

**Part B**  
**Syllabus Prescribed for Three Year UG/PG Programme**  
**Programme: B.Sc. with Chemistry**

**Semester 4**

Code of the Course/Subject	Title of the Course/Subject	(Total Number of Periods)
CHE(4S)T	Chemistry 4S	84

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

1. Application of methods of synthesis of soaps and detergents
2. Commercial method for extraction of elements and acquaintance of transition series elements
3. Compare functional group chemistry through the study of methods of preparation, properties and chemical reactions with underlying mechanism.
4. Choose correct synthetic approach to prepare derivatives of industrially important molecules
5. Solve different numerical problem of varying difficulty associated with electrochemistry and photochemistry.
6. Apply the concepts of UV and IR spectroscopy for structure elucidation.

Unit	Content
Unit I	<p><b>A) Noble Gases-</b>Inertness of noble gases. Compounds of noble gases-only structure and bonding in XeF<sub>2</sub>, XeF<sub>4</sub>, XeF<sub>6</sub>, XeO<sub>3</sub>, and XeO.</p> <p><b>B) Polarisation-</b>Definition, polarising power, polarizability, effect of polarization on nature of bond. Fajan's rules of polarisation and its applications.</p> <p><b>B) General Principles of Metallurgy:</b> Definition of metallurgy, steps in metallurgy. Ore dressing by gravity separation, froth floatation and electromagnetic separation. Calcination, roasting, smelting and refining of metals. Meaning of terms hydrometallurgy and pyrometallurgy.</p> <p style="text-align: right;"><b>Periods: 14</b></p>
Unit II	<p><b>A) Inner transition elements:</b> Definition, Lanthanides and Actinides. Comparative study of Lanthanides with respect to following properties:(i) Electronic configuration (ii) Atomic and ionic radii lanthanide contraction-definition, cause and effect of lanthanide contraction (iii) Oxidation states (iv) Magnetic properties (v) Colour of salts (vi) Complex formation behaviour. Occurrence of lanthanides. Isolation of lanthanides by ion exchange method. Actinides- Electronic configuration and oxidation states. Comparison of lanthanides and actinides.</p> <p><b>B) Extraction of elements:</b> Principles involved in extraction of elements. Major methods of extraction of elements. Factors affecting choice of extraction method. Thermodynamics of reduction processes- Ellingham diagrams for oxides and importance of this diagram (only preliminary ideas).</p> <p style="text-align: right;"><b>Periods: 14</b></p>
Unit III	<p><b>A) Soaps and Detergents</b>  <b>Soaps:</b> -Introduction, Manufacture of soaps by i)Kettles process, ii) Hydrolyser process, Cleansing action of soap.  <b>Synthetic Detergents:</b> -Introduction, Synthetic detergent classification, i)Anionic detergent, ii) Cationic detergents, iii) Non-ionic detergents.            Synthetic detergent versus soaps, Soft versus Hard detergents.</p> <p><b>B) Reactive methylene compounds:</b> Malonic Ester: Synthesis from acetic acid, Synthetic applications- Synthesis of acetic acid, succinic acid, glutaric acid, crotonic acid and malonyl urea. Acetoacetic ester: Synthesis from ethyl acetate, Synthetic applications- Synthesis of acetic acid, propionic acid, isobutyric acid, succinic acid, glutaric acid, crotonic acid, acetyl acetone and 4-methyl uracil.</p> <p><b>C) Carbohydrates:</b> Constitution of glucose, cyclic structure, Pyranose and Furanose structure, Epimerization, conversion of glucose to fructose and vice-versa, Introduction to fructose, ribose, 2-deoxyribose, maltose, sucrose. (their structures only- determination not needed).</p>

	<b>Periods: 14</b>
Unit IV	<p><b>A) Aromatic nitro compounds:</b> Nitrobenzene: Synthesis from benzene, Reduction of nitrobenzene in acidic, neutral and alkaline medium.</p> <p><b>B) Amino Compounds:</b> Basicity and effect of substituents. Methods of preparation of aniline from nitrobenzene, Reactions: with acetyl and benzoyl chlorides, Br<sub>2</sub> (aq) and Br<sub>2</sub>(CS<sub>2</sub>), Carbylamine reaction, alkylation, Hoffmann's exhaustive methylation and its mechanism.</p> <p><b>C) Diazonium Salts:</b> Preparation benzene diazonium chloride, Synthetic applications- Preparation of benzene, phenol, halobenzene, nitrobenzene, benzonitrile, coupling with phenol and aniline.</p> <p><b>D) Amino acids and Proteins:</b> Classification, Strecker and Gabriel phthalimide synthesis, Zwitterion structure, Isoelectric point, peptide synthesis, Structure determination of polypeptides by end group analysis.</p> <p style="text-align: right;"><b>Periods: 14</b></p>
Unit V	<p><b>A) Electrochemistry -I:</b> Conductance of electrolyte solution. Specific, equivalent and molar conductance. Determination of conductance of electrolyte solution, variation of specific and equivalent conductance with dilution for strong electrolyte. Conductometric titrations. Applications of conductometric titration. Migration of ions under the influence of electric field. Transport number of ions. Determination of transport number by Hottorf's method and Moving boundary method. Kohlrausch's law of independent migration of ions. Determination of <math>\lambda^\infty</math> and degree of dissociation <math>\alpha</math> of a weak electrolyte. Determination of dissociation constant of weak electrolyte. Numerical.</p> <p><b>B) Electrochemistry-II</b> pH of a solution and pH scale. Determination of pH of solution using Hydrogen, Quinhydrone and Glass electrodes. Advantages and Disadvantages of these electrodes. pH metric titrations. Determination of pK<sub>a</sub> of a weak acid by pH metric titration. Potentiometric titration. Advantages of Potentiometric titrations. Study of following potentiometric titrations- (a) Acid-Base (b) Redox (c) Precipitation. Numerical.</p> <p style="text-align: right;"><b>Periods: 14</b></p>
Unit VI	<p><b>Photochemistry:</b> Photochemical and thermal reactions. Lambert's law (Statement and derivation). Beer's law (Statement and derivation). Reasons for deviations from Beer's law. Laws of photochemistry- Grotthus-Draper law, Stark-Einstein law. Quantum yield of photochemical reaction. Reasons for high and low quantum yields. Experimental determination of quantum yield. Photosensitized reactions. Kinetics of photochemical decomposition of HI. Fluorescence and Phosphorescence. Selection rule for electronic transitions. Internal conversion and Intersystem crossing. Explanation of Fluorescence and Phosphorescence on the basis of Jablonski Diagram. Chemiluminescence and Bioluminescence (with examples). Numerical.</p> <p style="text-align: right;"><b>Periods: 14</b></p>
<p><b>*SEM:</b></p> <p>A) Extraction of metals, synthesis of soaps and detergents.</p> <p>B) Applications of nitrogen-based compounds and groups as starting materials for commercial compounds</p> <p>C) Numerical associated with electrochemistry and photochemistry.</p>	
<p><b>COs:</b></p> <p>By the end of this module, the students will be able to:</p> <ol style="list-style-type: none"> <li>1. Create charts and posters for nitrogen-based compounds and groups</li> <li>2. Use of carbonyl compounds for starting material for different commercially important molecules</li> <li>3. Solve numerical problem associated with thermodynamics and colligative properties.</li> </ol>	
<b>**Activities:</b>	<p>Model creation, poster, chart preparation, memory maps, Class tests, assignments, project, survey, group discussion, industrial visit, or any other innovative pedagogical method.</p> <p>Any two activities be conducted from above. Class tests are compulsory. Equal weightage for each activity.</p>

## Course Material/Learning Resources

### Text books:

1. Text book of Inorganic Chemistry by K.N. Upadhyaya, Vikas Publishing House, Delhi.
2. A Text Book of Chemistry for first Semester of B.Sc. by AUCTA Association and DnyanPath Publication

### Reference Books:

1. Principles of Inorganic Chemistry by Puri, Sharma and Kalia- S. Naginchand & Co., Delhi.
2. Inorganic Chemistry by A.K. De, Wiley East Ltd.
3. Selected Topics in Inorganic Chemistry by Malik, Tuli and Madan, S. Chand & Co.
4. Concise Inorganic Chemistry by J.D. Lee, ELBS.
5. Inorganic Chemistry by J.E. Huheey- and Kettle, Harper & Row.
6. Advanced Inorganic Chemistry, Vol-I, Satya Prakash, Madan, Tuli, Basu.
7. Organic Chemistry Vol. I, II and III by Mukharjee, Singh and Kapoor- Wiley Eastern.
8. Organic Chemistry by S.K. Ghosh.
9. Reaction Mechanism in Organic Chemistry by S.M. Mukharjee and S.P. Singh.
10. Stereochemistry and mechanism through solved problems by P.S. Kalsi.
11. Organic Chemistry by TWG Solomons, 8th edition, John Wiley
12. Organic chemistry by R. K. Bansal
13. Physical Chemistry: Walter, J. Moore, 5th edn., New Delhi.
14. Physical Chemistry: G.M. Barrow, McGraw Hill, Indian Edn.
15. Principles of Physical Chemistry: Maron and Prutton.
16. Principles of Physical Chemistry: Puri, Sharma, and Pathania.
17. Physical Chemistry: P.W. Atkins, 6th Edn.
18. Physical Chemistry: Levine
19. Practical Organic Chemistry by F.G. Mann, B.C. Saunders, Orient Longman.
20. Comparative Practical Organic Chemistry (Qualitative Analysis) by V.K. Ahluwalia and Sunita Dhingra, Orient Longman.
21. Comprehensive Practical Organic Chemistry (Preparation and Qualitative Analysis) by V.K. Ahluwalia and Renu Agrawal, Orient Longman.
22. Practical Physical Chemistry: Palit and De.
23. Practical Physical Chemistry: Yadao.
24. Practical Physical Chemistry: Khosla.
25. Advanced Practical Inorganic Chemistry by Gurdeep Raj, Goel Publishing House, Meerut.

Weblink to Equivalent MOOC on SWAYAM if relevant:

Weblink to Equivalent Virtual Lab if relevant:

Any pertinent media (recorded lectures, YouTube, etc.) if relevant:

**Sant Gadge Baba Amravati University, Amravati**  
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**Semester 4**

<b>Code of the Course/Subject</b>	<b>Title of the Course/Subject (Laboratory/Practical/practicum/hands-on/Activity)</b>	<b>(No. of Periods/Week)</b>
<b>CHE(4S)PR</b>	<b>Chemistry 4S</b>	<b>Total 26 per Semester</b>

**COs:** At the end of Lab/Practical course, students will be able to -

1. prepare soap from available oil or fat and determine its different parameters.
2. extract different constituents of milk.
3. prepare glucose from cane sugar
4. use advanced instruments like pH-meter, potentiometer, conductometer, etc.
5. determine electrode potential of a metal.
6. determine pH of given soil sample.

**\* List of Practical/Laboratory Experiments/Activities etc.**

<b>Exercise-1 organic</b>	
1	To prepare glucose from cane sugar.
2	To determine the iodine value of the given Oil or Fat.
3	Determination of equivalent weight of an organic acid.
4	Determination of equivalent weight of an ester by saponification.
5	Preparation of soap from oil or fat.
6	Determination of properties of soaps (at least two samples) with respect to pH, Foam, interaction with oil, and hard water test.
7	Isolation of casein from milk.
8	Isolation of lactose from milk.
<b>Exercise II: Physical Chemistry Experiments</b>	
9	Determination of standard electrode potential of Cu/Cu <sup>+2</sup> or Zn/Zn <sup>+2</sup> electrodes potentiometrically.
10	To determine dissociation constant of weak acid by conductometry.
11	To determine dissociation constant of weak acid by potentiometry.
12	To determine dissociation constant of dibasic acid by pH-metry.
13	To determine solubility and solubility product of sparingly soluble salts conductometrically.
14	To study strong acid and strong base titration by pH-metry.
15	To determine pH of a soil sample by pH-meter.
16	To verify Beer's Lambert's law using KMnO <sub>4</sub> /K <sub>2</sub> Cr <sub>2</sub> O <sub>7</sub> .
17	To determine solubility of benzoic acid at different temperature and heat of solution.

**Note:**

**Distribution of Marks for Practical Examination**

**Time : 04 hours (One Day Examination)**

<b>Total Practical Marks 50, Duration of Exam 04 Hours</b>	
<b>Internal Practical Exam (25 Marks)</b>	<b>External Practical Exam* (25 Marks)</b>

Attendance, Students' Performance, Activity, Practical Record Book / Laboratory Manual/Journal Report : 20 Internal Viva/Assignment/Quiz/Test : 05	Experiment 1 Performance / Demonstration : 10 Experiment 2 Performance / Demonstration : 10 External Viva (by External and Internal Examiner: 05
<b>Total : 25</b>	<b>Total : 25</b>

\*Note: One practical from respective exercise