

**Objectives:**

- To study the theory of atomic structures.
- To understand the important features of the quantum theory of the atom.
- To explain the formation of organic compounds.
- To predict the geometry of simple molecules.
- To explain the different types of hybridization and draw shapes of hybrid orbitals.
- To study the zeroth and 1<sup>st</sup> laws of thermodynamics, Internal Energy, Enthalpy and Heat capacities.
- To study the laws of thermochemistry and its applications.

**Credits Earned:** 5 Credits

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

- Understand the basic idea of atomic structure and its quantum mechanical concept.
- Be aware of the basic concepts of various types of chemical bonding.
- Obtain the basic idea of thermodynamics and analyse simple systems involving energy balance by applying the concept of thermodynamics.
- Get the idea of various thermochemical processes and their applications.
- Recognize the basic involvement of electronic configuration and their consequences on formation of orbital's.

**Pre-requisite of course:** The beginning to study of inorganic chemistry part in Chemistry-I, all students should have basic conceptual clarity of inorganic chemistry at 12<sup>th</sup> standard level chemistry. It involves electronic configuration and their active involvement for the formation of orbital structure. This unit also demands the modest knowledge of periodic table to understand the chemical and physical properties of the elements and their effect in thermodynamics and thermo-chemical applications.

**Teaching and Examination Scheme**

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

**Contents:**

<b>Unit</b>	<b>Topics</b>	<b>Contact Hours</b>
1	<b>Atomic structure</b> Basic introduction, Atomic number, atomic mass, isotopes, isobar, isotones, Electromagnetic radiations, Dual nature of electrons, Quantum number, shapes of s, p, d and f orbitals, Heisenberg's uncertainty principle, De-Broglie's equations, Aufbau's principle, Pauli's principle, Hund's rule of maximum multiplicity.	15
2	<b>Thermodynamics:</b> Definition of thermodynamics term: system, surroundings, types of systems, Intensive and extensive properties, Concept of heat and work, First Law of Thermodynamics: Theory & Mathematical form, Definition of internal energy and enthalpy, Calculation of w, q, $\Delta E$ & $\Delta H$ for the expansion of ideal gases under isothermal and adiabatic conditions for reversible process, Work obtained during adiabatic and isothermal change, Heat capacity: heat capacities at constant volume and pressure and their relationship $C_p - C_v = R$ Joule's law-joule Thomson coefficient and inversion temperature (only definition), Zeroth Law: mathematical treatment of Zeroth law and its limitation and various statements of law,	15
3	<b>Solution and their Properties:</b> Solutions, classification of solution, units of concentration, colligative properties, numericals based on concentration and colligative properties, Henry's law, vapour-pressure lowering of solution, Raoult's law, boiling point elevation and freezing point depression of solutions, osmosis, osmotic pressure, problems based on osmotic pressure.	15
4	<b>Basics in organic chemistry and Aliphatic Hydrocarbons</b> Hybridization, types of hybridization, Inductive effect, Electronegativity, Electromeric effect, Hyperconjugation, Homolytic and heterolytic fission, Reaction intermediates (carbocation, carbanion and free radicals), Hydrocarbons and its classification, synthesis and reactions of alkanes, alkenes and alkynes, Types of organic reaction, Electrophiles and nucleophiles.	15
<b>Total Hours</b>		<b>60</b>

**References:**

1. E. J. D. Lee, Concise Inorganic Chemistry, 5th edn., Blackwell Science, London.



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2. Basics of Organic chemistry by Arun S. Bahl
3. B. R. Puri, L. R. Sharma, Kalia, Principles of Inorganic Chemistry, Milestone Publishers, New Delhi.
4. D. F. Shriver and P. W. Atkins, Inorganic Chemistry, 3<sup>rd</sup>edn., Oxford University Press.
5. K L Kapoor, A Textbook of Physical Chemistry, Volume 1, 3<sup>rd</sup> Edition, Macmillan India Ltd.
6. K.L. Kapoor, A Textbook of Physical Chemistry, Volume 2, 3<sup>rd</sup> Edition, Macmillan India Ltd.
7. P. W. Atkins & J. de Paula, Atkin's Physical Chemistry 8<sup>th</sup> Ed., Oxford University Press (2006).
8. R. P. Rastogi, R. R. Misra, An Introduction to Chemical Thermodynamics, 6<sup>th</sup>edn., Vikas Pub. Pvt. Ltd. (2003).
9. 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:**

**Volumetric Analysis:**

1. To prepare solutions of acid and base with definite concentration.
2. To determine normality, molarity and gm/lit of given strong acid with the help of known concentration of strong base.
3. To determine normality, molarity and gm/lit of given weak acid with the help of known concentration of strong base.
4. To determine normality, molarity and gm/lit of given weak base ( $\text{Na}_2\text{CO}_3/\text{NaHCO}_3$ ) with the help of known concentration of strong acid.
5. To determine normality, molarity and gm/lit of given  $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$  with the help of known concentration of  $\text{KMnO}_4$ .



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6. To determine normality, molarity and gm/lit of given  $\text{FeSO}_4(\text{NH}_4)_2\text{SO}_4 \cdot 6\text{H}_2\text{O}$  with the help of known concentration of  $\text{K}_2\text{Cr}_2\text{O}_7$ .
7. To determine normality, molarity and gm/lit of each component in the given mixture of  $\text{Na}_2\text{CO}_3$  and  $\text{NaHCO}_3$  with the help of known concentration of  $\text{HCl}$ .
8. To determine the amount of chloride in the given sample of water using 'X' N  $\text{AgNO}_3$  solution.

**Reference Books:**

1. Textbook of quantitative chemical analysis by J. Mendham, R. C. Denney and B. Sivasankar.
2. Concise Inorganic Chemistry by J. D. Lee, ELBS.
3. Basic Inorganic Chemistry by - FA. Cotton and G. Wilkinson
4. Principles of Inorganic Chemistry- B.R. Puri, L.R. Sharma & K.C. Kalia; Vallabh Publications, Delhi
5. 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.



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7. During practical and experimental section student must wear shoes to avoid accidents cause by spilling or rush handling of acidic chemicals (Especially during inorganic estimation experiments).

**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](http://www.vlab.co.in/ba_labs_all.php?id=9)
5. <https://www.youtube.com/watch?v=gyxgVsXMYq0&list=PL7jfMV2bTYmqnYac3pdt9uaDNCXvffayK>
6. [https://www.youtube.com/watch?v=2iqUB\\_N-uzw](https://www.youtube.com/watch?v=2iqUB_N-uzw)