

Syllabus

2nd Semester

Bachelor of Science in Physical Sciences
Chemistry

240/CHEP/CC201

Core Course (Multidisciplinary)

Semester-II

COURSE DETAILS:

Course Title	Chemistry-II
Semester	Semester-II
Course Code	CC-A2
Course ID	
Total Credits	04 (Lecture: 03, Tutorial: 0, Practical: 01)
Total Marks	100
Marks Distribution	Theory External: 50 Theory Internal: 25 Practical External: 20 Practical Internal: 05

COURSE CURRICULUM DELIVERY WEEKLY DISTRIBUTION:

Total Hours per Week: 5	
Lectures (L) Hours per Week: 3	Practical (P) Hours per Week: 2

COURSE OBJECTIVES:

- To understand chemical bonding theories and predict molecular properties.
- To study the chemistry of s-block elements and noble gases.
- To analyze acid-base theories and their applications.
- Knowledge of alkanes, alkenes, alkynes and aromatic compounds in terms of synthesis and reactivity
- Understanding of kinetic theory of gases and associated concepts
- Knowledge of Ideal gas equation and deviation from ideal behaviour.
- Understanding of liquid associated properties
- Understanding of Crystallography, Structural Analysis and Close Packing and Bonding in Solids.

COURSE OUTCOMES:

Students will be able to learn:-

- Bonding theory associated with atoms and molecules.
- Explain the properties and bonding of s-block elements and noble gases.
- Apply acid-base theories and HSAB principles to chemical systems.
- Synthesis and chemical reactions of alkanes, alkenes, alkynes and aromatic compounds
- Physical properties of gases and liquids

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- Basics of crystallography of solids, structure of common crystalline solids and packing patterns including defects in packing

DETAILED CONTENT OF COURSE:

Theory Syllabus: Total Contact Hours: 45

Unit	Topics	Contact Hours
I	<p>Chemical Bonding - Part II Valence shell electron pair repulsion (VSEPR) theory to NH_3, H_3O^+, SF_4, ClF_3, H_2O, SnCl_2, ClO_3^- and ICl_2^-. Molecular orbital theory of homonuclear and heteronuclear diatomic molecules (N_2, O_2, C_2, CO, and NO), bond order, bond length and bond energy. Covalent character in ionic compounds, polarizing power and polarizability, Fajan's rules.</p> <p>Chemistry of s-block elements and Noble gases Inert pair effect, Diagonal relationship and anomalous behaviour of the first member of each group. Complex formation tendency of s-block elements, crown ethers and cryptands. Noble gases: Occurrence, inertness and use of noble gases, Structure and bonding of fluorides, oxides and oxyfluorides of Xe.</p> <p>Acid-Base Theories Acid-Base Theories: Arrhenius, Brønsted-Lowry, Lewis, and Usanovich concepts. Relative strength of acids and bases, levelling solvents. hard and soft acids and bases (HSAB), Applications of HSAB principle. Acid-Base Equilibria: pH, pKa, and pKb, buffer solutions.</p>	12
II	<p>Hydrocarbons: Alkanes: General introduction alkanes, general methods of preparation: Wurtz reaction, Kolbe reaction, Corey-House reaction and decarboxylation of carboxylic acids, Reactivity and Mechanisms: Free radical substitutions, halogenation: relative reactivity and selectivity. Alkenes: Synthesis, Saytzeff and Hoffmann elimination, Reactions of alkenes: Electrophilic additions their mechanisms (Markownikov/ Anti Markownikov addition), mechanism of oxymercuration-demercuration, hydroboration-oxidation, ozonolysis, reduction (catalytic and chemical), syn and anti-hydroxylation (oxidation). Alkynes: General methods of preparation, reactions of alkynes: acidity, electrophilic and nucleophilic additions. Aromatics: Electrophilic aromatic substitution: halogenation, nitration, sulphonation, Friedel Crafts alkylation/ acylation with their mechanism. Directing effects of groups in electrophilic substitution.</p>	12
III	<p>Gaseous and Liquid State Kinetic molecular model of a gas: collision frequency; collision diameter; mean free path and viscosity of gases; Maxwell-Boltzmann distribution: molecular velocities, law of equipartition of energy, molecular basis of heat capacities; Ideal gases, and deviations from ideal gas behaviour, van der</p>	11

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	<p>Waals equation of state; critical state, law of corresponding states.</p> <p>Physical properties of Liquid, vapour pressure, surface tension and coefficient of viscosity and their applications; effect of concentration of solutes on surface tension and viscosity; effect of temperature on viscosity of liquids.</p>	
IV	<p>Solid State</p> <p>Unit Cells, Miller indices, crystal systems and Bravais Lattices, elementary applications of vectors to crystal systems; X-ray diffraction, Bragg's Law, Structure of NaCl, CsCl, and KCl, diamond, and graphite; Close packing in metals and metal compounds, semiconductors, insulators; Defects in crystals, lattice energy; isomorphism; heat capacity of solids.</p>	10
V	<p>Practicals:</p> <ol style="list-style-type: none"> 1. Acid-Base Titrations: Principles of acid-base titrations to be discussed. <ol style="list-style-type: none"> (i) Estimation of oxalic acid using standardized NaOH solution (ii) Estimation of sodium carbonate using standardized HCl. (iii) Estimation of carbonate and hydroxide present together in a mixture. (iv) Estimation of carbonate and bicarbonate present together in a mixture. 2. Detection of extra elements (N, S, Cl, Br, I) in organic compounds (containing upto two extra elements). 3. Dibenzalacetone from acetone and benzaldehyde. 4. 2,4-DNP derivative of Benzophenone/Acetophenone. 5. pH metric titration of a strong acid vs. a strong base. 6. pH metric titration of a weak acid vs. a strong base. 7. Conductometric titration of a weak acid vs. a weak base. 8. Conductometric titration of a mixture of acids vs. a base. 	30

COURSE EVALUATION METHODS

Theory Exams: Total Marks: 75 (External: 50 + Internal: 25)

Internal Assessment: 25 Marks	<ul style="list-style-type: none"> • Class Participation: 05 Marks • Seminar/Presentation/ Assignment: 05 Marks • Mid Term Exam: 15 Marks
External Assessment: 50 Marks (02 Hours)	<ul style="list-style-type: none"> • End Term Exam: 50 Marks

Practical Exam: Total Marks: 25 (External: 20 + Internal: 05)

Internal Assessment: 05 Marks	<ul style="list-style-type: none"> • Class Participation: 05 Marks
External Assessment: 20 Marks (02 Hours)	<ul style="list-style-type: none"> • End Term Practical Exam: 10 Marks • Lab record: 05 Marks • Viva Voce: 05 Marks

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Instruction for End-Term Theory Exam:

The Examiner is requested to set nine questions in total, selecting two questions from each section. Question-1 will be a compulsory question consisting short answer type questions covering all the units of the syllabus. All questions should carry equal marks. Log table and non-programmable calculator is allowed.

RECOMMENDED BOOKS

1. "Concise Inorganic Chemistry" by J.D. Lee
2. "Inorganic Chemistry" by Gary L. Miessler, Paul J. Fischer, and Donald A. Tarr
3. "Inorganic Chemistry" by Puri, Sharma, and Kalia
4. "Quantitative Inorganic Analysis" by A.I. Vogel
5. "Physical Chemistry" by P. Bahadur
6. "Principles of Physical Chemistry" by Puri, Sharma, and Pathania
7. "Vogel's Textbook of Quantitative Chemical Analysis" by G. H. Jeffery, J. Bassett, J. Mendham, and R.C. Denney
8. Morrison, R. N.; Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
9. McMurry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013.
10. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
11. Ahluwalia, V.K.; Bhagat, P.; Aggarwal, R.; Chandra, R. (2005), Intermediate for Organic Synthesis, I.K.International.
12. Solomons, T. W. G.; Fryhle, C. B.; Snyder, S. A. (2016), Organic Chemistry, 12th Edition, Wiley.
13. Chandra, R.; Singh, S.; Singh, A. (2019), Organic reactions and their nomenclature, Arcler Press.
14. Mann, F. G.; Saunders, B. C. (2009), Practical Organic Chemistry, Pearson Education.
15. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. (2012), Vogel's Textbook of Practical Organic Chemistry, Pearson.
16. Ahluwalia, V.K.; Aggarwal, R. (2004), Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, University Press.

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