Human Resource Development Centre
The Delhi Public School Society

CHEMISTRY

Programme for Educators of Classes IX - XII

August 23 - August 26, 2023

Participants of The Programme in Chemistry
With
Dr. (Mrs.) Kiran Datar
Member, The Delhi Public School Society

CONTENTS

INTRODUCTION

Chemistry Education is important because the universe is subject to the Laws of Chemistry and human beings depend on the orderly progress of chemical reactions within their bodies. Chemistry connects Physical Sciences with Life Sciences and Applied Sciences. Chemistry is all pervasive and its role can be seen in diverse areas including food, environment, medicine, and industries. Learning Chemistry allows students to gain skills in critical thinking, deductive reasoning, problem-solving, and communication that can be applied to any career.

Continuous professional development of Chemistry Educators is essential for effective Chemistry teaching due to the evolving nature of the subject and its instructional techniques.

To provide a platform for the Chemistry teachers to become acquainted with the latest information in their field, HRDC, DPSS organised a four-day In-person Residential Programme in Chemistry from August 23 - August 26, 2023, for the Chemistry Educators of Classes IX - XII at its campus in Knowledge Park-V, Greater Noida, Uttar Pradesh. Fifty teachers from DPS schools across the country attended this programme.

The programme dealt with a variety of topics and the sessions focussed on the pedagogy and skills required to make Chemistry interesting and easy to understand for the students. It also provided a great avenue for the Educators to share information and teaching methodologies, related to their subject, with each other.

LIST OF PARTICIPANTS

S. No.	Schools	Participants
1	DPS Anand	Tanvirbanu Saiyed
2	DPS Azad Nagar, Kanpur	Sanjay Kumar Kushwaha
3	DPS Bareilly	Pradeep Kumar Golay
4	DPS Barra, Kanpur South	Rajesh Kumar Srivastava
5	DPS Bharuch	Piyali Chowdhary
6	DPS Bilaspur	Bhargavi R
7	DPS Bokaro	Rahul Kumar
8	DPS Bulandshahr	Arindam Ghosh
9	DPS Chhatarpur	Azam Mohammad Khan
10	DPS Damanjodi	K. V. S. Ramprasad
11	DPS Dehradun	Ankit Kumar
12	DPS Dhaligaon	Prabhu Nath Kushwaha
13	DPS Dibrugarh	Chayanika Barua
14	DPS Durg	Lethika D Nair
15	DPS Durgapur	Alokdut Dutta
16	DPS Faridabad	Bhavnesh Dhiman
17	DPS Fulbari	Koushik Sen
18	DPS Greater Noida	Sangeeta
19	DPS Gwalior	Satish Sharma
20	DPS Haldwani	Krishna Chandra Pathak
21	DPS Harni, Vadodara	Anant Panchal
22	DPS Hisar	Vikas Sharma
23	DPS Hyderabad	Mala Khattar
24	DPS International, Saket	B. K. Tejeswi
25	DPS Kalyanpur, Kanpur	Reetika Kapoor
26	DPS Knowledge Park-V	Ria Nanda
27	DPS Lava, Nagpur	Adiba Sheikh
28	DPS Mangalore	P. G. Venkat Rao
29	DPS Mathura Road	Mukta Midha
30	DPS Nacharam - Hyderabad	Silpa Kambhammettu
31	DPS Navi Mumbai	Renu Dogra
32	DPS Nazira	Nilkamal Goswami
33	DPS Nigahi	Ramesh Kumar
34	DPS Noida	Punam Jina
35	DPS Numaligarh	Dhruba Borah
36	DPS Panvel	Teena Rokade

S. No.	Schools	Participants
37	DPS Pune	Manisha Tripathi
38	DPS R. K. Puram	Shruti Gupta
39	DPS Rohini	Nitasha Jose
40	DPS Ruby Park, Kolkata	Subrata Mitra
41	DPS Sangrur	Nishikant Verma
42	DPS Sec. – 132, Expressway, Gautam Buddh Nagar	Sharmila Basu
43	DPS Sector - 84, Gurugram	Pulkit Goyal
44	DPS Siliguri	Pealy Paul Moirangthem
45	DPS Udaipur	Shweta Soni
46	DPS Udhampur	Humera Hussain
47	DPS Vadodara	Aarti Harkauli
48	DPS Vasant Kunj	Upma Raizada
49	DPS Vindhyanagar	Rajeev Kumar Pathak
50	DPS Visakhapatnam	T. N. Nagini

SCHEDULE

Timings	Topic	Guest Speaker
Wednesday, August 23, 2023		
8:30 am - 9:00 am Admin Block Lobby	Inaugural Session	
9:00 am - 11:00 am Lecture Hall - 5	• Quantum Mechanical Model • Spectrum • Valence Shell Electron Pair Repulsion Theory	Dr. Sourav Pal Senior Professor and Head Department of Chemistry Ashoka University
11:30 am - 1:30 pm Lecture Hall - 5	• Molecular Orbital Theory • Electron gain enthalpy • Balancing of redox reaction in basic medium	Dr. Sourav Pal Senior Professor and Head Department of Chemistry Ashoka University
2:15 pm - 4:15 pm Lecture Hall - 5	Solutions: Van't Hoff Factor	Dr. Saptarshi Mukherjee Professor Department of Chemistry Indian Institute of Science Education and Research (IISER) Bhopal
4:45 pm - 5:45 pm Lecture Hall - 5	Solutions: Van't Hoff Factor (contd.)	Dr. Saptarshi Mukherjee Professor Department of Chemistry Indian Institute of Science Education and Research (IISER) Bhopal
5:45 pm - 6:45 pm Lecture Hall - 5	Sharing of Best Teaching Practices	Participants of the Programme
Thursday, August 24, 2023		
9:00 am - 11:00 am Lecture Hall - 5	Pedagogy	Dr. Rajeev Gupta Professor Department of Chemistry University of Delhi
11:30 am - 1:30 pm Lecture Hall - 5	Stoichiometric calculations Numericals based on NTP (normal temperature pressure)	Dr. Saptarshi Mukherjee Professor Department of Chemistry Indian Institute of Science Education and Research (IISER) Bhopal

Timings	Topic	Guest Speaker
2: 30 pm - 4:30 pm Lecture Hall -5	Computational Chemistry	Dr. Smriti Sharma Professor Department Chemistry Miranda House University of Delhi
5:00 pm - 6:00 pm Lecture Hall - 5	Stoichiometric Calculations Numericals based on NTP (Normal Temperature Pressure) (contd.)	Dr. Saptarshi Mukherjee Professor Department of Chemistry Indian Institute of Science Education and Research (IISER) Bhopal
6:00 pm - 7:00 pm Lecture Hall - 5	Sharing of Best Teaching Practices	Participants of the Programme
Friday, August 25, 2023		
6:40 am - 7:20 am Activity Room No. 2	Yoga Session	Yoga Expert
9:00 am - 11:00 am Lecture Hall - 5	d and f Block Elements Data Interpretation, Logistic-Exceptional Cases	Dr. J. Sankar Professor Department of Chemistry Indian Institute of Science Education and Research (IISER) Bhopal
11:30 am - 1:30 pm Lecture Hall - 5	Crystal field theory (CFT)	Dr. J. Sankar Professor Department of Chemistry Indian Institute of Science Education and Research (IISER), Bhopal
2:15 pm - 4:15 pm Lecture Hall - 5	Chemical Thermodynamics	Dr. Arijit Kumar De Associate Professor Department of Chemistry Indian Institute of Science Education and Research (IISER) Mohali
4:45 pm - 5:45 pm Lecture Hall - 5	Chemical Thermodynamics (contd.)	Dr. Arijit Kumar De Associate Professor Department of Chemistry Indian Institute of Science Education and Research (IISER) Mohali

Timings	Topic	Guest Speaker
5:45 pm - 6:45 pm Lecture Hall - 5	Sharing of Best Teaching Practices	Participants of the Programme
Saturday, August 26, 2023		
8:30 am - 10:30 am Lecture Hall - 5	Chemical Kinetics	Dr. Arijit Kumar De Associate Professor Department of Chemistry Indian Institute of Science Education and Research (IISER), Mohali
11: 00 am - 12:00 pm Lecture Hall - 5	Chemical Kinetics (contd.)	Dr. Arijit Kumar De Associate Professor Department of Chemistry Indian Institute of Science Education and Research (IISER), Mohali
12:00 pm - 1:30 pm Lecture Hall - 5	Organic Chemistry	Dr. Vidya Avasare Professor Department of Chemistry Ashoka University
2:15 pm - 3:45 pm Lecture Hall - 5	Organic Chemistry (Contd.)	Dr. Vidya Avasare Professor Department of Chemistry Ashoka University
4:15 pm - 5:15 pm Multipurpose Hall	Valedictory Function	Dr. (Mrs.) Kiran Datar Member The Delhi Public School Society

THE INAUGURAL SESSION

August 23, 2023

8:30 am - 9:00 am

A four-day in-person training Programme in Chemistry for the Educators of Classes IX to XII was organised by the HRDC, DPSS at its campus from August 23-26, 2023. The programme was attended by 50 educators from the DPS Schools across India. The Inaugural Session of the programme was held on August 23, 2023.

Welcoming the participants to the four-day training programme, Ms. Vanita Sehgal, Executive Director, HRDC, DPSS emphasised the importance of completing a given task with utmost sincerity and efficiency. She said that there would always be challenges along the way, but this must not dampen the spirits or prove a deterrent to reaching the goals we have set for ourselves.

She gave an overview of the programme and informed the participants that the sessions in the Training Programme were based on the feedback of teachers from many schools, and aimed to cater to all the important aspects of teaching Chemistry in Classes IX - XII.

She appreciated the support and seamless coordination of her Team HRDC. She introduced the Joint Directors, Ms. Jyoti Sharma, and Ms. M. Sudeshna, as well as other team members who worked as a cohesive unit in the organisation for the execution of all the training programmes that are held at the HRDC Campus.

QUANTUM MECHANICAL MODEL, SPECTRUM, VALENCE SHELL ELECTRON PAIR REPULSION THEORY, MOLECULAR ORBITAL THEORY, ELECTRON GAIN ENTHALPY, BALANCING OF REDOX REACTION IN BASIC MEDIUM

August 23, 2023

9:00 am - 11:00 am & 11:30 am - 1:30 pm

Dr. Sourav Pal, Senior Professor and Head Department of Chemistry, Ashoka University conducted a session on the topics: 'Quantum Mechanical Model, Spectrum and Valence Shell Electron Repulsion Theory'. Dr. Sourav Pal began the session with LCAO (Linear Combination of Atomic Orbitals) by interlinking it with quantum mechanics. He integrated all three branches of science with the help of Quantum Mechanics. Dr. Pal said that everything which is interesting has Physical Chemistry as a part of it. Although Lavoisier is known as the 'Father of Modern Chemistry', the first paper in the Modern Chemistry Journal (1661) was contributed by Robert Boyle. He explained that the wave function representing Molecular Orbital possesses both covalent and ionic character.

He compared the Valence Bond Theory and Molecular Orbital Theory to explain the shapes of molecules and the advantages of Molecular Orbital Theory Valence Bond Theory. Valence Bond Theory is applicable only to non-orthogonal orbitals whereas Molecular Orbital Theory is applicable to both orthogonal and orthonormal orbitals.

He explained Electron Gain Enthalpy and ionisation enthalpy by considering HOMO (Highest occupied molecular orbital) and LUMO (Least unoccupied molecular orbital). He explained that IE > EA by giving the example of Cs and Cl. He used IP and EA to explain Mulliken's scale of electronegativity. He also explained the concept of negative and positive values of IP and EA.

The lecture was headed by probing questions about Oxidation-Reduction and Balance Redox Reactions. The following steps for balancing Redox Reactions were discussed:

- Generally, the equation is separated into two half-equations, one for oxidation, and one for reduction.
- The equation is balanced by adjusting coefficients and adding H_2O, H^+, and e^- in this order:
    - Balance the atoms in the equation, apart from O and H.

- Add the appropriate number of water (H_2O) molecules to the other side to balance the Oxygen atoms.
- Add H^+ ions to balance the Hydrogen atoms (including those added in step 2).
- Add up the charges on each side. They must be made equal by adding enough electrons (e^-) to the more positive side.
- The e^- on each side must be made equal; if they are not equal, they must be multiplied by appropriate integers to be made the same.

- The half-equations are added together, cancelling out the electrons to form one balanced equation. (If the equation is being balanced in a basic solution, the appropriate number of OH^- must be added to turn the remaining H^+ into water molecules).

Dr. Sourav Pal discussed and explained the following in the session:

- Calculations related to stationary Energy with the help of electron density.
- General relation for Hamiltonior operator and its application.
- Quantum Mechanical Model of an atom given by the German Scientist Schrödinger
- The valence bond theory of hydrogen molecules proposed by Heitler & London.
- The work done by Pauling who was awarded the Nobel Prize in 1954 & in 1962
- The normalisation of the wave function and its applications.
- Density Functional Theory (DFT), the most popular theory, to understand the mechanism of chemical reactions.
- The work of Van't Hoff, Emil Fisher and Arrhenius who were awarded the Nobel prize.
- The work of Mullikan & Slater related to Molecular orbital theory which explains the covalent as well as Ionic character of a molecule.
- Linear combination of atomic orbitals (LCAO) for the explanation of molecules.
- Orthonormal (bonding) and Orthonormal (antibonding molecular orbitals).
- The term garadey(g) and ungaradey(u).
- Einstein paradox and Hamiltonian operator.
- All the shapes of molecules on the basis of molecular orbital theory.
- Electron density, separated into electronic and nuclear parts.
- Nuclear coordinates, mandatory for the shapes due to the nucleus being heavier.
- With the covalent character being more dominant than the ionic character, then molecules show covalent behaviour or vice-versa.
- With the shape of all the atoms always being spherical, the shape of molecules may become non-spherical due to the presence of more than one centre of attraction.
- During the formation of a molecule, nucleus and electron attraction is a dominant factor as compared to electron-electron or nucleus and nucleus repulsion.

The Participants learnt how to apply quantum mechanics to explain the facts in Chemistry and that the wave function is a combination of covalent and ionic characters. The concept of the spherical shape of all atoms can be understood by the degeneration of orbitals.

SOLUTIONS: VAN'T HOFF FACTOR

August 23, 2023
2:15 pm - 5:45 pm

Dr. Saptarshi Mukherjee, Professor, Department of Chemistry, Indian Institute of Science Education and Research (IISER) Bhopal conducted a session on the topic, 'Van't Hoff Factor'. The lecture aimed to elucidate the concept of the Van't Hoff Factor and its relevance in various chemical processes. Dr. Mukherjee's presentation was insightful and engaging, as he skillfully explained several related concepts such as solubility products, buffer solutions, Gibbs-Duhem equation, and pH.

Introduction to the Van't Hoff Factor

Dr. Mukherjee began and introduced Van't Hoff Factor, which is a measure of the extent of dissociation or ionization of solute particles in a solution. He elaborated on the importance of understanding this factor in a variety of chemical and biological processes. The Van't Hoff Factor provides valuable insights into colligative properties, osmotic pressure, and electrolyte behaviour.

Explanation of Solubility Product

Dr. Mukherjee highlighted the concept of solubility product (Ksp) and its relevance in determining the solubility of sparingly soluble salts. He emphasized how the Van't Hoff Factor influences the solubility product and discussed cases of common ion effect.

Insight into Buffer Solutions

The lecture also delved into the significance of buffer solutions in maintaining a stable pH environment. Dr. Mukherjee explained how the common ion effect affects the buffer capacity of a solution, which is crucial in various chemical and biological processes. He elucidated the concept of pH range and the Henderson-Hasselbalch equation.

The Gibbs-Duhem Equation and its Implications

During the lecture, Dr. Mukherjee touched upon the Gibbs-Duhem equation, which relates changes in chemical potential and composition of a system in equilibrium. He illustrated the practical applications of this equation.

Dr. Saptarshi Mukherjee employed a diverse range of teaching methodologies, including demonstrations and storytelling, to simplify complex concepts. His ability to connect theoretical knowledge to real-world scenarios captivated the audience's attention and facilitated a deeper understanding of the subject matter.

The lecture was an interactive and participatory learning experience. Attendees had the opportunity to ask questions and engage in discussions with Dr. Mukherjee. His willingness to address queries and provide practical examples enhanced the overall learning experience.

In conclusion, Dr. Saptarshi Mukherjee's lecture on the Van't Hoff factor provided attendees with a comprehensive understanding of this fundamental concept in chemistry. By integrating practical demonstrations, storytelling, and interactive discussions, he effectively conveyed the significance of Van't Hoff factor in various chemical processes, including solubility products, buffer solutions, Gibbs-Duhem equation, and pH calculations. The lecture was a valuable learning opportunity for students and professionals alike, contributing to a deeper appreciation of the role of the Van't Hoff Factor in the realm of chemical science

PEDAGOGY

August 24, 2023

9:00 am - 11:00 am

Dr. Rajeev Gupta, Professor, Department of Chemistry, University of Delhi took a session on Pedagogy and the teaching-learning objectives and threw light on the ways and means to effective teaching.

Dr. Rajeev Gupta spoke about engaging students in meaningful and practical ways to foster a deeper understanding of scientific concepts, critical thinking and technical skills so that they can develop a genuine interest in the subject matter and become independent thinkers.

The Taxonomy of Learning Objectives

The Three-Dimensional teaching involves child, society, and subject matter. The formulation of educational objectives is a matter of careful choice on the part of both the teacher and the administrator. The following factors are involved:

- The needs and capabilities of students (Child).
- The specific demands of their social environment (Society).
- The nature of the subject matter (Subject matter).

The Criteria of Good Educational Objectives are:

- In accordance with the general aims of education (i.e. Three-Dimensional teaching).
- Unambiguous (i.e. Clear Objective).
- Usefulness (i.e. Objective should be clear).
- Specific (i.e. Only Necessary assignment should be given).
- Feasible (i.e. Any useful topic should have feasibility).

Classification of Educational Objectives (Bloom Taxonomy):

- Cognitive Domain (Knowing): Knowledge, Comprehensive Idea, Application, Analysis, Synthesis, and Evaluation are certain areas of the cognitive domain.
- Psyco-Motor Domain (doing): Perception, Imitation Manipulation, Precision etc are the area of Psyco-Motor Domain.
- Affective Domain (Feeling): Receive and Responding, Organizing, Valuing, and Characterising, etc are some areas of affective domain.

Objectives of the Teaching of Science at the Higher Secondary Level of Education:

- Hands-on Experiments and the Teaching related to the real world.
- Problem solving / Analysis to challenge the students' minds.
- Group tasks and Project work.
- Being creative with the students.

Dr. Rajeev employed a wide range of teaching methodologies and strategies to engage the attendees including an interactive session. He worked on the teaching maxims and went from simple to complex concepts to inculcate a deeper understanding of concepts. He added that it is the teachers' task to:

- Never stop researching.
- Collect resources.
- Create memorable experiences.
- Give classrooms a vibrant feel.
- Teach dynamically with the lessons based on a live display of experiments.

It should also be taken into consideration that science should be made compulsory up to Class XII, so that students are able to relate science to day-to-day life (like knowing about generic drugs).

Dr. Rajeev Gupta provided participants with extensive ideas of educational development and educational enforcement in multidisciplinary pedagogy. His overall presentation guided the participants to understand the deeper and holistic educational objectives for the senior secondary students. His proposed methodologies were useful and can be implemented in school-level education to benefit the students.

STOICHIOMETRIC CALCULATIONS AND NUMERICALS BASED ON NTP

August 24, 2023

11:30 am - 1:30 pm & 5:00 pm - 6:00 pm

Dr. Saptarshi Mukherjee, Professor, Department of Chemistry, Indian Institute of Science Education and Research (IISER), Bhopal conducted a session on the topic 'Stoichiometric Calculations and Numericals based on NTP'.

Dr. Mukherjee began with the graph-based numerical calculation of the molar mass of protein from experimental data; the solution not only facilitated better understanding of graphical concepts, but also clarified misconceptions of the same.

Dr. Mukherjee commenced his address by asking teachers challenging questions on the subject of physical chemistry. Diverse topics of physical chemistry like surfactants, the solubility of ionic compounds especially nitrates, Van`t hoff factor, volumetric analysis, degree of dissociation, etc. were discussed in detail. He also introduced new topics like the chemistry of microemulsions, reverse micelles, and drug delivery.

Physical chemistry is a challenge for most learners due to the huge weightage given to numericals. The session included vigorous practice of numerical problems of the JEE level, which will definitely help the students. In addition, very fundamental scientific concepts were discussed through interesting examples, which helped clear many misconceptions. The session was a beautiful amalgamation of mathematical formulae, graphical and data interpretations as well as derivations. Some very innovative modern-age applications of the subject taught at the senior secondary level were introduced to the participants.

It was a highly interactive session as the participants were actively engaged throughout the session. Theoretical concepts were explained with the help of data; for example, elevation in boiling point is taught in class XII as one of the colligative properties, but the quantification of the same was calculated by all the teachers with the help of data given. This added a new dimension to the learning process. He shared very interesting factual knowledge such as the shape of micelles, reverse micelle formation, the meaning of indicator blank, self - assembly, enthalpy - entropy

compensation, Claussius - Clayperon equation, and zwitter ion vs. Ylides ion. The session was mostly Q&A and discussion-based where participants were challenged to solve higher application-based questions.

Dr. Mukherjee concluded by emphasising the concept drill of theoretical science with the help of scientific tools such as the plotting of graphs, mathematical derivation, problem-solving, and data analysis to quantify learning.

COMPUTATIONAL CHEMISTRY

August 24, 2023

2:30 pm to 4:30 pm

Dr. Smriti Sharma, Professor, Department of Chemistry, Miranda House, Delhi University conducted a session on Computational Chemistry.

Dr. Sharma introduced the Pillars of Computational Chemistry as Observational, Experimental, and Theoretical Science and said that Computational Chemistry is also called 'In Silico Chemistry.'

With the upcoming demand for more drugs in Medicinal Chemistry, Computational Chemistry is taking its place in Research and Development. Making a drug requires almost 14 years and a large investment in terms of money. Computational Chemistry helps us in such a process in a very short time and with a comparatively higher success rate. Computational Chemistry not only avoids the use of harmful chemicals or the release of hazardous radiations, but it also saves lab costs and can avoid unrealistic lab conditions such as extreme temperature and pressure.

The major concerns of Computational Chemistry are to find an initial starting point for the synthesis of new compounds and to assist in the understanding of available data. It can also not predict the possibility of so far entirely unknown molecules nor explore the reaction mechanisms that are not readily studied by experimental means.

Dr. Sharma said that the objective of the session was, 'The Lab in your Laptop' and then shared the names of open software with the teachers. A tutorial was also shown on Argus Lab for molecular drawing and energy calculations that can be installed in the PC. The results obtained on Argus Labs are pretty close to the data available in the labs.

Argus Lab can be used to find the energy difference between Geometrical isomers. The proposed method of calculation of resonance energy of Benzene and a graph on the relative stability of rotamers of Butane with the help of a potential energy curve were also demonstrated. Hydrogenation of benzene and cyclohexene was also shown which gave an insight on how to use these platforms for chemical analysis and calculations.

The taught topic can be easily applied to Stereochemistry and Organic Chemistry and to study the shapes of the molecules based on energy considerations. Exposure to computational Chemistry motivates students to pursue their careers in pure sciences and go for further research. Dr Smriti said that school students can learn Computational Chemistry under the 'Innovation in Science Pursuit for Inspired Research' (INSPIRE) programme sponsored and managed by the Department of Science & Technology to attract talent to Science.

d AND f BLOCK ELEMENTS
DATA INTERPRETATION LOGISTIC - EXCEPTIONAL CASES

August 25, 2023
9:00 am – 11:00 am

Dr. J. Sankar, Professor, Department of Chemistry, Indian Institute of Science Education and Research(IISER) Bhopal, conducted a session on 'd and f Block Elements' and 'Data Interpretation Logistic - Exceptional Cases'.

Dr. J. Sankar explained the behaviour of this unique set of elements extensively. He explained all the important properties and exceptional behaviour at length. Following are a few of the noteworthy points that were discussed:

- Use real life examples while teaching such as the brand name Ray Ban, which originated from its purpose, that of banning UV rays.
- Exceptions should be addressed with relevant and rational reasoning e.g. the system achieves the minimum energy by attaining a particular (exceptional) state.
- Certain cobalt complexes have different intensities of colour. Tetrahedral complexes are more intense in colour than octahedral complexes.
- The Leporte selection rule explains the intensities of absorption spectra for chemical species.
- The reason no rusting takes place in our bodies though we have iron and oxygen.

Strategies discussed by Dr. J. Sankar are listed below:

- Interactive and two-way communication is the best approach to learning.
- Development of the lesson/ session by asking students questions.
- Keeping control of the class in one's own hands.
- Planning the class in such a manner that students are encouraged to ask questions to clear relevant doubts.

CRYSTAL FIELD THEORY

August 25, 2023

11:30 am - 1:30 pm

Dr. J. Sankar, Professor, Department Of Chemistry, Indian Institute of Science Education and Research (IISER) Bhopal conducted a session on the topic 'Crystal Field Theory'.

Important takeaways from the session:

- Introduction to the basics of the Crystal field theory and explanation of the splitting of d-orbitals under the influence of ligands.
- Explanation of why the energy of degenerate d-orbitals is increased in the presence of solvents before the splitting of d-orbitals.
- Metal ions are assumed to be spherical in shape and its geometry will be decided only when it splits.
- Taking the examples of complexes $[Co(NH_3)_6]^{3+}$ and $[Co(NH_3)_5(H_2O)]^{3+}$, it was discussed that both have octahedral geometry but still have different shapes due to the centre of inversion and the two have variation in their splitting energy.
- $[Co(NH_3)_5(H_2O)]^{3+}$ has no centre of inversion.
- Out of cis- and trans-isomers the trans has the centre of inversion.
- Comparison of the colour intensity of tetrahedral and octahedral complexes based on the basis of symmetry and centre of inversion.
- In Tetrahedral complexes, there is no centre of symmetry and hence the molecular orbitals formed have the character of both d- and p- orbitals from which they are formed. This is called d-p mixing.
- Atomic orbitals of metal ion d_{xy}, dyz and d_{zx} are triply degenerate, and px, py and pz of ligands are also triply degenerate. Since the energy and synergy of these orbitals match, d-p mixing takes place.
- Ligands forming both sigma and pi bonds are stronger ligands compared to ligands

forming only sigma bonds.

- In the Spectro chemical series the negatively charged ligands like OH^-, and Cl^- are supposed to be stronger, but this can't be explained by the Crystal Field Theory and requires more spectroscopic data to explain it.
- Chelate ligands form more stable complexes than monodentate ligands as they have more than one donor atom with high electron density.
- The colour of MnO_4^- and MnO_4^{2-} was explained through charge transfer
- Silica gel kept in the desiccator are bluish when fresh, on keeping for some time turns pinkish as Cobalt absorbs moisture and converts tetrahedral complex to octahedral complex.

The session was highly interactive, interesting and the doubts put forward by the participants were answered.

CHEMICAL THERMODYNAMICS

August 25, 2023

2:15 pm - 4:15 pm & 4:45 pm - 5:45 pm

Dr. Arijit Kumar De, Department of Chemistry, Indian Institute of Science Education and Research (IISER), Mohali conducted a session on the topic ' Chemical Thermodynamics'.

The following topics were discussed in detail:

- The experiments of James Watt and James Joule.
- The basic thermodynamic concepts of system, surroundings, universe, and the modes of energy transfer in the form of heat and work.
- Different types of thermodynamic processes like isothermal, isothermal, isochoric, isobaric adiabatic, cyclic-acyclic, and reversible-irreversible processes with graphical illustrations.
- Various laws that govern thermodynamics through mathematical derivations.
- Concepts of molar heat capacity at constant pressure and constant volume
- Derivation of the relation between molar heat capacity at constant volume and pressure (C_p - C_v) for an ideal gas.
- Residual entropy and conceptual difference between Intensive and extensive properties of a system.
- Illustrations of adiabatic and isothermal processes in terms of energy at the molecular level.
- Derivation for the work done during isothermal expansion of an ideal gas in a reversible process.
- Various numerical problems based on various laws and concepts of thermodynamics.
- Reinforcing theoretical concepts through practical application as a way to concretize abstract ideas, making them more relatable for students.
- A systematic approach to solving numerical problems.
- Proper unit conversions and substitution of variables in order to maintain accuracy.

Dr. Arijit Kumar De reiterated that teachers must encourage high-achieving students to delve deeper into the subject matter. One effective suggestion was to motivate the students to derive formulas and solutions and Frame numerical problems with graphical representations. This approach can provide a holistic evaluation of students' grasp of the subject matter. The topic of Thermodynamics can be introduced through motivational stories that can capture students' attention and stimulate their curiosity. Dr. Arijit Kumar De reminded Educators to adopt a systematic and structured approach when introducing Thermodynamics concepts.

Participants recognized that while Thermodynamics is challenging, it serves as a bridge to understanding other concepts within chemistry, such as Kinetics and Solutions. Highlighting these connections can help promote good problem-solving habits among students and improve their ability to apply them to real-world scenarios.

CHEMICAL KINETICS

August 26, 2023

8:30 am - 10:30 am & 11:00 am - 12:00 pm

Dr. Arijit Kumar De, Associate Professor, Department of Chemistry, Indian Institute of Science Education and Research (IISER), Mohali conducted a session on the topic 'Chemical Kinetics'.

Dr. Arijit Kumar De started the session with the comparison of Chemical Kinetics, which depends on temperature and time, with Chemical Thermodynamics which does not depend on time nor gives information about when the process will get over. He gave examples of fast reactions (e- and p+ transfer occurring in 10-15 sec) and slow reactions (fossil formation, formation of galaxies, etc.).

Kinetics of the following processes were taken up in detail:

- Formation of HBr which follows a radical pathway reaction mechanism with emphasis on the Matrix Isolation Spectroscopy (MIS) technique to confirm the formation of intermediates during the process.
- Kinetics of Haber's Process and Gerhardt Ertl's work using the Scanning Tunnelling Microscope (STM).
- Acid hydrolysis of ester involving the cooling of the reaction mixture at regular intervals.
- The study of fast reactions was taken up next. The following techniques for the same were discussed to study their kinetics.
- Flow Technique Method involving two gases or solutions introduced rapidly into a mixing vessel and allowing the resulting mixture to flow rapidly along a long tube.
- Relaxation method involving perturbation of a system in equilibrium by rapid change in external conditions so that the system relaxes to a new equilibrium.
- Flash Photolysis Method involving an exposure of a system to an intense flash of visible or UV light so that the molecule is broken down.

The session continued with the study of the dynamic strategy and the role of collision in studying kinetics. The underlying differences between dynamics, kinetics, and thermodynamics were made clear.

A visual presentation on real-life applications of thermodynamics, viz., melting of ice, car engine operation, working on air conditioners, etc. was shared with the audience.

A PowerPoint presentation was also shown and explained on the following topics associated with kinetics:

- Horse in motion
- Stroboscopy
- LASER technique
- Flash Photolysis.
- Ultrafast (femtosecond) dynamics of molecules.
- Pump-probe Spectroscopy.
- Molecular Vibration
- Attosecond dynamics of molecules
- Chemistry of Vision.

The session helped the participants to understand the underlying differences between dynamics, thermodynamics, kinetics, and modern techniques like Matrix, Isolation Spectroscopy, Stroboscopy, Pulse Lasers, and Femtosecond Spectroscopy. Queries about catalyst poisoning, reaction-free energy, and catalytic influence on the rate of reactions were clearly explained. Anecdotes about various scientists were also shared.

ORGANIC CHEMISTRY

August 26, 2023

12:00 pm - 1:30 pm & 2:15 pm to 3:45 pm

Dr. Vidya Avasare, Professor, Department Of Chemistry, Ashoka University conducted a session on the topic, 'Organic Chemistry'.

Dr. Vidya Avasare began the session by saying that Organic Chemistry is a laboratory-based science that involves the study of naturally occurring as well as synthetic compounds. She presented a PowerPoint presentation to show the timeline for the development of Organic Chemistry. She emphasised the peak years i.e., 1800-1960, which marked the development of Organic Compounds. Dr. Vidya Avasare covered some important topics of organic chemistry like Aldehydes, Ketones, Carboxylic acids, and Substitution reactions. She explained the importance of Aldehydes and Ketones in the formation of Covalent Organic compounds in Pharmaceutical drug delivery.

Dr. Vidya Avasare further discussed the structure, properties, composition, chemical reactions, and preparation of organic compounds. She explained the 'power of mechanisms' involved in various reactions like:

- Oxidation of Toulene to Benzoic acid
- Oxidation of Benzaldehyde to Benzoic acid
- Aerial Oxidation of aldehydes
- Oxidation of Ketones

Dr. Vidya Avasare further talked about the importance of various organic compounds in our daily life and how the study of Organic compounds (Carbon Capture technique) can be used to solve Global warming problem. The importance of Optical activity was discussed with respect to naturally occurring compounds and various drugs. She discussed the case of the Thalidomide Drug from 1950 which emphasised the importance of Clinical Trials. She explained how around one lakh children were born with deformities due to the use of this drug during pregnancy for treating morning sickness. The importance of Substitution reaction, SN1 and SN2 reactions, and

Visualisation of intermediates was done by use of the software.

Dr. Vidya Avasare related the concepts to the experiences from daily life, which made the concepts more relatable. Interesting videos were shown to explain the importance of nanocapsules. Dr. Vidya Avasare said that organic chemistry is not just about studying and synthesising organic compounds, but also involves the creation of organic chemical-based products which we use on a daily basis. She discussed the use of flashcards and board games like Snakes and Ladder to explain concepts and introduce topics in a more interactive and interesting manner.

Dr. Vidya Avasare suggested the participants use an app that can be used in schools for:

- Visualisation of intermediates.
- 3-D Visualisation of compounds.
- Stability of carbocations.
- Understanding the concept of availability and accessibility to explain the strength of nucleophiles.

SHARING OF BEST TEACHING PRACTICES




S. No.	School	Participant	Best Teaching Practice
1	DPS Anand	Tanvirbanu Saiyed	**Topic:** Thermodynamics Explaining the topic of Thermodynamics with the help of activity related to everyday life.
2	DPS Azad Nagar Kanpur	Sanjay Kumar Kushwaha	**Topic:** How to memorise Chemistry? Discussing the last 5-10 years question papers in the classroom and asking students to practise organic reactions repeatedly to score good grades.
3	DPS Bareilly	Pradeep Kumar Golay	Topic: Question Bank Doing Revision through questions based on previous lecture.
4	DPS Barra Kanpur South	Rajesh K Srivastava	Topic: Applying various Teaching strategies Designing teaching strategies according to the level of the students.

S. No.	School	Participant	Best Teaching Practice
5	DPS Bharuch	Piyali Chowdhary	**Topic:** Cooperative learning method Using Co-operative learning method for redox reaction and preparing learning sheets along with peers.
6	DPS Bilaspur	Bhargavi R	**Topic:** Flipped Classroom. Using the Flipped classroom strategy after the completion of the lesson where students create questions to ask the teacher.
7	DPS Bokaro	Rahul Kumar	**Topic:** Activity-based Learning & Cartooning. Teaching the Effect of high sound energy on titration for colour change through the above strategy. Using cartoons to show the Interaction between benzene and electrophile.
8	DPS Bulandshahr	Arindam Ghosh	**Topic:** Framing of Questions Asking Students to frame their own questions and discussing them in the class. Taking Enrichment classes to reinforce the concepts.
9	DPS Chhatarpur	Azam Mohammad Khan	**Topic:** Remedial Class teaching Teaching Hydrocarbons using balls and straws to make a 3-D model.
10	DPS Damanjodi	K.V.S. Ramprasad	**Topic:** Giving Smart and Quick tips to students Giving students quick and smart tips to make them understand chemical reactions
11	DPS Dehradun	Ankit Kumar	**Topic:** Storytelling Method Using the Story telling method to introduce the concepts in class. Holding Separate classes for Above Average, Average, and Below Average students.
12	DPS Dhaligaon	Prabhu Nath Kushwaha	**Topic:** Storytelling Grouping the students as Above Average, Average, and Below Average and giving the Above Average students a chance to prepare the topic and discuss it in the class.
13	DPS Dibrugarh	Chayanika Barua	**Topic:** Active Learning Strategy Spinning the wheel strategy used to recapitulate a topic.
14	DPS Durg	Lethika D Nair	**Topic:** Interdisciplinary Project Doing a project on the Analysis of cation,

S. No.	School	Participant	Best Teaching Practice
			anion, and foodstuff present in coconut water
15	DPS Durgapur	Alokdut Dutta	**Topic:** Modes of Examination Discussing the importance of introducing online examination for different competitive examinations in the school curriculum.
16	DPS Faridabad	Bhavnesh Dhiman	**Topic:** Periodic Table Role Play done in the classroom to enable students to memorise different chemistry topics like the Periodic Table.
17	DPS Fulbari	Koushik Sen	**Topic:** Assessment Using Problem based assessment to improve the performance of students.
18	DPS Greater Noida	Sangeeta	**Topic:** Thermodynamics Discussing the concept of reversible process and free energy change by taking two real-life situations in the classroom.
19	DPS Gwalior	Satish Sharma	**Topic:** Question Bank Asking students to bring their own questions related to different topics.
20	DPS Haldwani	Krishna Chandra Pathak	**Topic:** Art Integration Methodology Explaining the Diagrammatic method of showing & explaining the physical properties such as solubility.
21	DPS Harni, Vadodara	Anant Panchal	**Topic:** Revision As An Integral Part Of The Learning System Revising the principles on which a topic is based.Discussion of questions (from NCERT) based on the same topic.
22	DPS Hisar	Vikas Sharma	**Topic:** Practical-Based Teaching Showing Chemical Reactions to teach the concepts with the focus on conceptual teaching along with practical-based teaching.
23	DPS Hyderabad	Mala Khattar	**Topic:** Ease of Transition from Class X to XI through Activities Organising Experimental activities to revise the concepts covered in Class X. Doing Chorus singing to explain the electronic configuration and molecular orbitals. Comparing structures of compounds using illustrations.

S. No.	School	Participant	Best Teaching Practice
24	DPS International Saket	B. K. Tejeswi	**Topic:** Activity-Based Learning Ball and stick methodology of explaining stereoisomers of organic molecules thus adding fun to the learning processes.
25	DPS Kalyanpur Kanpur	Reetika Kapoor	**Topic:** Relating Chemistry to daily life for Smart Learning To make Chemistry interesting in the class, relating concepts to everyday life experiences of the students. Explaining the formation of ionic and covalents compounds by using the shopping experience of a student in the market.
26	DPS Knowledge Park V	Ria Nanda	**Topic:** Clay modelling & Role Play. Asking one student to act as a name reaction and another student to conduct his/her interview. Using clay modelling to teach bonding in atoms.
27	DPS Lava Nagpur	Adiba Sheikh	**Topic:** Active Learning Strategy Use of response sheet for Organic Chemistry. Integrating other subjects with Chemistry such as writing essays on elements. Following Board protocol to create empathy & relevance to the topic.
28	DPS Mangalore	P G Venkat Rao	**Topic:** Art Integration & Roleplay. Organising a science rangoli competition where students can make rangoli of chemical compounds and share pictures with each other.
29	DPS Mathura Road	Mukta Midha	**Topic:** Valency Chart, Relating day to day life activities Writing Formulae of Anions and cations and practising using the Valency Chart.
30	DPS Nacharam - Hyderabad	Silpa Kambhammettu	**Topic:** Methods of Teaching Discussing flipped classroom, ball and stick model, and think-pair-share to solve intext questions.
31	DPS Navi Mumbai	Renu Dogra	**Topic:** Audio-Visual Aids Using Power point presentations, Audio-Visual Aids.
32	DPS Nazira	Nilkamal Goswami	**Topic:** Organic Reaction Explaining reaction mechanisms using examples and using selective reagents in organic reactions.

S. No.	School	Participant	Best Teaching Practice
33	DPS Nigahi	Ramesh Kumar	**Topic:** Teaching Practices Using technology in the classroom to explain different concepts.
34	DPS Noida	Punam Jina	**Topic:** Teaching Aids Using Practical knowledge to demonstrate and clear the concept of overpotential and shape of molecules.
35	DPS Numaligarh.	Dhruba Borah	**Topic:** Organic Reaction Explaining the benefits of the use of mind maps to recall the organic reaction in different conversions.
36	DPS Panvel	Teena Rokade	**Topic:** Organic Chemistry Explaining the inductive effect through a game(tug of war) and IUPAC nomenclature with the use of the English alphabets present in their own names.
37	DPS Pune	Manisha Tripathi	**Topic:** Activity/Project Based Learning Using balloons to demonstrate the organic structures of various molecules.
38	DPS R. K. Puram	Shruti Gupta	**Topic:** Competency-based questioning through demonstrations and smart classes Using daily life examples, case-based questioning, practical demonstrations, images, videos & graphs on smart class system for better understanding of competency-based questions.
39	DPS Rohini	Nitasha Jose	**Topic:** Flowchart method Use of flowcharts for easy memorization.
40	DPS Ruby Park Kolkata	Subrata Mitra	**Topic:** Data based teaching Sharing the history of scientists, Flowcharts Use of Data based teaching to help students understand colligative properties. Using Flowcharts to teach Historical stories of scientists relating to the concept and to connect the topics.
41	DPS Sangrur	Nishikant Verma	**Topic:** Demonstration of Activities To inculcate and motivate interest in Science, using activities based on students' real life situations.
42	DPS Sector – 132, Expressway Gautam Buddh Nagar	Sharmila Basu	**Topic:** Teaching through Fun activities Asking students to make cards and write the name of the compound and its atomic

S. No.	School	Participant	Best Teaching Practice
			no. On the basis of cards, students can find out the Lone pair of electrons and hybridization.
43	DPS Sector - 84 Gurugram	Pulkit Goyal	**Topic:** Motivate the students and give revision assignments Giving Assignments on the basis of the concepts taught, to the low achievers, medium achievers, and high achievers. Helping students to prepare for the competitive exams.
44	DPS Siliguri	Pealy Paul Moirangtham	**Topic:** Mnemonics Mnemonics for learning Electronic Configuration.
45	DPS Udaipur	Shweta Soni	**Topic:** Flashcards, Roadmaps, Flowcharts Asking students asked to make flashcards to memorise the organic name reactions. Roadmaps help in relating functional groups. Flowcharts help to remember difficult concepts.
46	DPS Udhampur	Humera Hussain	**Topic:** Experiential learning Using technology & students' interest to assign them activities for experiential learning related to real life situations.
47	DPS Vadodara	Aarti Harkauli	**Topic:** Revision methodology Clarity of Teaching Basic concepts & revising.
48	DPS Vasant Kunj	Upma Raizada	**Topic:** Number line rule for redox reactions Explaining & demonstrating redox reactions & electrode potential using number line tool.
49	DPS Vindhyanagar	Rajeev Kumar Pathak	**Topic:** Revision Emphasising on self study and practice of question banks.
50	DPS Visakhapatnam	T N Nagini	**Topic:** Organic reaction through Flow Chart Making the students learn chemical equations by using flowcharts and mind maps.

BEGINNING THE DAY WITH YOGA

August 24 & 25, 2023

6:40 am - 7:20 am

"*Yogaha chittah vritti nirodhakaha*", which means Yoga, stops the mind from racing in various distractions. It helps in the unity of thought, word and deed.

The yoga sessions organised by HRDC, DPSS gave a fresh start to the morning and filled everyone with high spirits. The sessions started with the chanting of 'OM' while teachers sitting straight with closed eyes. This was followed by chanting the Gayatri mantra and Shanti mantra. The participants performed different asanas under the guidance of a trained Yoga expert. The asanas were first demonstrated by the expert and then step-by-step instructions were given to the participants to perform the same. The following asanas were performed: Tadasan, Katichakrasan, Rotation of Neck, Shoulders, Hip, Knee and other Joint Movements, Cat Pose, Shashank-Bhujang Asana-, Mandukasan, Half Butterfly Pose, Cycling Uttanapada (300 And 900), Salabhasan.

The sessions also included various breathing exercises: i) Kapalbhati, ii) Anulom-Vilom pranayama, iii) Bhramari pranayama and ended with the Laughter Therapy.

The expert encouraged the teachers to include yoga in their daily busy routine to improve their mental, emotional and physical health. He reiterated that the asanas and breathing exercises will relieve stress, increase concentration and aid in building their immunity.

THE VALEDICTORY FUNCTION

August 26, 2023
4:15 pm - 5:15 pm

The Valedictory Function commenced with the welcome of the esteemed Chief Guest, Dr. (Mrs) Kiran Datar, Member, The Delhi Public School Society. Dr. Kiran Datar along with Ms. Vanita Sehgal, Executive Director, HRDC, DPSS and the participants lit the auspicious Lamp, which was followed by a bouquet presentation to the Chief Guest.

A short overview of the training programme and the session details were shared by Ms. Jyoti Sharma, Joint Director, HRDC, DPSS. Then, the representative participants were invited to share their learning experiences and takeaways from the four day Programme in Chemistry for the Educators of Classes IX - XII.

Ms. Renu Dogra, from DPS Navi Mumbai, said that she felt delighted to be a part of the exhilarating programme. She added that all the sessions in the programme enriched her understanding of varied teaching methodologies and the latest developments in the subject. She stated that the takeaways from the sessions were innumerable. She also extended her gratitude to the participants for the lively discussions and knowledge sharing.

Dr. Vikas Sharma, DPS Hissar, was deeply appreciative of the thought provoking sessions in the programme. He said that he had learnt many productive techniques from the sessions. He said that the sessions were extremely enriching and had several takeaways. He also spoke about the Sharing of the Best Teaching Practices, which he felt was a great concept as it gave a wonderful platform for peer learning. He expressed his heartfelt gratitude to the HRDC team organising such a dynamic and interactive programme and for the cordial hospitality extended during their stay.

This was followed by the teachers singing medleys of popular songs. Their melodious and joyful rendition was beautifully presented.

Dr. Mrs Kiran Datar, Member, The Delhi Public School Society, addressed the gathering. Through her inspirational and thought-provoking words of wisdom, she encouraged the participants to work hard and shine. She said that teachers are the nation builders and have a huge responsibility on their shoulders. Therefore, they must work on the character building of students and must create awareness amongst them regarding the present needs of society and their social responsibilities. She praised the educators for their enthusiastic participation in the workshop. She told the educators that they are the torch bearers and needed to pass the learning to the other educators at their respective schools.

Dr. Datar also praised the HRDC team for their hard work and said that the programmes conducted by them were much appreciated by everyone.

Dr. Kiran Datar and Ms. Vanita Sehgal gave away the Certificates of Participation to the educators.

Ms. Vanita Sehgal, Executive Director, HRDC, DPSS proposed the Vote of Thanks, where she shared a beautiful message about living life to the fullest and not wasting a moment of it in regret and recriminations. She said that passion about one's work is the path to success. She asked the educators to be confident and positive so as to inculcate the same attitude in their students.

The four-day enrichment Programme in Chemistry for the Educators of classes IX - XII concluded with a Group Photograph with the Chief Guest.

Memories...

The Beginning

Back to the Class Room

Watching the Soft Landing of Chandrayaan-3 together

"I believe that the science of chemistry alone almost proves the existence of an intelligent creator." - Thomas A. Edison

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