

Part A: Introduction			
Program: <b>Certificate Course</b>		Class: <b>B.Sc. I Year</b>	Year: <b>2022</b> Session: <b>2022-23</b>
1.	Course Code	CHEM-IT	
2.	Course Title	Inorganic and Physical Chemistry	
3.	Course Type	Theory	
4.	Pre-requisite (if any)	To Study this course our students must have had the subject chemistry in class +2 or equivalent	
5.	Course Learning Outcomes (CLO)	At the end of this course, the students will be able to learn the following aspects of Chemistry <ul style="list-style-type: none"> <li>• To learn basic concept of atomic structure and the periodic properties of elements</li> <li>• To understand chemical bonding in ionic and covalent compounds</li> <li>• To study group trends for <i>s</i> and <i>p</i>-block elements in the periodic table</li> <li>• learn properties and bonding of compounds of the noble gases</li> <li>• Understand the metallurgical extraction of metals.</li> <li>• Basic concepts of Mathematics and Computer for Chemists.</li> <li>• Basics and mechanism of chemical kinetics and catalysis.</li> </ul>	
6.	Credit Value	Theory: <b>4</b>	
7.	Total Marks	<b>Max. Marks: 50</b>	<b>Min. Passing Marks: 17</b>

Part B: Content of the Course		
Total No. of Lecturers: <b>90</b>		
Unit	Topics	No. of Lectures
I	<b>Atomic structure :</b> Bohr's theory and its limitation, General idea of de-Broglie matter-waves, Heisenberg uncertainty principle, Schrödinger wave equation, significance of $\Psi$ and $\Psi^2$ , radial & angular wave functions and probability distribution curves, quantum numbers, Atomicorbital and shapes of <i>s</i> , <i>p</i> , <i>d</i> orbitals, Aufbau and Pauli exclusion principles, Hund's Multiplicity rule, electronic configuration of the elements. <b>Periodic properties:</b> Detailed discussion of the following periodic properties of the elements, with reference to <i>s</i> - and <i>p</i> - block. Trends in periodic table and applications in predicting and explaining the chemical behavior. a. Atomic and ionic radii, b. Ionization enthalpy, c. Electron gain enthalpy, d. Electronegativity, Pauling's, Mulliken's, Allred Rochow's scales. Effective nuclear charge, shielding or screening effect, Slater rules, variation of effective nuclear charge in periodic table.	15
II	<b>Chemical bonding- I: Ionic bond:</b> Ionic Solids - Ionic structures, radius ratio & co-ordination number, limitation of radius ratio rule, lattice defects, semiconductors, lattice energy Born-Haber cycle, Solvation energy and solubility of ionic solids, polarizing power & polarizability of ions, Fajan's rule, Ionic character in covalent compounds: Bond moment and dipole	15

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	moment, Percentage ionic character from dipole moment and electronegativity difference, Metallic bond-free electron and band theories.	
III	<b>Chemical bonding-II: Covalent bond:</b> Valence bond theory and its limitations, Concept of hybridization, equivalent and non-equivalent hybrid orbitals. Valence shell electron pair repulsion theory (VSEPR), shapes of the following simple molecules and ions containing lone pairs and bond pairs of electrons: $\text{H}_2\text{O}$ , $\text{NH}_3$ , $\text{PCl}_3$ , $\text{H}_3\text{O}^+$ , $\text{SF}_4$ , $\text{ClF}_3$ , $\text{ICl}_2^-$ , $\text{XeF}_2$ , $\text{XeF}_4$ , $\text{XeF}_6$ , $\text{XeOF}_2$ , $\text{XeOF}_4$ , Molecular orbital theory. Bond order and bond strength, Molecular orbital diagrams of diatomic and simple heteroatomic molecules $\text{N}_2$ , $\text{O}_2$ , $\text{F}_2$ , $\text{CO}$ , $\text{NO}$ .	15
IV	<b>Chemistry of s- &amp; p- block elements:</b> General concepts on group relationships and gradation properties, Comparative study, salient features of hydrides, solvation & complexation tendencies, General concepts on group relationships and gradation properties. Halides, hydrides, oxides and oxyacids of Boron, Aluminum, Nitrogen and Phosphorus. Boranes, borazines, fullerenes, graphene and silicates, interhalogens and pseudohalogens. Chemical properties of the noble gases. <b>Metallurgical extraction of Fe, Al and Cu :</b> Principle of extraction of metal, The occurrence, extraction & isolation of Fe, Al, and Cu	15
V	<b>Mathematical concepts for chemist:</b> Basic Mathematical Concepts: Logarithmic relations, curve sketching, linear graphs, Properties of straight line, slope and intercept, Functions, Differentiation of functions, maxima and minima; integrals; ordinary differential equations; vectors and matrices; determinants; Permutation and combination and probability theory, Significant figures and their applications. <b>Computer for chemists:</b> Introduction to computer, introduction to operating systems like DOS, Windows, Linux <b>Use of computer programs:</b> Running up standard programs & packages such as MS –Word, MS- Excel, Power Point. Execution of linear regression x-y plot, use of software for drawing structures and molecular formulae	15
VI	<b>Chemical kinetics :</b> Rate of reaction, Factors influencing rate of reaction, rate law, rate constant, Order and molecularity of reactions, rate determining step, Zero, First and Second order reactions, Rate and Rate Law, methods of determining order of reaction, Chain reactions. Temperature dependence of reaction rate, Arrhenius theory, Physical significance of Activation energy, collision theory, demerits of collision theory, non-mathematical concept of transition state theory. <b>Catalysis:</b> Homogeneous and Heterogeneous Catalysis, types of catalyst, characteristics of catalyst, Enzyme catalyzed reactions, Micellar catalyzed reactions, Industrial applications of catalysis.	15
<b>Keywords:</b> Atomic structure, Periodic properties, ionic bonding, covalent bonding, diagonal relationship, metallurgy, computer, memory, chemical kinetics, catalysis		

Part C : Learning Resources	
Text Books, Reference Books, Other Resources	
<b>Suggested Readings :</b> <ol style="list-style-type: none"> <li>1. Lee, J. D. Concise Inorganic Chemistry, Wiley, 5th Edition, 2008.</li> <li>2. Douglas, B.; McDaniel, D. and Alexander J. Concepts &amp; Models of Inorganic Chemistry, Wiley, 3rd Edition, 2006</li> <li>3. Atkins, P.W. &amp; Paula, J. Physical Chemistry, 10th Ed., Oxford University Press, 2014.</li> <li>4. Puri, B. R., Sharma, L. R. and Kalia, K. C., Principles of Inorganic Chemistry, Milestone Publishers/ Vishal Publishing Co.; 33rd Edition 2016</li> <li>5. Madan, R. D. Modern Inorganic Chemistry, S Chand Publishing, 1987.</li> </ol>	

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7. Rodger, G.E. Inorganic and Solid State Chemistry, Cengage Learning India Edition, 2002.
8. Pfennig, B. W. Principles of Inorganic Chemistry, Wiley, 2015.
9. Housecroft, C. E. and Sharpe, A. G. Inorganic Chemistry, Pearson, 4th Edition, 2012
10. Rajaramana, V., Computers for beginners, PHI Learning Private Publishers, New Delhi, 2021
11. Tebbutt, P., Basic mathematics for Chemists, 2nd Edn. ELBS, 1999
12. Khera, H.C., Gurtu, J.N., Singh, J., Chemistry for B.Sc. Ist Year, Pragati Prakashan
13. Bariyar, A. & Goyal, S., B.Sc. Chemistry Combined (in Hindi), Krishna Educational Publishers Year 2019
14. Puri, B.R., Pathania, M.S., Sharma, L.R., Principles of Physical Chemistry, Vishal Publishing Company 2020
15. Gurtu, J.N., Gurtu, A., Advanced Physical Chemistry, Pragati Prakashan, Meerut, Edition IV, 2017
16. Atkins' Physical Chemistry, 10th Edition, Oxford University Press, 2014
17. Barrow, G.M., Physical Chemistry Tata McGraw-Hill, 2007
18. Ball, D.W., Physical Chemistry, Thomson Press, India, 2007
19. Castellan, G.W., Physical Chemistry, 4th Edition, Narosa, 2004
20. Mortimer, R.G., Physical Chemistry, 3rd Edition, Elsevier, Noida, UP, 2009
21. Levine, I.N., Physical Chemistry, 6th Edition, Tata McGraw-Hill, 2010
22. Metz, C.R., 2000 Solved Problems in Chemistry, Sahaun Series, 2006
23. Engel, T. and Reid, P., Physical Chemistry, 3rd Edition, Prentice Hall, 2012
24. Negi, A.S. & Anand, S.C., A Text Book of Physical Chemistry, 3rd Edition, New Age International Publication
25. Bajpai, D.N., Advanced Physical Chemistry, S. Chand, 2019
26. Bahal & Tuli, Essential of Physical Chemistry, 2020

#### E- Learning Resources:

1. <http://heecontent.upsdc.gov.in/Home.aspx>
2. <https://nptel.ac.in/courses/104/106/104106096/>
3. <http://heecontent.upsdc.gov.in/Home.aspx>
4. <https://nptel.ac.in/courses/104/106/104106096/>
5. <https://www2.chemistry.msu.edu/faculty/reusch/VirtTxtJml/introl.htm>
6. <https://nptel.ac.in/courses/104/103/104103071/#>

**Fundamental Chemistry related topics on SWAYAM platform and E-pathshala**

#### Part D: Assessment and Evaluation

Maximum Marks: 50

### DECLARATION

This is to certify that the syllabus is framed by the Central Board of Studies (Chemistry) as per the guidelines (TOR) of the Department of Higher Education, Raipur Chhattisgarh.

1. Dr. Alka Shrivastav,  
Assistant Professor,  
Govt. E.V.P.G. College, Korba
2. Smt. Priyanka Tiwari,  
Assistant Professor,  
Govt. J.P. Verma P.G. College, Bilaspur (C.G.)

- Chairman

*Alka*  
2.6.22

- Member

*Priyanka*

3. Mr. Vijay Kumar Lahare,  
Assistant Professor,  
Govt. Lahiri P.G. College Chirimiri(C.G.)
4. Dr. Rajmani Patel,  
Assistant Professor,  
Hemchand Yadav University, Durg (C.G.)
5. Dr. A.K. Singh,  
Professor,  
Govt. V.Y.T. P.G. College Durg (C.G.)
6. Dr. P.K. Singh,  
Assistant Professor,  
Govt. T.C.L. P.G. College Janjgir(C.G.)
7. Dr. P.K. Agnihotri,  
Professor,  
Govt. Yuganandam Chhattisgarh College Raipur(C.G.)
8. Dr. B.D. Diwan,  
Professor,  
Govt. M.M.R. P.G. College Champa(C.G.)
9. Dr. Sandhya Patre,  
Assistant Professor,  
Sant Shiromani Guru Ravidas Govt. College Sargaon,  
Mungeli(C.G.)
10. Mrs. Mousami Lahare,  
Assistant Professor,  
Govt. G.N.A. P.G. College Bhatapara, (C.G.)
11. Dr. Alka Shukla,  
Assistant Professor,  
Mohan Lal Jain(Mohan Bhaiya) Govt. College Khursipar,  
Bhilai(C.G.)
12. Dr. Arti Gupta,  
Professor, Govt. Dr. W.W.P. Girl's P.G. College Durg (C.G.)
13. Dr. Deepti Tikariha,  
Assistant Professor, APSGMNS Govt. P.G. College  
Kawardha(C.G.)
14. Dr. Seema Negi,  
Assistant Professor, Govt. J.M.P. College, Takhatpur (C.G.)
15. Dr. Vikesh Kumar Jha,  
Assistant Professor, Govt. R.R.M. P.G. College Surajpur  
(C.G.)
16. Dr. Ashish Tiwari,  
Assistant Professor,  
Dr. Bhimrao Ambedkar Govt. College Pamgarh(C.G.)
17. Mr. Laxmi Chand Manwani,  
Assistant Professor,  
Government Vivekand PG College Manendragarh(C.G.)

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Part A: Introduction			
Program: <b>Certificate Course</b>		Class: <b>B.Sc. I Year</b>	Year: <b>2022</b> Session: <b>2022-23</b>
1.	Course Code	CHEM-2T	
2.	Course Title	Organic and Physical Chemistry	
3.	Course Type	Theory	
4.	Pre-requisite (if any)	To Study this course our students must have had the subject chemistry in class +2 or equivalent	
5.	Course Learning Outcomes (CLO)	<p>At the end of this course, the students will be able to learn the following aspects of Chemistry</p> <ul style="list-style-type: none"> <li>• Understand the fundamentals of physical organic chemistry</li> <li>• Stereochemistry of carbon compounds</li> <li>• Chemistry of Alkenes and Alkynes</li> <li>• Chemistry of Alicyclic and aromatic Hydrocarbons</li> <li>• Understanding kinetic model of gases and its properties, Behavior of real gases, its derivation from ideal behavior, equation of state, isotherms and Law of corresponding states and molecular velocities.</li> <li>• Fundamental concepts of liquid state and colloids &amp; surface chemistry.</li> <li>• Solids, Lattice parameters – its calculation, application of symmetry, solid characteristics of simple salts.</li> </ul>	
6.	Credit Value	Theory: 4	
7.	Total Marks	Max. Marks: 50	Min. Passing Marks: 17

Part B: Content of the Course		
Total No. of Lecturers: 90		
Unit	Topics	No. of Lectures
I	<b>Basics of organic chemistry:</b> Influence of hybridization on bond properties (as applicable to ethane, ethene, and ethyne). Application of inductive effect (a) Basicity of amines (b) Acidity of carboxylic acids (c) Stability of carbocations. Resonance or Mesomeric effect, application to (a) acidity of phenol, and (b) acidity of carboxylic acids. Hyper conjugation and its application to stability of carbocations, Free radicals and alkenes. Reactive intermediates: carbanions, carbenes, Nitrene, Basic concept of S <sub>N</sub> 1, S <sub>N</sub> 2, E1, E2, E1cb reactions and Neighboring group Participation (NGP). Electrophiles and Nucleophiles; Nucleophilicity and basicity.	15
II	<b>Introduction to stereochemistry:</b> Optical Isomerism: Optical Activity, Specific Rotation, Chirality/Asymmetry, Enantiomers, Molecules with two or more chiral-centres, Diastereoisomers, meso compounds, Relative and absolute configuration: Fischer, Newman and Sawhorse Projection formulae and their interconversions; Erythrose and threose, D/L, d/l system of nomenclature, Cahn-Ingold-Prelog system of nomenclature (C.I.P rules),	15

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	R/S nomenclature. Geometrical isomerism: cis-trans, syn-anti and E/Z notations. Stereospecific and stereoselective synthesis. Asymmetric synthesis.	
III	<b>Acyclic hydrocarbons:</b> Alkenes - Preparation of alkenes. Properties: Addition of hydrogen - heat of hydrogenation and stability of alkenes. Addition of halogen and its mechanism. Addition of HX, Markonikov's rule, addition of H <sub>2</sub> O, (Oxymercuration-reduction and hydroboration -oxidation), HOX, H <sub>2</sub> SO <sub>4</sub> with mechanism and addition of HBr in the presence of peroxide (anti - Markonikov's addition). Dienes - Types of dienes, reactions of conjugated dienes - 1,2 and 1,4 addition of HBr to 1,3 - butadiene and Diel's - Alder reaction. Alkynes: Preparation by dehydrohalogenation of dihalides, dehalogenation of tetrahalides, Properties; Acidity of acetylenic hydrogen (formation of Metal acetylides). Preparation of higher acetylenes, Metal ammonia reductions, Physical properties. Chemical reactivity - electrophilic addition of X <sub>2</sub> , HX, H <sub>2</sub> O (Tautomerism), Oxidation with KMnO <sub>4</sub> , OsO <sub>4</sub> , reduction and Polymerization, reaction of acetylene.	15
IV	<b>Alicyclic hydrocarbons (cycloalkanes):</b> Nomenclature, Preparation by Freunds method, Wislicenus method. Properties - reactivity of cyclopropane and cyclobutane by comparing with alkanes, Stability of cycloalkanes - Baeyer's strain theory, Sachse and Mohr predictions and Pitzer's strain theory. Conformational structures of cyclobutane, cyclopentane, cyclohexane. Confirmers: in substituted cyclohexane, decalins. <b>Aromatic hydrocarbons:</b> Aromaticity: Hückel's rule, aromatic character of arenes, cyclic carbocations/ carbanions and heterocyclic compounds with suitable examples. Electrophilic aromatic substitution: halogenation, nitration, sulphonation and Friedel-Craft's alkylation/acylation with their mechanism. Directive effects of the groups.	15
V	<b>Gaseous state chemistry:</b> Kinetic molecular model of a gas: postulates and derivation of the kinetic gas equation; collision frequency; collision diameter; mean free path; Maxwell distribution and its use in evaluating molecular velocities (average, root mean square and most probable) and average kinetic energy, law of equipartition of energy, degrees of freedom and molecular basis of heat capacities. Joule Thomson effect, Liquefaction of Gases. <b>Behavior of real gases:</b> Deviations from ideal gas behavior, compressibility factor (Z), and its variation with pressure and temperature for different gases. Causes of deviation from ideal behavior. Vander Waals equation of state, its derivation and application in explaining real gas behavior, calculation of Boyle temperature. Isotherms of real gases and their comparison with Vander Waals isotherms, continuity of states, critical state, relation between critical constants and Vander Waals constants, law of corresponding states.	15
VI	<b>Liquid state chemistry:</b> Intermolecular forces, magnitude of intermolecular force, structure of liquids, Properties of liquids, viscosity and surface tension. <b>Colloids and surface chemistry:</b> Classification, Optical, Kinetic and Electrical Properties of colloids, Coagulation, Hardy Schulze law, flocculation value, Protection, Gold number, Emulsion, micelles and types, Gel, Syneresis and thixotropy, Application of colloids. Physical adsorption, chemisorption, adsorption isotherms (Langmuir and Freundlich). Qualitative	15

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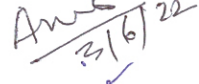


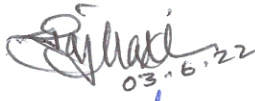

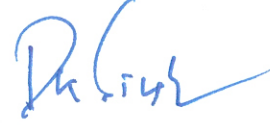
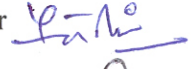
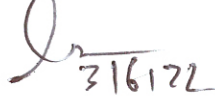
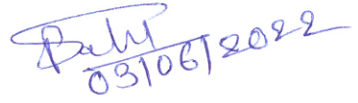
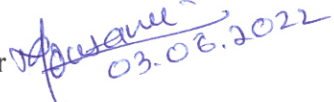
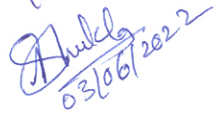


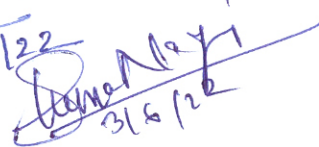

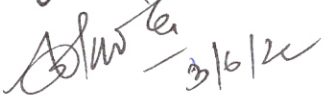

	<p>discussion of BET.</p> <p><b>Solid state chemistry:</b> Nature of the solid state, law of constancy of interfacial angles, law of rational indices, Miller indices, elementary ideas of symmetry, symmetry elements and symmetry operations, seven crystal systems and fourteen Bravais lattices; X-ray diffraction, Bragg's law, a simple account of rotating crystal method and powder pattern method. Crystal defects.</p>	
<b>Keywords:</b> Electronic effect, Reactive intermediates, Stereochemistry, Alkenes, Alkynes, Cycloalkanes, Aromaticity, Gas, Liquid, Colloidal state and Solid		
<b>Part C: Learning Resource</b>		
Text Books, Reference Books, Other Resources		
<p><b>Suggested Readings :</b></p> <ol style="list-style-type: none"> <li>1. Morrison, R. N. &amp; Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd.(Pearson Education).</li> <li>2. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).</li> <li>3. Finar, I. L. Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).</li> <li>4. Eliel, E. L. &amp; Wilen, S. H. Stereochemistry of Organic Compounds, Wiley: London, 1994.</li> <li>5. Kalsi, P. S. Stereochemistry Conformation and Mechanism, New Age International, 2005.</li> <li>6. McMurry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013.</li> <li>7. Bruice, P. Y. Organic Chemistry, 2nd Edition, Prentice-Hall, International Edition (1998).</li> <li>8. Atkins' Physical Chemistry, 10th Edition, Oxford University Press, 2014</li> <li>9. Barrow, G.M., Physical Chemistry Tata McGraw-Hill, 2007</li> <li>10. Ball, D.W., Physical Chemistry, Thomson Press, India, 2007</li> <li>11. Castellan, G.W., Physical Chemistry, 4th Edition, Narosa, 2004</li> <li>12. Mortimer, R.G., Physical Chemistry, 3rd Edition, Elsevier, Noida, UP, 2009</li> <li>13. Levine, I.N., Physical Chemistry, 6th Edition, Tata McGraw-Hill, 2010</li> <li>14. Metz, C.R., 2000 Solved Problems in Chemistry, Sahaun Series, 2006</li> <li>15. Negi, A.S. &amp; Anand, S.C., A Text Book of Physical Chemistry, 3rd Edition, New Age International Publication</li> <li>16. Bajpai, D.N., Advanced Physical Chemistry, S. Chand, 2019</li> <li>17. Bahal &amp; Tuli, Essential of Physical Chemistry, 2020</li> </ol> <p style="text-align: center;"><b>E- Learning Resources:</b></p> <ol style="list-style-type: none"> <li>1. <a href="http://heecontent.upsdc.gov.in/Home.aspx">http://heecontent.upsdc.gov.in/Home.aspx</a></li> <li>2. <a href="https://nptel.ac.in/courses/104/106/104106096/">https://nptel.ac.in/courses/104/106/104106096/</a></li> <li>3. <a href="http://heecontent.upsdc.gov.in/Home.aspx">http://heecontent.upsdc.gov.in/Home.aspx</a></li> <li>4. <a href="https://nptel.ac.in/courses/104/106/104106096/">https://nptel.ac.in/courses/104/106/104106096/</a></li> <li>5. <a href="https://www2.chemistry.msu.edu/faculty/reusch/VirtTxtJml/intro1.htm">https://www2.chemistry.msu.edu/faculty/reusch/VirtTxtJml/intro1.htm</a></li> <li>6. <a href="https://nptel.ac.in/courses/104/103/104103071/#">https://nptel.ac.in/courses/104/103/104103071/#</a></li> </ol> <p><b>Fundamental Chemistry related topics on SWAYAM platform and E-pathshala</b></p>		
<b>Part D: Assessment and Evaluation</b>		
Maximum Marks: 50		

## **DECLARATION**

This is to certify that the syllabus is framed by the Central Board of Studies (Chemistry) as per the

  
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guidelines (TOR) of the Department of Higher Education, Raipur Chhattisgarh.

- |                                                                                                                       |            |                                                                                                     |
|-----------------------------------------------------------------------------------------------------------------------|------------|-----------------------------------------------------------------------------------------------------|
| 1. Dr. Alka Shrivastav,<br>Assistant Professor,<br>Govt. E.V.P.G. College, Korba                                      | - Chairman | <br>3/6/22       |
| 2. Smt. Priyanka Tiwari,<br>Assistant Professor,<br>Govt. J.P. Verma P.G. College, Bilaspur                           | - Member   | <br>3/6/22       |
| 3. Mr. Vijay Kumar Lahare,<br>Assistant Professor,<br>Govt. Lahiri P.G. College Chirimiri(C.G.)                       | - Member   |                  |
| 4. Dr. Rajmani Patel,<br>Assistant Professor,<br>Hemchand Yadav University, Durg                                      | - Member   | <br>03.06.22     |
| 5. Dr. A.K. Singh,<br>Professor,<br>Govt. V.Y.T. P.G. College Durg                                                    | - Member   |                  |
| 6. Dr. P.K. Singh,<br>Assistant Professor,<br>Govt. T.C.L. P.G. College Janjgir(C.G.)                                 | - Member   |                  |
| 7. DR. P.K. Agnihotri,<br>Professor,<br>Govt. Yuganandam Chhattisgarh College Raipur(C.G.)                            | - Member   |                  |
| 8. Dr. B.D. Diwan,<br>Professor,<br>Govt. M.M.R. P.G. College Champa(C.G.)                                            | - Member   | <br>3/6/22       |
| 9. Dr. Sandhya Patre,<br>Assistant Professor,<br>Sant Shiromani Guru Ravidas Govt. College Sargaon,<br>Mungeli(C.G.)  | - Member   | <br>03/06/2022  |
| 10. Mrs. Mousami Lahare,<br>Assistant Professor,<br>Govt. G.N.A. P.G. College                                         | - Member   | <br>03.06.2022 |
| 11. Dr. Alka Shukla,<br>Assistant Professor,<br>Mohan Lal Jain(Mohan Bhaiya) Govt. College Khursipar,<br>Bhilai(C.G.) | - Member   | <br>03/06/2022 |
| 12. Dr. Arti Gupta,<br>Professor, Govt. Dr. W.W.P. Girls P.G. College Durg (C.G.)                                     | - Member   | <br>3/6/22     |
| 13. Dr. Deepti Tikariha,<br>Assistant Professor, APSGMNS Govt. P.G. College<br>Kawardha(C.G.)                         | - Member   | <br>3/6/22     |
| 14. Dr. Seema Negi,<br>Assistant Professor, Govt. J.M.P. College, Takhatpur (C.G.)                                    | - Member   | <br>3/6/22     |
| 15. Dr. Vikesh Kumar Jha,<br>Assistant Professor, Govt. R.R.M. P.G. College Surajpur<br>(C.G.)                        | - Member   |                |
| 16. Dr. Ashish Tiwari,<br>Assistant Professor,<br>Dr. Bhimrao Ambedkar Govt. College Pamgarh(C.G.)                    | - Member   | <br>3/6/22     |
| 17. Mr. Laxmi Chand Manwani,<br>Assistant Professor,<br>Government Vivekanand PG College Manendragarh(C.G.)           | - Member   |                |



Part A: Introduction			
Program: <b>Certificate Course</b>		Class: <b>B.Sc. I Year</b>	Year: <b>2022</b>
		Session: <b>2022-23</b>	
1.	Course Code	CHEM-1P	
2.	Course Title	Lab. 1	
3.	Course Type	Practical	
4.	Pre-requisite (if any)	To Study this course our students must have had the subject chemistry in class +2 or equivalent	
5.	Course Learning Outcomes (CLO)	At the end of this course, the students will be able to learn the following aspects of Chemistry <ul style="list-style-type: none"> <li>• To analyse the given mixture for anions (acid radicals) and cations (basic radicals).</li> <li>• Titrations</li> <li>• Qualitative Analysis</li> <li>• Surface tension measurements.</li> <li>• Viscosity measurement</li> <li>• Chemical Kinetics</li> </ul>	
6.	Credit Value	Practical: <b>2</b>	
7.	Total Marks	<b>Max. Marks: 50</b>	<b>Min Passing Marks: 17</b>

Part B: Content of the Course		
Total No. of Lecturers: <b>30</b>		
LABATORY COURSE		No. of Lectures
Tentative list of Practical	<b>A. Inorganic chemistry</b> Semi-micro qualitative analysis (using H <sub>2</sub> S or other methods) of mixtures - not more than four ionic species (two anions and two cations, excluding interfering, insoluble salts) out of the following: <b>Cations :</b> NH <sub>4</sub> <sup>+</sup> , Pb <sup>2+</sup> , Bi <sup>3+</sup> , Cu <sup>2+</sup> , Cd <sup>2+</sup> , Fe <sup>3+</sup> , Al <sup>3+</sup> , Co <sup>2+</sup> , Ni <sup>2+</sup> , Mn <sup>2+</sup> , Zn <sup>2+</sup> , Ba <sup>2+</sup> , Sr <sup>2+</sup> , Ca <sup>2+</sup> , Na <sup>+</sup> <b>Anions :</b> CO <sub>3</sub> <sup>2-</sup> , S <sup>2-</sup> , SO <sub>3</sub> <sup>2-</sup> , NO <sub>2</sub> <sup>-</sup> , CH <sub>3</sub> COO <sup>-</sup> , Cl <sup>-</sup> , Br <sup>-</sup> , I <sup>-</sup> , NO <sub>3</sub> <sup>-</sup> , SO <sub>4</sub> <sup>2-</sup> (Spot tests may be carried out wherever feasible)	10
	<b>B. Acid-Base Titrations</b> <ul style="list-style-type: none"> <li>• Standardization of sodium hydroxide by oxalic acid solution.</li> <li>• Determination of strength of HCl solution using sodium hydroxide as intermediate.</li> <li>• Estimation of carbonate and hydroxide present together in mixture.</li> <li>• Estimation of carbonate and bicarbonate present together in a mixture.</li> <li>• Estimation of free alkali present in different soaps/detergents</li> </ul>	

Aws  
3/6

	<b>C. Redox Titrations</b> <ul style="list-style-type: none"> <li>• Standardization of <math>\text{KMnO}_4</math> by oxalic acid solution.</li> <li>• Estimation of <math>\text{Fe(II)}</math> using standardized <math>\text{KMnO}_4</math> solution.</li> <li>• Estimation of oxalic acid and sodium oxalate in a given mixture.</li> <li>• Estimation of <math>\text{Fe(II)}</math> with <math>\text{K}_2\text{Cr}_2\text{O}_7</math> using internal (diphenylamine, anthranilic acid) and external indicator.</li> </ul>	
	<b>Organic chemistry</b> <ol style="list-style-type: none"> <li>1. Demonstration of laboratory Glassware's and Equipments.</li> <li>2. Calibration of the thermometer. <math>80^\circ - 82^\circ</math> (Naphthalene), <math>113.5^\circ - 114^\circ</math> (Acetanilide), <math>132.5^\circ - 133^\circ</math> (Urea), <math>100^\circ</math> (Distilled Water).</li> <li>3. Purification of organic compounds by crystallization using different solvents. Phthalic acid from hot water (using fluted filter paper and stemless funnel). Acetanilide from boiling water. Naphthalene from ethanol. Benzoic acid from water.</li> <li>4. Determination of the melting points of organic compounds. Naphthalene <math>80^\circ - 82^\circ</math>, Benzoic acid <math>121.5^\circ - 122^\circ</math>, Urea <math>132.5^\circ - 133^\circ</math> Succinic acid <math>184.5^\circ - 185^\circ</math>, Cinnamic acid <math>132.5^\circ - 133^\circ</math>, Salicylic acid <math>157.5^\circ - 158^\circ</math>, Acetanilide <math>113.5^\circ - 114^\circ</math>, m-Dinitrobenzene <math>90^\circ</math>, p-Dichlorobenzene <math>52^\circ</math>, Aspirin <math>135^\circ</math>.</li> <li>5. Effect of impurities on the melting point – mixed melting point of two unknown organic compounds. Urea–Cinnamic acid mixture of various compositions (1:4, 1:1, 4:1).</li> <li>6. Determination of boiling point of liquid compounds. (boiling point lower than and more than <math>100^\circ\text{C}</math> by distillation and capillary method). Ethanol <math>78^\circ</math>, Cyclohexane <math>81.4^\circ</math>, Toluene <math>110.6^\circ</math>, Benzene <math>80^\circ</math>.               <ol style="list-style-type: none"> <li>i. Distillation (Demonstration) Simple distillation of ethanol-water mixture using water condenser. Distillation of nitrobenzene and aniline using air condenser.</li> <li>ii. Sublimation Camphor, Naphthalene, Phthalic acid and Succinic acid.</li> <li>iii. Decolorisation and crystallization using charcoal. Decolorisation of brown sugar with animal charcoal using gravity filtrations crystallization and decolorisation of impure naphthalene (100 g of naphthalene mixed with 0.3 g of Congo red using 1 g of decolorizing carbon) from ethanol.</li> </ol> </li> <li>7. Qualitative Analysis Detection of elements (N, S and halogens) and functional groups (Phenolic, Carboxylic, Carbonyl, Esters, Carbohydrates, Amines, Amides, Nitro and Anilide) in simple organic compounds.</li> <li>8. Preparation and characterization of biodiesel from vegetable oil.</li> <li>9. Preparation of soap.</li> </ol>	10
	<b>Physical chemistry</b> <ol style="list-style-type: none"> <li>1. Surface tension measurements. Determine the surface tension by (i) drop number (ii) drop weight method. • Surface tension composition curve for a binary liquid mixture.</li> <li>2. Viscosity measurement using Ostwald's viscometer. Determination of viscosity of aqueous solutions of (i) sugar (ii) ethanol at room temperature. Study of the variation of viscosity of sucrose solution with the concentration of solute. Viscosity Composition curve for a binary liquid mixture.</li> </ol>	10

Acad  
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	<p>3. Chemical Kinetics To determine the specific rate of hydrolysis of methyl/ethyl acetate catalysed by hydrogen ions at room temperature. To study the effect of acid strength on the hydrolysis of an ester. To compare the strengths of HCl &amp; H<sub>2</sub>SO<sub>4</sub> by studying the kinetics of hydrolysis of ethyl acetate.</p> <p>4. Colloids To prepare colloidal solution of silver nanoparticles (reduction method) and other metal nanoparticles using capping agents.</p>	
<p><b>Keywords:</b> Semi-micro qualitative analysis, Qualitative analysis, Titrations, Chemical Kinetics, Colloids, Viscosity, Surface tension, Decolorization and crystallization, Distillation, Sublimation, Soap, biodiesel.</p>		

### Part C: Learning Resource

Text Books, Reference Books, Other Resources

#### Suggested Readings :

1. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009.
2. Ahluwalia, V. K., Dhingra, S. and Gulati, A. College practical Chemistry, University Press.
3. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009).
4. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry, 5th Ed., Pearson (2012)
5. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011).
6. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. Experiments in Physical Chemistry 8th Ed.; McGraw-Hill: New York (2003).
7. Halpern, A. M. & McBane, G. C. Experimental Physical Chemistry 3rd Ed.; W.H. Freeman & Co.: New York (2003).
- Sidhwani, I.T., Saini, G., Chowdhury, S., Garg, D., Malovika, Garg, N. Wealth from waste: 8.A green method to produce biodiesel from waste cooking oil and generation of useful products from waste further generated "A Social Awareness Project", Delhi University Journal of Undergraduate Research and Innovation.
9. Carpenter, William Lant; Leask, Henry (1895). A treatise on the manufacture of soap and candles, lubricants and glycerin. Free ebook at Google Books.

#### E- Learning Resources:

1. <http://heecontent.upsdc.gov.in/Home.aspx>
2. <https://nptel.ac.in/courses/104/106/104106096/>
3. <http://heecontent.upsdc.gov.in/Home.aspx>
4. <https://nptel.ac.in/courses/104/106/104106096/>
5. <https://www2.chemistry.msu.edu/faculty/reusch/VirtTxtJml/intro1.htm>
6. <https://nptel.ac.in/courses/104/103/104103071/#>

Fundamental Chemistry related topics on SWAYAM platform and E-pathshala

### Part D: Assessment and Evaluation

Maximum Marks: 50

Ans  
2/6

<b>PRACTICAL EXAMINATION</b> <b>B. Sc. – I</b>	<b>05 Hrs.</b> <b>M.M. 50</b>
<p>Three experiments are to be performed</p> <p>1. Inorganic Mixture Analysis, four radicals two basic &amp; two acid (excluding insoluble, Interfering &amp; combination of acid radicals)  <b>OR</b>  Two Titrations (Acid Bases, Redox and Iodo/Iodimetry/Complexometric titration)</p> <p>2. Detection of functional group in the given organic compound and determine its MPt/BPt.  <b>OR</b>  Crystallization of any one compound as given in the prospectus along with the determination of mixed MPt.  <b>OR</b>  Decolorisation of brown sugar along with sublimation of camphor/ Naphthlene.</p> <p>3. Any one physical experiment that can be completed in two hours including calculations.</p> <p>4. Viva</p> <p>5. Sessionals</p> <p>In case of Ex-Students two marks will be added to each of the experiments</p>	<p><b>12 marks</b></p> <p><b>8 marks</b></p> <p><b>14 marks</b></p> <p><b>10 marks</b>  <b>06 marks</b></p>

### **DECLARATION**

This is to certify that the syllabus is framed by the Central Board of Studies (Chemistry) as per the guidelines (TOR) of the Department of Higher Education, Raipur Chhattisgarh.

- |                                                                                                 |                                                                                                  |
|-------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|
| 1. Dr. Alka Shrivastav,<br>Assistant Professor,<br>Govt. E.V.P.G. College, Korba                | - Chairman  |
| 2. Smt. Priyanka Tiwari,<br>Assistant Professor,<br>Govt. J.P. Verma P.G. College, Bilaspur     | - Member    |
| 3. Mr. Vijay Kumar Lahare,<br>Assistant Professor,<br>Govt. Lahiri P.G. College Chirimiri(C.G.) | - Member    |
| 4. Dr. Rajmani Patel,<br>Assistant Professor,<br>Hemchand Yadav University, Durg                | - Member    |
| 5. Dr. A.K. Singh,<br>Professor,<br>Govt. V.Y.T. P.G. College Durg                              | - Member    |
| 6. Dr. P.K. Singh,<br>Assistant Professor,<br>Govt. T.C.L. P.G. College Janjgir(C.G.)           | - Member    |
| 7. DR. P.K. Agnihotri,<br>Professor,<br>Govt. Yuganandam Chhattisgarh College Raipur(C.G.)      | - Member    |
| 8. Dr. B.D. Diwan,                                                                              | - Member    |



- Professor,  
Govt. M.M.R. P.G. College Champa(C.G.)
9. Dr. Sandhya Patre,  
Assistant Professor,  
Sant Shiromani Guru Ravidas Govt. College Sargaon,  
Mungeli(C.G.)
10. Mrs. Mousami Lahare,  
Assistant Professor,  
Govt. G.N.A. P.G. College
11. Dr. Alka Shukla,  
Assistant Professor,  
Mohan Lal Jain(Mohan Bhaiya) Govt. College Khursipar,  
Bhilai(C.G.)
12. Dr. Arti Gupta,  
Professor, Govt. Dr. W.W.P. Girls P.G. College Durg (C.G.)
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Assistant Professor,  
Government Vivekand PG College Manedragarh(C.G.)

- Member Pali  
03/06/2022
- Member Mousami  
03.06.2022
- Member Shukla  
3/06/2022
- Member Arti  
3/6/22
- Member Deepti  
03/6/22
- Member Seema Negi  
3/6/22
- Member Vikesh  
3/6/22
- Member Ashish  
3/6/22
- Member Laxmi  
3/6/22