

### Scheme of B. Sc. Chemistry

Year	Course Code	Subject Name	Theory/ Practical	Total Credit	Total Marks	
					Max	Min
First year	CHEM-1T	Inorganic and Physical Chemistry	Theory	4	50	17
	CHEM-2T	Organic and Physical Chemistry	Theory	4	50	17
	CHEM-1P	LAB 1 : General Chemistry-1	Practical	2	50	17
Second year	CHEM-3T	Inorganic and Physical Chemistry	Theory	4	50	17
	CHEM-4T	Organic and Physical Chemistry	Theory	4	50	17
	CHEM-2P	LAB 2 : General Chemistry-2	Practical	2	50	17
Third year	CHEM-5T	Inorganic and Physical Chemistry	Theory	4	50	17
	CHEM-6T	Organic and Physical Chemistry	Theory	4	50	17
	CHEM-3P	LAB 3 : General Chemistry-3	Practical	2	50	17

**Note:** There shall be four extra credits in each year for internship/apprenticeship. The certificate of extra credits for this would be provided by the concern university and it is not mandatory.



Part A: Introduction			
Program: <b>Diploma Course</b>		Class: <b>B.Sc. II Year</b>	Year: <b>2023</b> Session: <b>2023-24</b>
1.	Course Code	CHEM-3T	
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 B.Sc. I Year/ Certificate Course 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>• Understand the general characteristics of transition elements.</li> <li>• Explain the chemistry of Coordination Compounds.</li> <li>• Analyze water and coal.</li> <li>• Basic concepts of thermodynamics.</li> <li>• Basic concepts of Chemical and Ionic Equilibrium</li> </ul>	
6.	Credit Value	Theory: 4	
7.	Total Marks	<b>Max. Marks: 50</b>	<b>Min. Passing Marks: 17</b>

Part B: Content of the Course		
Total No. of Lecturers: 90		
Unit	Topics	No. of Lectures
I	<p><b>Chemistry of transition series elements:</b> Transition elements- Position in periodic table, electronic configuration, General characteristics, viz., atomic and ionic radii, variable oxidation states, ability to form complexes, formation of colored ions, magnetic moment <math>\mu_{so}</math> (spin only) and <math>\mu_{eff}</math> and catalytic behaviour. General comparative treatment of 4d and 5d elements with their 3d analogues with respect to ionic radii, oxidation states and magnetic properties.</p> <p><b>Chemistry of lanthanides and actinides:</b> Electronic structure, oxidation states and ionic radii and lanthanide and actinide contraction, complex formation. Chemistry of separation of Np, Pu, and Am from Uranium. Later actinides and later lanthanides.</p>	15
II	<p><b>Concepts of acids and bases:</b> Arrhenius theory, Bronsted–Lowry concepts, conjugate acids and bases, relative strength of acids and bases, Lewis concepts of acids and bases,</p> <p><b>Hard and soft acids and bases (HSAB):</b> Classification of acids and bases as hard and soft. Pearson's HSAB concept, acid-base strength, hardness and softness. Symbiosis, Applications of HSAB principle.</p> <p><b>Non- aqueous solvents:</b> Physical properties of a solvent, types of solvents and their general characteristics, reaction in non-aqueous solvents with reference to liquid ammonia, liquid sulphur dioxide, sulphuric acid, liquid HF, ionic liquids.</p>	15
III	<p><b>Coordination chemistry:</b> Werner's theory and its experimental verification, IUPAC nomenclature of coordination compounds, Chelates, polynuclear complexes, Isomerism in coordination compound, stereochemistry of complexes 4 &amp; 6 coordination compounds.</p>	15

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	<b>Valence bond theory (inner and outer orbital complexes) :</b> Limitations of valence bond theory, electroneutrality principle and back bonding. Crystal field theory, Crystal field splitting and stabilization energy, measurement of $10 Dq$ ( $\Delta_o$ ), CFSE in weak and strong fields, pairing energies, factors affecting the magnitude of $10 Dq$ ( $\Delta_o$ , $\Delta_t$ ). Octahedral vs. tetrahedral coordination.	
IV	<b>Chemistry of water analysis:</b> Water quality parameters and its determination – Acidity and alkalinity of water, Total dissolved solid (TDS), Hardness of water, Chloride, Phosphate, Fluoride, Dissolved Oxygen, Chemical oxygen demand, Biological oxygen demand. <b>Coal analysis:</b> Classification of coal, Proximate and Ultimate analysis of coal, Carbonization of coal, Coal gas-composition and uses.	15
V	<b>Thermodynamics:</b> Basics of Thermodynamics, brief review of zeroth and first law of thermodynamics. Concept of heat capacity, Relation between heat capacities, Joule-Thomson expansion, inversion temperature of gases, Joule Thomson coefficient of ideal and real gases. <b>Second law of thermodynamics:</b> Spontaneous process, second law, Statement of Carnot cycle and efficiency of heat engine, Carnot's theorem, thermodynamic state of temperature. Concept of entropy: Entropy change in a reversible and irreversible process, entropy change in isothermal reversible expansion of an ideal gas, entropy change in isothermal mixing of ideal gases, physical significance of entropy, Molecular and statistical interpretation of entropy, Gibbs and Helmholtz free energy, variation of $G$ and $A$ with pressure, volume, temperature, Gibbs-Helmholtz equation, Maxwell relations, Nernst heat theorem, Elementary idea of Third law of Thermodynamics, concept of residual entropy, calculation of absolute entropy of molecule.	15
VI	<b>Chemical equilibrium:</b> Criteria of thermodynamic equilibrium, degree of advancement of reaction, chemical equilibria in ideal gases. Concept of Fugacity, Thermodynamic derivation of relation between Gibbs free energy of reaction and reaction quotient. Concept of activity, activity coefficient and ionic strength, Equilibrium constants and their quantitative dependence on temperature, pressure and concentration. Thermodynamic derivation of relations between the various equilibrium constants $K_p$ and $K_c$ . Le-Chatelier's principle (quantitative treatment). Equilibrium between ideal gas and a pure condensed phase. <b>Ionic equilibrium:</b> Ionization of weak acids and bases, pH scale, common ion effect; dissociation constants of mono protonic acids (exact treatment). Salt hydrolysis- calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions; derivation of Henderson equation and its applications. Solubility, solubility product of sparingly soluble salts and its applications.	15
<b>Keywords:</b> Transition Elements, Lanthanides and Actinides, Coordination Compounds, Redox potential, Water Analysis, Coal Analysis, Non-aqueous solvents, Carnot's theorem, Fugacity, Salt hydrolysis .		

<b>Part C : Learning Resources</b>	
Text Books, Reference Books, Other Resources	
<b>Suggested Readings :</b> <ol style="list-style-type: none"> <li>1. Basic Inorganic Chemistry, Cotton F.A, G. Wilkinson and P. L. Gaus, Wiley,</li> <li>2. Concise Inorganic Chemistry, J. D. Lee, ELBS,</li> <li>3. Concepts of Models of Inorganic Chemistry, B. Douglas, D. Mc Daniel and J. Alexander, John Wiley.</li> <li>4. Inorganic Chemistry, D. E. Shriver, P. W. Atkins and C. H. Langford, Oxford.</li> </ol>	

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5. Inorganic Chemistry, W. W. Porterfield, Addison – Wiley.
6. Inorganic Chemistry, A. G. Sharp, ELBS.
7. Inorganic Chemistry, G. L. Miessler and D. A. Tarr, Prentice Hall.
8. Advanced Inorganic Chemistry, Satya Prakash.
9. Advanced Inorganic Chemistry, Agrawal and Agrawal
10. Advanced Inorganic Chemistry, B.R. Puri, L. R. Sharma, S. Chand Publication
11. Inorganic Chemistry, R. D. Madan, S. Chand Publication.
12. Aadhunik Akarbanic Rasayan, A. K. Shrivastav & P. C. Jain, Goel Pub
13. Uchchattar Akarbanic Rasayan, Satya Prakash & G. D. Tuli, Shyamal Prakashan
14. Uchchattar Akarbanic Rasayan, B. R. Puri & L. R. Sharma
15. Selected topic in Inorganic Chemistry by R. D. Madan, M. Malik & G. R. Tuli, S. Chand Publication.
16. Environmental Chemistry, A. K. De, New Age International Publishers
17. Physical Chemistry, G.M. Barrow, International Student Edition, McGraw Hill.
18. University General Chemistry, C.N.R. Rao, Macmillan.
19. Physical Chemistry, R.A. Alberty, Willey Eastern.
20. The Elements of Physical Chemistry, Willey Eastern.
21. Physical Chemistry through problems, S.K. Dogra, Willey Eastern.
22. Physical Chemistry, B.D. Khosla.
23. Physical Chemistry, B.R. Puri and L. R. Sharma.
24. Physical Chemistry, R.L. Kapoor, Vol. I-IV.

#### 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

### 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,  
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Govt. J.P. Verma P.G. College, Bilaspur (C.G.)
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Hemchand Yadav University, Durg (C.G.)
5. Dr. A.K. Singh,  
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Govt. V.Y.T. P.G. College Durg (C.G.)

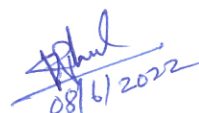
- Chairman



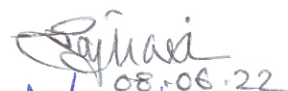
- Member



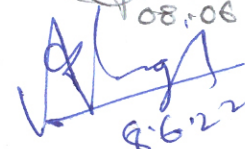
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6. Dr. P.K. Singh,  
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7. Dr. P.K. Agnihotri,  
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8. Dr. B.D. Diwan,  
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Assistant Professor, Govt. J.M.P. College, Takhatpur (C.G.)
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*P.K. Singh*

*P.K. Agnihotri*

*B.D. Diwan*

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08-06-2022

Part A: Introduction			
Program: <b>Diploma Course</b>		Class: <b>B.Sc. II Year</b>	Year: <b>2023</b>
		Session: <b>2023-24</b>	
1.	Course Code	CHEM-4T	
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 B.Sc. I Year/ Certificate Course 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>• Reactions of the alcohols and phenols.</li> <li>• Reactivity of carbonyl compounds</li> <li>• Carboxylic acid and its derivatives</li> <li>• Organic compounds containing nitrogen</li> <li>• Phase Equilibrium</li> <li>• Electrochemistry</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	<p><b>Chemistry of organic halides: Alkyl halides:</b> Methods of preparation, nucleophilic substitution reactions – <math>S_N1</math>, <math>S_N2</math> and <math>S_Ni</math> mechanisms with stereochemical aspects and effect of solvent etc.; nucleophilic substitution, elimination reactions.</p> <p><b>Aryl halides:</b> Preparation, including preparation from diazonium salts, Nucleophilic Aromatic Substitution; <math>S_NAr</math>, Benzyne mechanism. Relative reactivity of alkyl, allyl/benzyl, vinyl and aryl halides towards nucleophilic substitution reactions.</p> <p><b>Alcohols:</b> Dihydric alcohols – methods of formation, chemical reactions of vicinal glycols, oxidative cleavage <math>[Pb(OAc)_4</math> and <math>HIO_4]</math> and pinacol-pinacolone rearrangement.</p> <p>Trihydric alcohols - Nomenclature, methods of formation, chemical reactions of glycerol.</p> <p><b>Phenols:</b> Structure and bonding in phenols, physical properties and acidic character, Comparative acidic strength of alcohols and phenols, acylation and carboxylation.</p> <p>Mechanism of Claisen rearrangement, Gatterman synthesis and Reimer-Tiemann reaction.</p>	15
II	<p><b>Aldehydes and ketones :</b> Nomenclature, structure and reactivity of carbonyl group. General methods of preparation of aldehydes and ketones. Mechanism of nucleophilic addition to carbonyl groups: Benzoin and Aldol condensation. Wittig reaction, Mannich reaction and Benzil- Benzilic rearrangement. Use of acetal as protecting group, Oxidation of aldehydes, Baeyer-Villiger oxidation of Ketones, Clemmensen reduction, Wolf-Kishner reaction, <math>LiAlH_4</math> and <math>NaBH_4</math> reduction. Halogenation of enolizable</p>	15

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	ketones, An introduction to $\alpha$ , $\beta$ -unsaturated aldehydes and Ketones. (Michael Addition reaction)	
III	<p><b>Carboxylic acids</b> : Preparation, Structure and bonding, Physical and chemical properties including, acidity of carboxylic acids, effects of substituents on acid strength, Reduction of carboxylic groups, Mechanism of decarboxylation.</p> <p><b>Dicarboxylic acids</b>: Methods of formation and effect of heat and dehydrating agents, Hydroxyacids.</p> <p><b>Carboxylic acid derivatives</b> : Structure of acid chlorides, esters, amides and acid anhydrides, Relative stability of acyl derivatives. Physical properties, inter-conversion of acid derivatives by nucleophilic acyl substitution. Reaction with Grignard reagents, Organo-copper and Organo-lithium compound.</p>	15
IV	<p><b>Organic compounds of nitrogen</b> : Preparation of nitroalkanes and nitroarenes. Chemical reactions of nitroalkanes. Mechanism of nucleophilic substitution in nitroarenes and their reduction in acidic, neutral and alkaline medium. Reactivity, structure and nomenclature of amines, physical properties. Separation of mixture of primary, secondary and tertiary amines. Structural features affecting basicity of amines. Preparation of alkyl and aryl amines (reduction of nitro compounds and nitriles), reductive amination of aldehydic and ketonic compounds. Gabriel-Phthalimide reaction, Hofmann- Bromamide reaction, Reactions of amines, electrophilic aromatic substitution of aryl amines, Reaction of amines with nitrous acid. Synthetic transformations of aryl diazonium salts, Azo coupling.</p>	15
V	<p><b>Phase equilibrium</b> : Phase rule, phase, component and degree of freedom, derivation of Gibbs phase rule, Clausius-Clayperon equation and its applications to solid-liquid, liquid-vapor and solid-vapor, limitations of phase rule, applications of phase rule to one component system: water system and sulphur system. Application of phase rule to two component system: Pb-Ag system, desilverization of lead, eutectic point. Zn-Mg system, ferric chloride-water system, sodium chloride-water system, congruent and incongruent melting point and freezing mixture</p>	15
VI	<p><b>Electrochemistry</b> : Ostwald dilution law and its limitations, Elementary ideas of Debye-Huckel-Onsager's theory for strong electrolytes, relaxation and electrophoretic effects. Migration of ions: Transport number, Determination by Hittorf method and moving boundary method. Electrochemical cell—reversible and irreversible cells, conventional representation of electrochemical cells, Types of electrodes-metal-metal ion, metal-salt ion, gas, amalgam, redox electrodes. Electrode potential, Standard Redox potential, electrochemical series and its applications, derivation of Nernst equation and expression of Nernst equation for different electrodes. Calculation of <math>\Delta G</math>, and equilibrium constant. Conductometric, pH metric and potentiometric titration.</p>	15
<p><b>Keywords:</b> Alkyl and aryl halides, Alcohols and Phenols, Carboxylic Acid and its derivatives, Carbonyl Compounds, Organic Compounds of Nitrogen, Phase Equilibrium, Phase Rule, Phase, Component and Degree of Freedom, Gibbs phase rule, Clausius-Clayperon Equation, One Component System, Two Component System, Electrochemistry, Ostwald dilution law, Debye-Huckel-Onsager's theory, Electrochemical Cells, Electrode Potential, Nernst Equation, Conductometric Titration, pH Metric Titration, Potentiometric Titration.</p>		

### Part C : Learning Resources

Text Books, Reference Books, Other Resources

#### Suggested Readings :

1. Organic Chemistry, Morrison R.N. and Boyd R.N., Dorling Kindersley (India) Pvt. Ltd.(Pearson Education).

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2. Organic Chemistry, Finar I.L. Dorling Kindersley (India) Pvt. Ltd. (Pearson Education) Vol I.
3. Organic Chemistry, Paula Y. Bruice, 2nd Edition, Prentice-Hall, International Edition (1998).
4. Organic Chemistry, Mukherjee S.M., Singh S.P. and Kapoor R.P., Wiley Easterns (New Age) Vol I, II, III.
8. Fundamentals of Organic Chemistry, Solomons T. W. G., John Wiley & Sons.
6. Organic Chemistry Carey, F.A, McGraw Hill.
7. A Guide Book of Reaction Mechanism by Peter Sykes.
9. Organic Chemistry, J. Clayden, N. Greeves, S. Warren
10. Modern Methods of Organic Synthesis, William Carruthers, Iain Coldham
11. Fundamental of Organic Chemistry, Jahn E. Mc Murry
12. Organic Chemistry Principal and Mechanism, Joel Karty
13. Reaction, rearrangements and reagents, S. N. Sanyal
14. Physical Chemistry, Puri and Sharma.
15. Bhautik Rasayan, Puri, Sharma and Pathaniya, Vishal Publishing Company.
16. P. Atkins & Julio De Paula, Physical Chemistry Oxford university Press
17. R. G. Mortimer , Physical Chemistry, 3rd ed. Elsevier
18. G. W. Castalen, Physical Chemistry, 4th Ed. Narosa.

Suggested online links:

1. <https://www2.chemistry.msu.edu/faculty/reusch/virtTxtJml/intro1.htm>
2. <https://nptel.ac.in/courses/104/103/104103071/#>








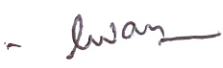
**Fundamental Chemistry related topics on SWAYAM platform and E-pathshala**

#### 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,<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 (C.G.) | - 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 (C.G.)            | - Member   | <br>08.06.22 |
| 5. Dr. A.K. Singh,<br>Professor,<br>Govt. V.Y.T. P.G. College Durg (C.G.)                          | - 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   |              |



9. Dr. Sandhya Patre,  
Assistant Professor,  
Sant Shiromani Guru Ravidas Govt. College Sargaon,  
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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,  
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Dr. Bhimrao Ambedkar Govt. College Pamgarh(C.G.)
17. Mr. Laxmi Chand Manwani,  
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18. Dr. K. Indira  
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*Salu*  
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- Member

*Hosaneel*

- Member

*Shukla*

- Member

*Deepa*  
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- Member

*Shukla*

- Member

*Seema Negi*  
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*VSN*  
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- Member

*Shukla*  
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- Member

*Saran*  
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- Member

*Indira*  
08-06-2022

Part A: Introduction			
Program: <b>Diploma Course</b>		Class: <b>B.Sc. II Year</b>	Year: <b>2023</b>
		Session: <b>2023-24</b>	
1.	Course Code	CHEM-2P	
2.	Course Title	Lab. 2 : General Chemistry-2	
3.	Course Type	Practical	
4.	Pre-requisite (if any)	To Study this course our students must have had the subject chemistry in class B.Sc. I Year/ Certificate Course or equivalent.	
5.	Course Learning Outcomes (CLO)	By the end of this course students will learn the following aspects of Laboratory exercises in Chemistry : <ul style="list-style-type: none"> <li>To analyze the given mixture for anions (acid radicals) and cations (basic radicals).</li> <li>Titration</li> <li>Qualitative Analysis</li> <li>Transition Temperature.</li> <li>Thermochemistry.</li> <li>Water Analysis.</li> <li>Phase Equilibrium</li> </ul>	
6.	Credit Value	Practical: 2	
7.	Total Marks	Max. Marks: 50	Min Passing Marks: 17

Part B: Content of the Course		
Total No. of Lecturers: 30		
LABORATORY COURSE		No. of Lectures
Tentative list of practical	<b>Inorganic chemistry</b> : Qualitative semimicro analysis of mixtures containing 5 radicals. Emphasis should be given to the understanding of the chemistry of different reactions. The following radicals are suggested: $\text{CO}_3^{2-}$ , $\text{NO}_2^-$ , $\text{S}^{2-}$ , $\text{SO}_3^{2-}$ , $\text{S}_2\text{O}_3^{2-}$ , $\text{CH}_3\text{COO}^-$ , $\text{F}^-$ , $\text{Cl}^-$ , $\text{Br}^-$ , $\text{I}^-$ , $\text{NO}_3^-$ , $\text{BO}_3^{3-}$ , $\text{C}_2\text{O}_4^{2-}$ , $\text{PO}_4^{3-}$ , $\text{NH}_4^+$ , $\text{K}^+$ , $\text{Pb}^{2+}$ , $\text{Cu}^{2+}$ , $\text{Cd}^{2+}$ , $\text{Bi}^{3+}$ , $\text{Sn}^{2+}$ , $\text{Sb}^{3+}$ , $\text{Fe}^{3+}$ , $\text{Al}^{3+}$ , $\text{Cr}^{3+}$ , $\text{Zn}^{2+}$ , $\text{Mn}^{2+}$ , $\text{Co}^{2+}$ , $\text{Ni}^{2+}$ , $\text{Ba}^{2+}$ , $\text{Sr}^{2+}$ , $\text{Ca}^{2+}$ , $\text{Mg}^{2+}$ . Mixtures should preferably contain one interfering anion, or insoluble component ( $\text{BaSO}_4$ , $\text{SrSO}_4$ , $\text{PbSO}_4$ , $\text{CaF}_2$ or $\text{Al}_2\text{O}_3$ ) or combination of anions e.g. $\text{CO}_3^{2-}$ and $\text{SO}_3^{2-}$ , $\text{NO}_2^-$ and $\text{NO}_3^-$ , $\text{Cl}^-$ , $\text{Br}^-$ , and $\text{I}^-$ .	10
	<b>Volumetric analysis</b> <ol style="list-style-type: none"> <li>Determination of acetic acid in commercial vinegar using NaOH.</li> <li>Determination of alkali content-antacid tablet using HCl.</li> <li>Estimation of calcium content in chalk as calcium oxalate by permanganometry.</li> <li>Estimation of hardness of water by EDTA.</li> <li>Estimation of ferrous &amp; ferric by dichromate method.</li> <li>Estimation of copper using thiosulphate.</li> </ol> <b>Chromatographic separations</b> Paper chromatographic separation of following metal ions: a) Ni (II) and Co (II) b) Fe (III) and Al (III) Paper chromatographic separation of mixture of dyes <b>Water Analysis</b> <ol style="list-style-type: none"> <li>Determine chemical oxygen demand (COD) of given Water sample.</li> <li>Determine Dissolved oxygen (DO) of given Water Sample.</li> </ol> <b>Organic chemistry</b>	10

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	<ol style="list-style-type: none"> <li>1. Detection of elements (X, N, S).</li> <li>2. Qualitative analysis of unknown organic compounds containing simple functional groups (alcohols, carboxylic acids, phenols, nitro, amine, amide, and carbonyl compounds, carbohydrates)</li> </ol> <p>Preparation of Organic Compounds: (i) m-dinitrobenzene, (ii) Acetanilide, (iii) Bromo/Nitro-acetanilide, (iv) Oxidation of primary alcohols-Benzoin acid from benzylalcohol, (v) azo dye.</p>	
	<p><b>Physical chemistry</b></p> <p><b>Transition Temperature</b></p> <p>Determination of the transition temperature of the given substance by thermometric/ dilatometric method (e.g. <math>\text{MnCl}_2 \cdot 4\text{H}_2\text{O}</math>/ <math>\text{SrBr}_2 \cdot 2\text{H}_2\text{O}</math>).</p> <p><b>Thermochemistry</b></p> <ol style="list-style-type: none"> <li>1. Determination of heat capacity of a calorimeter for different volumes using change of enthalpy data of a known system (method of back calculation of heat capacity of calorimeter from known enthalpy of solution or enthalpy of neutralization).</li> <li>2. Determination of heat capacity of the calorimeter and enthalpy of neutralization of hydrochloric acid with sodium hydroxide.</li> <li>3. To determine the solubility of benzoic acid at different temperature and to determine <math>\Delta H</math> of the dissolution process.</li> <li>4. To determine the enthalpy of neutralization of a weak acid/ weak base versus strong base/ strong acid and determine the enthalpy of ionization of the weak acid/ weak base.</li> <li>5. To determine the enthalpy of solution of solid calcium chloride and calculate the lattice energy of calcium chloride from its enthalpy data using Born Haber cycle.</li> </ol> <p><b>Phase Equilibrium</b></p> <ol style="list-style-type: none"> <li>6. To study the effect of a solute (e.g. NaCl, Succinic acid) on the critical solution temperature of two partially miscible liquids (e.g. phenol-water system) and to determine the concentration of that solute in the given phenol-water system.</li> <li>7. To construct the phase diagram of two component system (e.g. diphenylamine– benzophenone) by cooling curve method.</li> <li>8. Distribution of acetic/ benzoic acid between water and cyclohexane.</li> <li>9. Study the equilibrium of at least one of the following reactions by the distribution method: (i) <math>\text{I}_2(\text{aq}) + \text{I}^- \rightarrow \text{I}_3(\text{aq})^{2+}</math> (ii) <math>\text{Cu}^{2+}(\text{aq}) + n\text{NH}_3 \rightarrow \text{Cu}(\text{NH}_3)_n</math></li> </ol> <p><b>Molecular Weight Determination</b></p> <ol style="list-style-type: none"> <li>10. Determination of molecular weight by Rast Camphor and Landsburger method.</li> </ol>	10
<p><b>Keywords:</b> Qualitative semimicro analysis. Paper chromatographic Water Analysis. Transition Temperature Thermochemistry Molecular Weight.</p>		

### Part C: Learning Resource

#### 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).

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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).
8. 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

PRACTICAL EXAMINATION B. Sc. – II	05 Hrs. M.M. 50
<b>Three Experiments are to be performed.</b> <b>1. Inorganic – Qualitative semimicro analysis of mixtures (5 radicals) including interfering/insoluble radicals.</b>  <p style="text-align: center;"><b>OR</b></p> <b>One experiment from synthesis and analysis by preparing the standard solution.</b> <p style="text-align: center;"><b>OR</b></p> <ul style="list-style-type: none"> <li>• Determine chemical oxygen demand (COD) of given Water sample .</li> <li>• Determine Dissolved oxygen (DO) of given Water Sample.</li> </ul>	12 marks
<b>2. Organic (a) Identification of the given organic compound &amp; determine its M.Pt./B.Pt.</b>	6 marks
<b>(b) Determination of R<sub>f</sub> value and identification of metal ions/organic compounds by paper chromatography.</b>	6 marks
<b>3. Any one physical experiment that can be completed in two hours including calculations.</b>	12 marks
<b>4. Viva</b>	10 marks
<b>5. Sessional</b>	04 marks
<b>In case of Ex-Students one marks will be added to each of the experiment.</b>	

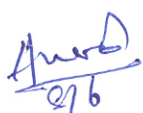

### DECLARATION

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.

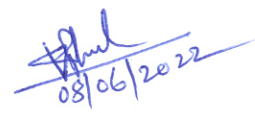



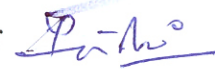

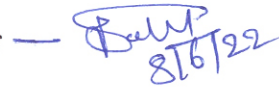

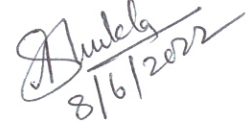


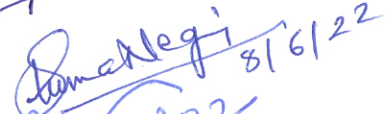

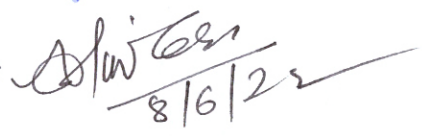
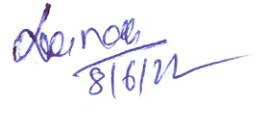
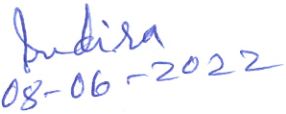

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2. Smt. Priyanka Tiwari,

- Chairman

- Member



- |   |          |   |
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