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DEPARTMENT OF CHEMISTRY

SEMESTER – II

B.Sc in Physical Sciences

Bachelor of Sciences in Physical Sciences

Category II

Physical Science Courses for Undergraduate Programme of study with Chemistry as one of the Core Disciplines

STRUCTURE OF SECOND SEMESTER

A student who pursues undergraduate programme with Physical Science is offered the following courses:

3 Discipline Specific Cores (DSCs) - 3 courses of 4 credits = 12 credits (offered by the parent Departments i.e. Chemistry, Physics, Mathematics)
0 Discipline Specific Electives (DSE) – No DSE courses in Semester II
1 Generic Elective (GE) – 1 course of 4 credits = 4 credits (one course to be chosen from the common pool of GE courses offered by Departments other than the parent Department)
1 Ability Enhancement Course (AEC) – 1 course of 4 credits = 4 credits (one course to be chosen from either 'Environmental Science: Theory to Practice' or one of the 22 Indian Languages listed in the 8th Schedule of the Constitution in the pool of AEC courses)
1 Skill Enhancement Course (SEC) - 1 course of 4 credits = 4 credits (one course to be chosen from the common pool of SEC courses offered by any Department)
1 Value Addition Course (VAC) - 1 course of 4 credits = 4 credits (one course to be chosen from the common pool of VAC courses offered by any Department)

Semester	Core (DSC) 4 credits	Elective (DSE) 4 credits	Generic Elective (GE) 4 credits	Ability Enhance-ment Course (AEC) – 2 credits	Skill Enhance-ment Course (SEC) – 2 credits	Internship/ Apprentice-ship/Project/ Community outreach 2 credits	Value addition course (VAC) 2 credits	Total Credits
I	DSC - 4 DSC - 5		Choose one	Choose one from	Choose one from		Choose one	22 credits

	DSC - 6	NIL	from a pool of courses GE-2 (4)	a pool of AEC courses (2)	a pool of SEC courses (2)	NIL	from a pool of VAC courses (2)	

DISCIPLINE SPECIFIC CORE COURSE – 4: Chemistry-II- Periodic Properties and Chemical Bonding

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Periodic Properties and Chemical Bonding (DSC-4: Chemistry-II)	4	2	0	2	Chemistry, Physics and Mathematics in class XII	**NA**

Learning Objectives

The Learning Objectives of the course are as follows:

- to discuss the periodicity in properties with reference to the s, p and d block, which is necessary in understanding their group chemistry.
- to provide basic knowledge about ionic, covalent and metallic bonding underlining the fact that chemical bonding is best regarded as a continuum between the three cases.
- to provide an overview of hydrogen bonding and van der Waal's forces which influence the melting points, boiling points, solubility and energetics of dissolution of compounds

Learning outcomes

By the end of the course, the students will be able to:

- Explain the periodicity in ionization enthalpy, electron gain enthalpy, electronegativity and enthalpy of atomization.
- Explain variability in oxidation state, colour, metallic character, magnetic and catalytic properties and ability to form complexes
- Comprehend the concept of lattice energy using Born-Landé expression.
- Use Born Haber Cycle to analyse reaction energies.
- Draw and explain the plausible geometries of molecules using VSEPR theory.
- Draw and explain MO diagrams (homo- & hetero-nuclear diatomic molecules).

SYLLABUS OF DSC-4

Unit 1: Periodic Properties **(6 weeks)**

Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy, inert pair effect.

General group trends of s, p and d block elements with special reference to Ionization Enthalpy, Electron Gain Enthalpy, Electronegativity, Enthalpy of Atomization, oxidation state, colour, metallic character, magnetic and catalytic properties, ability to form complexes

UNIT 2: Chemical Bonding **(9 weeks)**

Ionic Bonding: General characteristics of ionic bonding, Lattice Enthalpy and Solvation Enthalpy and their relation to stability and solubility of ionic compounds, Born-Lande equation for calculation of Lattice Enthalpy (no derivation), Born-Haber cycle and its applications, polarizing power and polarizability, Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character.
Covalent Bonding: Valence Bond Approach, Hybridization and VSEPR Theory with suitable examples, Concept of resonance and resonating structures in various inorganic and organic compounds, Molecular Orbital Approach: Rules for the LCAO method, bonding, nonbonding and antibonding MOs and their characteristics for s-s, s-p and p-p combinations of atomic orbitals, MO treatment of homonuclear diatomic molecules of 1st and 2nd periods (including idea of s-p mixing) and heteronuclear diatomic molecules such as CO, NO and NO^+.
Brief introduction to Metallic Bonding, Hydrogen Bonding, van der Waal's Forces

PRACTICALS: **(15 Weeks)**

(Laboratory periods: 60)

1. Preparation of standard solutions.
2. Estimation of Sodium carbonate with HCl
3. Estimation of oxalic acid by titrating it with $KMnO_4$.
4. Estimation of Mohr's salt by titrating it with $KMnO_4$.
5. Estimation of water of crystallization in Mohr's salt by titrating with $KMnO_4$.
6. Estimation of Fe (II) ions by titrating it with $K_2Cr_2O_7$ using internal and external indicators.
7. Estimation of Cu (II) ions iodometrically using $Na_2S_2O_3$.
8. Chromatographic separation of mixture of metal ions Cu^{2+}, Cd^{2+} or Ni^{2+}, Co^{2+}.
9. Estimation of Fe (II) ions by titrating it with $K_2Cr_2O_7$ using
   a). internal indicator
   b). external indicator
10. Estimation of Cu (II) ions iodometrically using $Na_2S_2O_3$.
11. Paper Chromatographic separation of mixture of metal ions
    a). Cu^{2+} , Cd^{2+}
    b). Ni^{2+} , Co^{2+}
12. Any suitable experiment (other than the listed ones) based upon neutralisation/redox reactions.

References:

Theory:

1. Huheey, J.E.; Keiter, E.A., Keiter; R. L.; Medhi, O.K. (2009), **Inorganic Chemistry-Principles of Structure and Reactivity**, Pearson Education

2. Shriver, D.D.; Atkins, P.; Langford, C.H. (1994), **Inorganic Chemistry** 2nd Ed., Oxford University Press.
3. Atkins, P.W.; Overton, T.L.; Rourke, J.P.; Weller, M.T.; Armstrong, F.A. (2010), **Inorganic Chemistry**, 5th Edition, W. H. Freeman and Company.
4. Lee, J.D.; (2010), **Concise Inorganic Chemistry**, Wiley India
5. Douglas, B.E.; McDaniel, D.H.; Alexander, J.J. (1994),**Concepts and Models of Inorganic Chemistry**, John Wiley & Sons.
6. Wulfsberg, G (2002), **Inorganic Chemistry**, Viva Books Private Limited.
7. Miessler, G.L.; Fischer P.J.; Tarr, D. A. (2014), **Inorganic Chemistry**, 5th Edition, Pearson.

Practical:

- Jeffery, G.H.; Bassett, J.; Mendham, J.; Denney, R.C. (1989), **Vogel's Textbook of Quantitative Chemical Analysis**, John Wiley and Sons.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.