Semester -VII

DISCIPLINE-SPECIFIC ELECTIVE COURSE - 14 (DSE-14)

Main Group Clusters-Basic and Applications

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Coursetitle & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Main Group Clusters-Basics and Applications (DSE-14)	**04**	**02**	**--**	**02**	__	**--**

Learning Objectives:
To introduce the basic concepts of clusters.To gather a good understanding of the chemistry and various aspects of main group cluster compounds with respect to synthesis, structure and properties.

Learning Outcomes
On completion of the course, the students will be able to:

1. Ensures the students understand the concepts and the properties of clusters.
2. Acquire knowledge of cluster compounds and explain structure-property, electron counts, and surface analogies of cluster compounds.
3. Identify the structure and bonding aspects of main group clusters.
4. Identify the different types of main group cluster reactions and apply the above concepts to explain reactivity of the clusters.

SYLLABUS OF DSE 14

Unit 1: (Hours: 7)
Introduction to molecular clusters - Clusters in elemental states, cluster classification, skeletal electron (Elm) counting.

Unit 2: (Hours: 8)
Main-group clusters: Geometric and electronic structure, three-, four- and higher connect clusters, the *closo-, nido-, arachno-hypho-, klado-,*borane structural paradigm

Unit 3: (Hours:8)

Wade-Mingos and Jemmis electron counting rules, Lipscomb topological diagrams, clusters with nuclearity 4-12 and beyond 12. Structure

Unit 4: (Hours 7)

Synthesis and reactivity. Heteroboranes, boron-carbides and metal-borides.Illustrative examples from recent literature.

Keywords: Clusters, skeletal electron count, boranes, synthesis, reactivity.

Practical Component

1. Determination of Boron colorimetrically.
2. Preparation of borax/ boric acid.
3. Synthesis of zinc borate from zinc oxide and boric acid and their analysis using various instrumentation techniques: IR, UV, TGA, and DSC. Thermal decomposition of borax and its structural characteristics using XRD, FTIR.
4. Qualitative analysis of cobalt, nickel, copper etc. using borax (borax bead test).
5. Other new novel synthesis reported in literature from time to time
6. Syntheses and characterisation of zinc(II)acetylacetonate and tin(II)acetylacetonate complexes

Recommended References and Textbooks

1. M. P. Mingos and D. J. Wales; Introduction to Cluster Chemistry, Prentice Hall, 1990.
2. N. Greenwood and E. A. Earnshaw; Chemistry of elements, Second Edition, Butterworth-Heinemann, 1997.
3. P. Fehlner, J. F. Halet and J-Y. Saillard; Molecular Clusters: A Bridge to solid-state Chemistry, Cambridge University press, 2007.
4. B. D. Gupta and A. J. Elias; Basic Organometallic Chemistry: Concepts, Synthesis, and Applications, Universities Press (India), 2010.
5. M. P. Mingos, Essential Trends in Inorganic Chemistry, Oxford, University Press, 1998.
6. C. E. Housecroft, Metal-Metal Bonded Carbonyl Dimers and Clusters, Oxford Chemistry Primers (44), Oxford, University Press, 1996.

References

1. F. Holleman and E. Wifrg, Inorganic Chemistry, Academic Press, New York, 1995.
2. F. A. Cotton, G. Wilkinson, C. M. Murillo and M. Bochmann, Advanced Inorganic Chemistry, 6th Edn, John Wiley & Sons, Inc, New York, 1999.
3. G. Wulfsberg, Inorganic Chemistry, Viva Books Pvt Ltd, New Delhi, 2001.
4. B. Douglas, D. McDaniel and J. Alexander, Concepts and Models of Inorganic Chemistry, 3rd Edn, John Wiley & Sons, Inc, New York, 2001.
5. P. Atkins, T. Overton, J. Rourke, M. Weller and F. Armstrong, Shriver & Atkins Inorganic Chemistry, 4th Edn, Oxford, 2006.

6. J. E. Huheey, E. A. Keiter, R. L. Keiter and O. K. Medhi, Inorgnic Chemistry: Principles of Structures and Reactivity, 4th Edn, Pearson, New Delhi, 2006.
7. R. Xu, W. Pang and Q. Huo (Eds), Modern Inorganic Synthetic Chemistry, Elsevier, New York, 2011.
8. G. L. Miessler and D. A. Tarr, Inorganic Chemistry, 3rd Edn, Pearson, New Delhi, 2009.
9. J. R. Anderson and M. Boudart (Eds), Catalysis: Science and Technology, Springer, London, 2012.
10. P. Powell, Principles of Organometallic Chemistry, 2nd Edn, Chapman and Hall, London, 1988.
11. G. O. Spessard and G. L. Miessler, Organometallic Chemistry, International 2nd Edn, Oxford University Press, Oxford, 2010.
12. D. F. Shriver, H. D. Kaesz and R. D. Adams (Eds), The Chemistry of Metal Cluster Complexes, VCH, New York, 1990.
13. K. J. Klabunde, Free Atoms, Clusters and Nanoscale Particles, Academic Press, New York, 1994.
14. D. M. P. Mingos (Ed.), Structural and Electronic Paradigms in Cluster Chemistry, Springer, Berlin, 1997.
15. P. Braunstein, L. A. Oro and P. R. Raithby (Eds), Metal Clusters in Chemistry, Wiley-VCH, Weinheim, 1999.
16. M. Driess and H. Noth (Eds), Molecular Clusters of the Main Group Elements, Wiley-VCH, Weinheim, 2004.
17. C. E. Housecraft and A. G. Sharpe, Inorganic Chemistry, 3rd Edn, Pearson Education Ltd, Essex, England, 2008.
18. F. Wells, Structural Inorganic Chemistry, 5th Edn, Oxford University Press, Oxford, 1984.