

Objectives:

- To understand the scope and principle of Adsorption and Water analysis.
- To explain the important features of Amines with its classification and synthesis.
- To understand the classification of elements and periodicity in properties.
- To acquire knowledge regarding the second law of thermodynamics with Carnot cycle and Heat engines,

Credits Earned: 5 Credits

Course Outcomes: After completion of this course, student will be able to

- Understand the basic idea of Water analysis and Adsorption.
- Be aware for the classification of elements and periodicity in property.
- Capable to explain division of s, p, d and f blocks and their electronic configuration.
- Obtain the basic idea of second law of Thermodynamics.
- Get the idea of various thermochemical processes and their applications.
- Get practical aspects of Water analysis.
- Will develop knowledge to distinguish the adsorption phenomenon which is very important for surface chemistry point of view and will also spread light on thermodynamics.

Pre-requisite of course: The beginning to study of chemistry part in Chemistry-II, all students should have basic conceptual clarity of inorganic chemistry at 12th standard level chemistry. Student must have know the knowledge of thermodynamics laws and some basics of adsorption studies.

Teaching and Examination Scheme

Teaching Scheme (Hours)			Credits	Theory Marks			Tutorial/ Practical Marks		Total Marks
Theory	Tutorial	Practical		ESE (E)	IA	CSE	Viva (V)	Term work (TW)	
4	0	2	5	50	30	20	25	25	150

Contents:

Unit	Topics	Contact Hours
1	<p>Adsorption and Water analysis: Introduction of Adsorption, Definition of Adsorbent, Adsorbate, Adsorption, Absorption, Sorption, Desorption, Types of Adsorption, Physical and Chemical Adsorption, Difference between them, Factor affection Adsorption, Adsorption isotherm, Freundlich and Langmuir Adsorption isotherm.</p> <p>Water analysis, Total solid and Volatile solid, Non filterable solids and non-filterable volatile solids, Filterable solids, Total dissolved solid (TDS), Total suspended solids (TSS), Acidity, Basicity, Turbidity, Hardness of water, Soap method.</p>	15
2	<p>Amines: Introduction, Definition and classification of Amines, Nomenclature of Amines, Properties: Physical and chemical, Preparation of Amines: From reduction of nitro compounds, Halides, Hoffmann degradation and alcohols, Chemical reaction of Amines: Reaction with alkyl halides, Acid chlorides, Preparation of diazonium salt and its uses, Sulphonation of aromatic amines.</p>	15
3	<p>Classification of elements and periodicity in properties: Introduction, Mendeleev's periodic law, Morden periodic law, Cause of periodicity, Bohr's table, Structure features of Bohr's table, Nomenclature, Division of s, p, d and f blocks and their electronic configuration, Periodic properties: Atomic radius, Ionic radii, Ionisation potential and Electronegativity.</p>	15
4	<p>Second law of Thermodynamics: Introduction, Process, Spontaneous processes, Nonspontaneous processes, Criteria of spontaneity, Statement of the second law, Cyclic process, The Carnot cycle, Heat engines, Efficiency of a heat engine, First operation – isothermal reversible expansion, Second operation – adiabatic reversible expansion, Third operation – isothermal reversible compression, Fourth operation – adiabatic reversible compression, Net heat absorbed in one cycle, Calculation of Thermodynamic efficiency, Carnot theorem, Entropy change in an irreversible process, The Clapeyron equation, Clausius–clapeyron equation, Numericals.</p>	15
Total Hours		60

Chemistry**References:**

1. E. J. D. Lee, Concise Inorganic Chemistry, 5th edn, Blackwell Science, London.
2. V. P. Kudesia, Water pollution 7th edition.
3. Basics of Organic chemistry by Arun S. Bahl
4. B. R. Puri, L. R. Sharma, Kalia, Principles of Inorganic Chemistry, Milestone Publishers, New Delhi.
5. D. F. Shriver and P. W. Atkins, Inorganic Chemistry, 3rd edn., Oxford University Press.
6. K L Kapoor, A Textbook of Physical Chemistry, 3rd Edition, Macmillan India Ltd.
7. Principle of physical chemistry: B. R. Puri, L. R. Sharma, M. S. Pathania.
8. P. W. Atkins & J. de Paula, Atkin's Physical Chemistry 8th Ed., Oxford University Press (2006).
9. R. P. Rastogi, R. R. Misra, An Introduction to Chemical Thermodynamics, 6th edn., Vikas Pub. Pvt. Ltd. (2003).
10. Arun Bahl & J.D Tuli, Physical Chemistry, Multicolour edition, S. Chand Publishing.

Suggested Theory distribution:

The suggested theory distribution as per Bloom's taxonomy is as per follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process.

Distribution of Theory for course delivery and evaluation					
Remember	Understand	Apply	Analyze	Evaluate	Create
20%	20%	30%	15%	10%	5%

Suggested List of Experiments:**Water Analysis:**

1. To determine Total Dissolved Solids in the given sample.
2. To determine Total Suspended Solids in the given sample.
3. Estimation of Total hardness of water.

Conductometry and pH metry:

4. To determine concentration of HCl with the help of known concentration of NaOH by conductometry.
5. To determine concentration and dissociation constant of CH₃COOH with the help of known concentration of NaOH by conductometry.
6. To determine concentration of HCl with the help of known concentration of NaOH by pH metry.
7. To determine concentration and dissociation constant of CH₃COOH with the help of known concentration of NaOH by pH metry.
8. To determine concentration of each component in the given mixture of HCl and CH₃COOH with the help of known concentration of NaOH by pH metry.

Chemistry**Reference Books:**

1. Vogel's Qualitative Inorganic Analysis (7th Edition).
2. Handbook of Water Analysis, Third Edition by Leo M.L. Nollet, Leen S. P. De Gelder.
3. Fundamentals of analytical chemistry (9th edition), by James Holler.
4. Concise Inorganic Chemistry by J. D. Lee, ELBS.
5. Inorganic Chemistry by SuretkeThate
6. Principles of Inorganic Chemistry- B.R. Puri, L.R. Sharma & K.C Kalia; Vallabh Publications, Delhi
7. Modern Aspects of Inorganic Chemistry - H.J. Emeleus and A.G. Sharpe; Routledge & Kegan Paul Ltd., 39 Store street, London WC1E7DD

Instructional Method:

1. The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.
2. The internal evaluation will be done on the basis of continuous evaluation of students in the laboratory and class-room.
3. Practical examination will be conducted at the end of semester for evaluation of performance of students in laboratory.
4. Students will use supplementary resources such as online videos, NPTEL videos, e-courses, Virtual Laboratory.
5. Use of hazardous/toxic chemicals should be avoided as far as possible in laboratory.
6. All students in the laboratory must wear safety goggles and lab coats during lab session.

Supplementary Resources:

1. <http://www.nptel.ac.in/courses/104103069/#>
2. <http://ocw.mit.edu/courses/chemistry/>
3. <http://vlab.amrita.edu/index.php?sub=2>
4. http://www.vlab.co.in/ba_labs_all.php?id=9