



# C. U. SHAH UNIVERSITY

## FACULTY OF SCIENCE

### DEPARTMENT OF CHEMISTRY

COURSE: B.Sc.

SEMESTER: II

SUBJECT NAME: Chemistry-II

SUBJECT CODE: BSCCHC201

#### Teaching & Evaluation Scheme:-

Teaching Scheme(hrs)			Evaluation Scheme									
Th	Pr	Total	Theory					Practical (Marks)			Total	
			Sessional Exam		University Exam		Total	External	Internal	Total		
			Marks	Hrs	Marks	Hrs						
4	0	4	30	1.5	70	3	100	--	--	--	100	

#### Objectives: -

- The course will help the student to understand internal (atomic and molecular) structure of compound.
- To understand the properties of different types of chemical bonding and in addition to that what are the factors which affect nature of bonding.
- To understand basic characteristic and use of Electromotive Force, Photochemistry, Catalysis.
- Principles of thermodynamics and application.

#### Prerequisites:-

- Students should have basic knowledge of chemistry up to 10+2 level.

#### Course outline:-

Sr. No.	Course Contents	Hours
1	<b>Organic Chemistry:</b> <b>Alcohols, Phenols and Ethers</b> <ul style="list-style-type: none"><li>▪ IUPAC Nomenclature of Alcohols (Mono, di and trihydric alcohols), Phenols and Ethers</li><li>▪ Physical Properties of Alcohols</li><li>▪ Chemical Properties of Alcohols [Reactions of O-H bond cleavage and C-O bond cleavage - only reactions, no mechanisms]</li></ul>	10



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	<ul style="list-style-type: none"> <li>▪ Industrial Production of Phenol               <ol style="list-style-type: none"> <li>1. Dow Process</li> <li>2. Cumene Process</li> </ol> </li> <li>▪ Physical Properties of Phenol</li> <li>▪ Chemical Properties of Phenol               <ol style="list-style-type: none"> <li>1. Reactions of O-H group</li> <li>2. Reactions of aromatic ring [Electrophilic substitution reactions, Reimer Tiemann Reaction, Kolbe Schmitt Reaction, Fries Rearrangement – with reaction mechanism]</li> </ol> </li> <li>▪ Relative acidity of Alcohols and Phenols</li> <li>▪ Preparation of Ethers – Williamson Synthesis</li> <li>▪ Physical Properties of Ethers</li> <li>▪ Chemical Properties of Ethers               <ol style="list-style-type: none"> <li>1. Substitution Reaction [Reaction with Cl<sub>2</sub> in dark &amp; Reaction of Cl<sub>2</sub> in light]</li> <li>2. Reactions involving C-O bond cleavage [hydrolysis, reaction with H<sub>2</sub>SO<sub>4</sub>, cold HI and hot HI]</li> </ol> </li> </ul>	
2	<p><b>Amines</b></p> <ul style="list-style-type: none"> <li>▪ Classification and Nomenclature</li> <li>▪ Basicity of Amines</li> <li>▪ Physical Properties of Amines</li> <li>▪ Preparation of Primary amines [Reduction of nitro compounds, reaction of organic halides with ammonia, Hoffmann degradation of amides]</li> <li>▪ Chemical Properties of Primary amines [Reaction with acid chlorides, aryl sulphonyl chlorides, reaction with alkyl halides]</li> <li>▪ Chemical Properties of Aniline [Reactions of Aniline with acid chlorides, aryl sulphonyl chlorides, Reaction with bromine (formation of 2,4,6 –tri bromo aniline and p- bromo aniline)]</li> <li>▪ Diazotization of Aniline and reactions of Diazonium salt</li> <li>▪ Hinesburg Reaction to distinguish between Primary, Secondary and Tertiary amines</li> </ul>	10
3	<p><b>Inorganic Chemistry:</b></p> <p><b>Ionic Solids</b></p> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Characteristics of ionic solids</li> <li>▪ Born Haber Cycle</li> <li>▪ Max Born Equation</li> <li>▪ Limiting radius ratio</li> <li>▪ Relation between radius ratio, coordination number and crystal structure</li> <li>▪ Derivation of r<sup>+</sup>/r<sup>-</sup> ratio in trigonal, square planar, body centred and tetrahedral crystal lattice</li> </ul>	08



	<ul style="list-style-type: none"> <li>▪ Crystal structure of ionic solids: HCP, BCP and FCC</li> <li>▪ Crystal structure of ionic solids               <ol style="list-style-type: none"> <li>1. AB type - CsCl and ZnS (zinc blende)</li> <li>2. AB<sub>2</sub> type - CaF<sub>2</sub> and TiO<sub>2</sub></li> </ol> </li> <li>▪ Defects in Ionic Crystal Lattice (stoichiometric and nonstoichiometric)</li> <li>▪ Semi conductors</li> </ul>	
4	<p><b>Molecular Orbital Theory</b></p> <ul style="list-style-type: none"> <li>▪ Basic Concepts of Molecular Orbital Theory</li> <li>▪ Characteristics of molecular orbitals with necessary diagram (i.e. Bonding, anti-bonding, gerade and ungerade orbitals)</li> <li>▪ Energy level diagram of diatomic molecules of First and Second row elements of periodic table and NO &amp; CO molecules</li> <li>▪ Electronic configuration of the above mentioned molecules and calculation of bond order and magnetic moment</li> <li>▪ Comparison of MO and VB Theories</li> </ul>	07
5	<p><b>Isomerism in Complexes</b></p> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Types of isomerism               <ol style="list-style-type: none"> <li>1. Ionization</li> <li>2. Polymerization</li> <li>3. Hydration</li> <li>4. Coordination</li> <li>5. Position isomerism</li> <li>6. Stereoisomerism</li> </ol> </li> </ul>	05
6	<p><b>Physical Chemistry:</b></p> <p><b>Electromotive Force</b></p> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Types of Cell</li> <li>▪ Half-cell</li> <li>▪ Reversible and irreversible cell</li> <li>▪ Convention sign</li> <li>▪ Types of Electrodes</li> <li>▪ Standard Electrode Potential</li> <li>▪ Electrolytic Cell</li> <li>▪ Galvanic Cell</li> <li>▪ Emf series</li> <li>▪ Representation of Cell</li> <li>▪ Relation between G, H and K</li> <li>▪ Nernst Equation and its applications</li> </ul>	10
7	<p><b>Photochemistry</b></p> <ul style="list-style-type: none"> <li>▪ Laws of Photochemistry: Grothus- Drapper law; Lambert-Beers law; Stark-Einstein's law (i.e. law of photochemical equivalence)</li> </ul>	07



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	<ul style="list-style-type: none"><li>▪ Quantum efficiency and Factors affecting quantum efficiency</li><li>▪ Reasons for low and high quantum yield</li><li>▪ Photo sensitization</li><li>▪ Fluorescence</li><li>▪ Phosphorescence</li><li>▪ Chemiluminescence</li></ul>	
8	<b>Catalysis</b> <ul style="list-style-type: none"><li>▪ Introduction</li><li>▪ Types of Catalyst</li><li>▪ Functions</li><li>▪ Theories</li><li>▪ Acid base Catalyst</li><li>▪ Enzyme Catalyst</li><li>▪ Applications</li></ul>	03
9	<b>Analytical Chemistry:</b> <b>Basic Principles of Qualitative Analysis</b> <ul style="list-style-type: none"><li>▪ Introduction</li><li>▪ Factors affecting qualitative analysis: common ion effect, solubility product (ksp)</li><li>▪ Use of NH<sub>4</sub>Cl and NH<sub>4</sub>OH in Qualitative Analysis</li><li>▪ Use of HCl and H<sub>2</sub>S in Qualitative Analysis</li><li>▪ Numerical on common ion effect and ksp</li><li>▪ Necessary explanation with chemical equations in<ol style="list-style-type: none"><li>1. Charcoal test</li><li>2. Cobalt nitrate test</li><li>3. Borax bead test</li><li>4. Flame test.</li></ol></li></ul>	10
10	<b>Water Analysis</b> <ul style="list-style-type: none"><li>▪ Analysis of hardness of water in terms of<ol style="list-style-type: none"><li>1. Total solid and volatile solid</li><li>2. Non-filterable solid and non-filterable volatile solid</li><li>3. Filterable solid</li><li>4. Total solid</li><li>5. Total Suspended Solid</li><li>6. Acidity</li><li>7. Basicity or Alkalinity</li><li>8. Turbidity</li></ol></li><li>▪ Various method of determination of Hardness of Water</li></ul>	10



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### **Learning Outcomes:-**

The students are expected to

- Understand basic atomic and molecular structure and factors that determine stability of inorganic compounds.
- Familiar with applications, hazards and precautions which should be taken while using radio-compounds.
- Apply thermodynamic to explain different types of chemical reactions.

### **Books Recommended:-**

#### **Organic Chemistry**

1. 'Advanced Organic Chemistry', **Arun Bahl and B.S. Bahl.**
2. 'Text Book of Organic Chemistry for BSc students', **B.S. Bahl.**
3. 'A Textbook of Organic Chemistry', **K.S. Tewari, N.K. Vishnoi and S.N. Mehrotra.**
4. 'Organic Chemistry (Volume I, II & III)', **S.M. Mukherji, S.P. Singh and R.P. Kapoor.**
5. 'Organic Chemistry' **Morrison and Boyd.**
6. 'Organic Chemistry', **T.W. Graham Solomons and Craig B. Fryhle.**
7. 'Organic Chemistry', **Francis A. Carey.**
8. 'Organic Chemistry', **Clayden.**
9. 'Fundamentals of Organic Chemistry', **Solomon, John Wiley.**
10. 'Textbook of Organic Chemistry', **P.L. Soni and H.M. Chawla.**
11. 'March's Advanced Organic Chemistry Reactions, Mechanism and Structure', **Michael B Smith and Jerry March.**
12. 'Reaction Mechanisms and Reagents in Organic Chemistry', **Gurudeep R. Chatwal.**
13. 'Advanced Organic Reaction Mechanism', **N. Tewari.**
14. 'Organic Chemistry', **I.L. Finar.**

#### **Inorganic Chemistry**

1. 'Concise Inorganic Chemistry', **J. D. Lee, ELBS.**
2. 'Basic Inorganic Chemistry', **FA. Cotton and G. Wilkinson.**
3. 'Advanced Inorganic Chemistry (3rd Edition)', **FA. Cotton and G. Wilkinson, Wiley Eastern Pvt. Ltd.**
4. 'Valence and Molecular Structure', **Cartmell and Fowels.**
5. 'Atomic Structure and Chemical Bonding', **Manas Chanda.**
6. 'Inorganic Chemistry', **Suretker Thate.**
7. 'Inorganic Chemistry', **James E. Huheey (3rd Edition), Harper International SI Edition.**
8. 'Coordination Chemistry', **Gurdeep Chatwal and M.S. Yadav, Himalaya Publishing House.**



## **C. U. SHAH UNIVERSITY**

9. 'Principles of Inorganic Chemistry', **B.R. Puri, L.R. Sharma & K.C Kalia**, *Vallabh Publications, Delhi*.
10. 'Modern Aspects of Inorganic Chemistry', **H.J. Emeleus and A.G. Sharpe**, *Routledge & Kegan Paul Ltd., 39 Store street, London WC1E7DD*.
11. 'Magneto Chemistry', **Shyamal & Datta**.

### **Physical Chemistry**

1. 'A Textbook of Physical Chemistry', **P. L. Soni, O.P. Dharmarha and U.N. Dash**.
2. 'Physical Chemistry', **Dr. D. R. Pandit, A. R. Rao and Padke**.
3. 'Progressive Physical Chemistry', **Dr. Snehi**, *Merrut Publications*.
4. 'Principles of Physical Chemistry', **Puri, Sharma, Pathania**.
5. 'A text book of Physical Chemistry', **Samuel Glasstone**.
6. 'Elements of Physical Chemistry', **Samuel Glasstone and D Lewis**.
7. 'Thermodynamics for Chemists', **Samuel Glasstone**.
8. 'Introduction to Electrochemistry', **S. Gladstone**.
9. 'A text book of Physical Chemistry', **B.K. Sharma**.
10. 'Emf', **B.K. Sharma**.
11. 'Principles of Physical Chemistry', **S.H Maron and C.F Prutton**.
12. 'Elements of Physical Chemistry', **B.R Puri, L.R Sharma, M.S Pathania**.
13. 'Advanced Physical Chemistry', **J.N Gurtu**.
14. 'Physical Chemistry', **N Kundu and S.K Jain**.
15. 'Physical Chemistry', **KL Kapoor**.
16. 'Thermodynamics', **Gurudeeep Raj**.
17. 'Comprehensive Physical Chemistry', **Hemand Snehi**.
18. 'Introduction to Physical Chemistry', **Madan and Madan**.

### **Analytical Chemistry**

1. 'Fundamental of analytical chemistry', **Skoog & West**.
2. 'Instrumental Method & Chemical Analysis', **B.K. Sharma**.
3. 'Water Analysis and Water pollution', **V.P. Kudesia**.
4. 'Instrumental Method & Chemical Analysis', **Chatwal Anand**.
5. 'Book for Water Analysis', **R. K. Trivedi, V. P. Kudesia**.
6. 'Analytical Chemistry', **Dick**.
7. 'Inorganic Qualitative Analysis', **Vogel and Gehani Parekh**.
8. 'Electrometric Methods of Analysis', **Browning**.
9. 'Principle of Instrumental Analysis', **Skoog**.

### **E-Resources:-**



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1. <http://www.chemguide.co.uk/atoms/properties/gcse.html>
2. [http://en.wikipedia.org/wiki/Chemical\\_bond](http://en.wikipedia.org/wiki/Chemical_bond)
3. <http://www.sparknotes.com/chemistry/bonding/properties/section1.rhtml>
4. <http://hyperphysics.phy-astr.gsu.edu/hbase/chemical/bond2.html>
5. <http://www.chem1.com/acad/webtext/chembond/cb01.html>
6. [http://en.wikipedia.org/wiki/Nuclear\\_chemistry](http://en.wikipedia.org/wiki/Nuclear_chemistry)
7. [http://www.chem.duke.edu/~jds/cruise\\_chem/nuclear/nuclear.html](http://www.chem.duke.edu/~jds/cruise_chem/nuclear/nuclear.html)
8. <http://library.thinkquest.org/10429/low/nuclear/nuclear.htm>
9. [http://www.visionlearning.com/library/module\\_viewer.php?mid=59](http://www.visionlearning.com/library/module_viewer.php?mid=59)
10. [http://en.wikipedia.org/wiki/Chemical\\_thermodynamics](http://en.wikipedia.org/wiki/Chemical_thermodynamics)
11. <http://www.shodor.org/unchem/advanced/thermo/>
12. <http://www.chem.arizona.edu/~salzmanr/480a/480ants/chemther.html>
13. [http://en.wikipedia.org/wiki/Laws\\_of\\_thermodynamics](http://en.wikipedia.org/wiki/Laws_of_thermodynamics)



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### DEPARTMENT OF CHEMISTRY

COURSE: B.Sc.

SEMESTER: II

SUBJECT NAME: Chemistry Practical-II

SUBJECT CODE: BSCCHP201

Teaching & Evaluation Scheme:-

Teaching Scheme(hrs)			Evaluation Scheme								
Th	Pr	Total	Theory					Practical (Marks)			Total
			Sessional Exam		University Exam		Total	External	Internal	Total	
			Marks	Hrs	Marks	Hrs					
0	6	6	--	--	--	--	--	30	20	50	50

Course outline:-

Sr. No.	Course Contents
1	<b>Qualitative Analysis of Inorganic Salts (15 salts - 2 radicals)</b> Inorganic salts containing chlorides, bromides iodides, nitrates, nitrites, sulphates, sulphites, sulphides, carbonates phosphates, oxides, chromates, and dichromates as an anion.
2	<b>Inorganic Volumetric Analysis: (Standard Solutions should be given)</b> <ul style="list-style-type: none"><li>Estimation of the amount of <math>\text{Cu}^{2+}</math> in the given <math>\text{CuCl}_2 \cdot 2\text{H}_2\text{O}</math> solution using 0.01 M EDTA solution</li><li>Estimation of the amount of <math>\text{Ni}^{2+}</math> in the given <math>\text{NiSO}_4 \cdot 7\text{H}_2\text{O}</math> solution using 0.01 M EDTA solution</li><li>Estimation of the amount of <math>\text{Zn}^{2+}</math> in the given <math>\text{ZnCl}_2</math> solution using 0.01 M EDTA solution</li><li>Estimation of total, temporary &amp; permanent hardness of water.</li><li>Determination of acetic acid in commercial vinegar using 0.1 M NaOH</li></ul>
3	<b>Demonstrative practical:</b>





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| <ul style="list-style-type: none"><li>▪ Calibration of Glassware (Measuring Cylinder &amp; flasks)</li><li>▪ Crystallization of Inorganic compounds (3-4 compounds)</li><li>▪ Preparation of standard solutions (Primary &amp; Secondary)</li></ul> |
|---|