot of learning experience among participants about the research field, especially in the chemistry subject. The interdisciplinary approach in the research will also be a part of the discussion with the students in the classroom.

ii. SCS (School of Chemical Sciences) Lab Visit by Dr. Amit B. Pawar (Experimental Facilities) & Dr. Bhashkar Mondal (Computational Facilities)

Learning Outcomes:
The participants can handle the various key instruments in the chemistry lab, along with the knowledge gained in computational chemistry. The operating procedure of the Super Computer is also discussed with the facilitator.

How to Implement Learning in the Classroom:
The knowledge about the functioning of the key laboratory apparatus (both in terms of miniature forms as well as a range of other applications)will surely enhance the handling skills of the participants, and this provides a good value of confidence in deliveringa similar task to the class students.

Day 5 (17th October 2025)

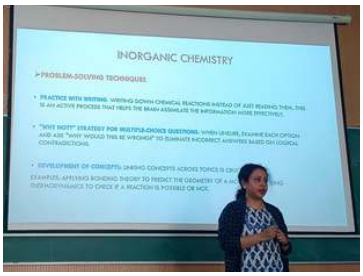
Session 10 - Electrochemistry by Prof. Aditi Halder

Learning Outcomes:

- Strengthened conceptual clarity of redox processes and electrochemical principles.
- Gained strategies to teach complex topics through models, simulations, and activity-based learning.
- Developed problem-solving and analytical thinking approaches applicable in classroom settings.
- Understood how to relate textbook concepts to real-life applications for deeper student engagement.

How to Implement Learning in the Classroom:
The concepts discussed can be effectively integrated into Class 11 and 12 Chemistry lessons. Teachers can demonstrate simple electrochemical experiments, such as making a lemon battery or observing corrosion, to explain the working of cells and redox reactions. Visual aids, animations, and small classroom activities can help students connect theory with practical understanding, promoting scientific curiosity and critical thinking.

Session 11 – General Outlook in Problem-Solving Approach in Chemistry by Dr. Moupriya Das



The session by Dr. Moupriya Das focused on developing a systematic and analytical approach to problem-solving in chemistry. She emphasized the importance of conceptual clarity, logical reasoning, and multiple representations (verbal, symbolic, and mathematical) in understanding chemical phenomena. The session demonstrated how stepwise analysis and visualization can simplify complex chemical equations and numerical problems. Dr. Das also shared effective strategies for guiding students in applying theoretical knowledge to practical and examination-oriented questions.

How to Implement Learning in the Classroom:

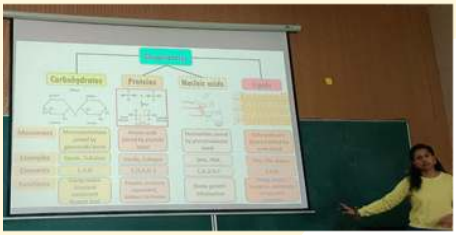
- Encourage students to analyze problems conceptually before attempting mathematical solutions.
- Use mind maps and flowcharts to illustrate the relationships between concepts, such as the mole concept, thermodynamics, and equilibrium.
- Incorporate real-life examples and inquiry-based activities to make abstract topics more relatable.
- Conduct problem-solving workshops or practice sessions to strengthen students' reasoning and confidence.
- Apply scaffolded questioning techniques to help learners gradually move from basic recall to higher-order thinking skills.

Session 12 – Biomolecules – Dr. Garima Agrawal

The session on Biomolecules, conducted by Dr. Garima Agrawal, provided an in-depth understanding of the structure, classification, and biological significance of carbohydrates, proteins, lipids, and nucleic acids. Dr. Agrawal explained the chemical composition and functional roles of these biomolecules in living systems with clarity and enthusiasm. Through engaging examples and visual presentations, she linked molecular structures with physiological processes, making the topic both scientific and relatable.

Pedagogical Insights:

- Emphasized concept-based and activity-oriented learning to simplify biochemical concepts.
- Suggested the use of models, charts, and molecular visualization tools to demonstrate structures and bonding in biomolecules.
- Encouraged the integration of cross-disciplinary approaches (linking biology and chemistry) to enhance student understanding.
- Recommended interactive discussions and inquiry-based questioning to promote curiosity and deeper learning.



Learning Outcomes:

- Enhanced conceptual understanding of biomolecular structures and their biological importance.
- Improved ability to explain the interrelationship between chemistry and biological systems.
- Developed strategies for simplifying complex biochemical reactions for high school learners.
- Strengthened skills in using visual aids and experimental analogies to make abstract concepts concrete.

How to Implement Learning in the Classroom:

At the school level, these insights can be applied by using simple experiments (e.g., test for proteins or sugars), 3D models, and interactive diagrams to explain biomolecular structures. Teachers can connect biochemical concepts to everyday examples such as digestion, nutrition, and metabolism to make lessons more engaging. Using ICT tools and animations, students can visualize molecular interactions and appreciate the chemical basis of life.

Session 13 - Human Potential Strength - Prof. Laxmidhar Behera, Director, IIT Mandi

The concluding session of the FDP was delivered by Prof. Laxmidhar Behera, Director, IIT Mandi, on the theme "Human Potential Strength." His lecture was deeply motivational, emphasizing the immense capabilities within every individual. Prof. Behera highlighted that true growth and excellence arise from self-awareness, discipline, and a positive mindset. Drawing from his vast experience, he spoke about the importance of emotional intelligence, ethical values, and spiritual balance in achieving holistic success. His words inspired participants to align their professional goals with a sense of purpose and humanity.

Learning Outcomes:

- Understood the concept of human potential and how to channel it for personal and professional excellence.
- Recognized the role of self-motivation, ethics, and emotional balance in effective teaching and leadership.
- Developed awareness of the importance of continuous learning and self-improvement.
- Gained motivation to nurture a growth mindset among students and colleagues.

Application in Personal & Professional Life:

Teachers can apply these insights by fostering confidence, discipline, and empathy in their students. Incorporating mindfulness, reflective practices, and value-based education in the classroom can help learners discover their strengths. On a personal level, educators can use these principles to maintain positivity, overcome challenges, and lead with integrity and compassion.

Valedictory Session

The Valedictory Session marked the successful completion of the Faculty Development Programme. Participants reflected upon the key learnings, shared feedback, and discussed how the sessions contributed to their professional and pedagogical growth. The coordinators expressed gratitude to the resource persons and participants for their active engagement. The session emphasized the importance of continuous professional development and collaboration in the field of education.

Other Activities

PARASHAR LAKE VISIT (Day 1)

On 13th October 2025, the participants of the Capacity Building Programme for PGT (Chemistry) organized by IIT Mandi visited the scenic Parashar Lake, located amidst the serene Himalayan ranges. The visit provided an opportunity for participants to connect with nature and appreciate the environmental and ecological diversity of the region. Surrounded by snow-clad peaks and lush greenery, the lake served as a perfect setting for an informal discussion. The excursion also helped in fostering peer bonding, reflection, and rejuvenation after the intensive academic sessions. Overall, the visit to Parashar Lake was a refreshing and enriching experience that beautifully combined learning with exploration.

GALA DINNER (Day 4)

On 16th October 2025 during the evening time a Gala Dinner was organized by the IIT-Mandi in which all the facilitators, along with support staff and participants, took part. The various teaching learning issues, besides career and research topics, were also discussed among the participants and faculty of the IIT-Mandi. It was really the most important event that provided a valuable platform for interaction. The participants also took part in dance events and enjoyed their 5-day visit to IIT-Mandi