

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: Certificate Course	Class: B.Sc. I Year	Year: 2022	Session: 2022-23
1. Course Code	CHEM-1T		
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)	<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"> To learn basic concept of atomic structure and the periodic properties of elements To understand chemical bonding in ionic and covalent compounds To study group trends for <i>s</i> and <i>p</i>-block elements in the periodic table Learn properties and bonding of compounds of the noble gases Understand the metallurgical extraction of metals. Basic concepts of Mathematics and Computer for Chemists. Basics and mechanism of chemical kinetics and catalysis. 		
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	<p>Atomic structure : Bohr's theory and its limitation, General idea of de-Broglie matter-waves, Heisenberg uncertainty principle, Schrödinger wave equation, significance of Ψ and Ψ^2, radial & angular wave functions and probability distribution curves, quantum numbers, Atomic orbital 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.</p> <p>Periodic properties: 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.</p> <ol style="list-style-type: none"> Atomic and ionic radii, Ionization enthalpy, Electron gain enthalpy, Electronegativity, Pauling's, Mulliken's, Allred Rochow's scales. <p>Effective nuclear charge, shielding or screening effect, Slater rules, variation of effective nuclear charge in periodic table.</p>	15
II	<p>Chemical bonding- I: Ionic bond: 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</p>	15

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	moment, Percentage ionic character from dipole moment and electronegativity difference, Metallic bond-free electron and band theories.	
III	Chemical bonding-II: Covalent bond: 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: H_2O , NH_3 , PCl_3 , H_3O^+ , SF_4 , ClF_3 , ICl_2^- , XeF_2 , XeF_4 , XeF_6 , $XeOF_2$, $XeOF_4$, Molecular orbital theory. Bond order and bond strength, Molecular orbital diagrams of diatomic and simple heteroatomic molecules N_2 , O_2 , F_2 , CO , NO .	15
IV	Chemistry of s- & p- block elements: 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. Metallurgical extraction of Fe, Al and Cu : Principle of extraction of metal, The occurrence, extraction & isolation of Fe, Al, and Cu	15
V	Mathematical concepts for chemist: 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. Computer for chemists: Introduction to computer, introduction to operating systems like DOS, Windows, Linux Use of computer programs: 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	Chemical kinetics : 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. Catalysis: Homogeneous and Heterogeneous Catalysis, types of catalyst, characteristics of catalyst, Enzyme catalyzed reactions, Micellar catalyzed reactions, Industrial applications of catalysis.	15
Keywords: 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

Suggested Readings :

1. Lee, J. D. Concise Inorganic Chemistry, Wiley, 5th Edition, 2008.
2. Douglas, B.; McDaniel, D. and Alexander J. Concepts & Models of Inorganic
3. Chemistry, Wiley, 3rd Edition, 2006
4. Atkins, P.W. & Paula, J. Physical Chemistry, 10th Ed., Oxford University Press, 2014.
5. Puri, B. R., Sharma, L. R. and Kalia, K. C., Principles of Inorganic Chemistry, Milestone Publishers/ Vishal Publishing Co.; 33rd Edition 2016
6. Madan, R. D. Modern Inorganic Chemistry, S Chand Publishing, 1987.

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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. Rajaramma, 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. 1st 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/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,
Assistant Professor,
Govt. J.P. Verma P.G. College, Bilaspur (C.G.)

- Chairman


- Member


3. Mr. Vijay Kumar Lahare,
Assistant Professor,
Govt. Lahiri P.G. College Chirimiri(C.G.) - Member *Shahul*

4. Dr. Rajmani Patel,
Assistant Professor,
Hemchand Yadav University, Durg (C.G.) - Member *Rajmani 03-6-22*

5. Dr. A.K. Singh,
Professor,
Govt. V.Y.T. P.G. College Durg (C.G.) - Member *AK Singh*

6. Dr. P.K. Singh,
Assistant Professor,
Govt. T.C.L. P.G. College Janjgir(C.G.) - Member *PK Singh*

7. Dr. P.K. Agnihotri,
Professor,
Govt. Yukanandam Chhattisgarh College Raipur(C.G.) - Member *Yanki*

8. Dr. B.D. Diwan,
Professor,
Govt. M.M.R. P.G. College Champa(C.G.) - Member *Diwan*

9. Dr. Sandhya Patre,
Assistant Professor,
Sant Shiromani Guru Ravidas Govt. College Sargaon,
Mungeli(C.G.) - Member *Sandhya Patre*

10. Mrs. Mousami Lahare,
Assistant Professor,
Govt. G.N.A. P.G. College Bhatapara, (C.G.) - Member *Mousami Lahare*

11. Dr. Alka Shukla,
Assistant Professor,
Mohan Lal Jain(Mohan Bhaiya) Govt. College Khursipar,
Bhilai(C.G.) - Member *Alka Shukla 03/06/2022*

12. Dr. Arti Gupta,
Professor, Govt. Dr. W.W.P. Girl's P.G. College Durg (C.G.) - Member *Arti Gupta*

13. Dr. Deepti Tikariha,
Assistant Professor, APSGMNS Govt. P.G. College
Kawardha(C.G.) - Member *Deepti Tikariha*

14. Dr. Seema Negi,
Assistant Professor, Govt. J.M.P. College, Takhatpur (C.G.) - Member *Seema Negi*

15. Dr. Vikesh Kumar Jha,
Assistant Professor, Govt. R.R.M. P.G. College Surajpur
(C.G.) - Member *Vikesh Kumar Jha*

16. Dr. Ashish Tiwari,
Assistant Professor,
Dr. Bhimrao Ambedkar Govt. College Pamgarh(C.G.) - Member *Ashish Tiwari*

17. Mr. Laxmi Chand Manwani,
Assistant Professor,
Government Vivekanand PG College Manendragarh(C.G.) - Member *Laxmi Chand Manwani*

Part A: Introduction				
Program: Certificate Course	Class: B.Sc. I Year	Year: 2022	Session: 2022-23	
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"> Understand the fundamentals of physical organic chemistry Stereochemistry of carbon compounds Chemistry of Alkenes and Alkynes Chemistry of Alicyclic and aromatic Hydrocarbons 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. Fundamental concepts of liquid state and colloids & surface chemistry. Solids, Lattice parameters – its calculation, application of symmetry, solid characteristics of simple salts. 			
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	Basics of organic chemistry: 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 _N 1, S _N 2, E1, E2, E1cb reactions and Neighboring group Participation (NGP). Electrophiles and Nucleophiles; Nucleophilicity and basicity.	15
II	Introduction to stereochemistry: 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	Acyclic hydrocarbons: 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_2O , (Oxymercuration-reduction and hydroboration -oxidation), HOX , H_2SO_4 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_2 , HX, H_2O (Tautomerism), Oxidation with $KMnO_4$, OsO_4 , reduction and Polymerization, reaction of acetylene.	15
IV	Alicyclic hydrocarbons (cycloalkanes): 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. Aromatic hydrocarbons: 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	Gaseous state chemistry: 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, Liquification of Gases. Behavior of real gases: 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	Liquid state chemistry: Intermolecular forces, magnitude of intermolecular force, structure of liquids, Properties of liquids, viscosity and surface tension. Colloids and surface chemistry: 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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discussion of BET.

Solid state chemistry: 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.

Keywords: Electronic effect, Reactive intermediates, Stereochemistry, Alkenes, Alkynes, Cycloalkanes, Aromaticity, Gas, Liquid, Colloidal state and Solid

Part C: Learning Resource

Text Books, Reference Books, Other Resources

Suggested Readings :

1. Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd.(Pearson Education).
2. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3. Finar, I. L. Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
4. Eliel, E. L. & Wilen, S. H. Stereochemistry of Organic Compounds, Wiley: London, 1994.
5. Kalsi, P. S. Stereochemistry Conformation and Mechanism, New Age International, 2005.
6. McMurry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013.
7. Bruice, P. Y. Organic Chemistry, 2nd Edition, Prentice-Hall, International Edition (1998).
8. Atkins' Physical Chemistry, 10th Edition, Oxford University Press, 2014
9. Barrow, G.M., Physical Chemistry Tata McGraw-Hill, 2007
10. Ball, D.W., Physical Chemistry, Thomson Press, India, 2007
11. Castellan, G.W., Physical Chemistry, 4th Edition, Narosa, 2004
12. Mortimer, R.G., Physical Chemistry, 3rd Edition, Elsevier, Noida, UP, 2009
13. Levine, I.N., Physical Chemistry, 6th Edition, Tata McGraw-Hill, 2010
14. Metz, C.R., 2000 Solved Problems in Chemistry, Sahaun Series, 2006
15. Negi, A.S. & Anand, S.C., A Text Book of Physical Chemistry, 3rd Edition, New Age International Publication
16. Bajpai, D.N., Advanced Physical Chemistry, S. Chand, 2019
17. Bahal & Tuli, Essential of Physical Chemistry, 2020

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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	- Chairman	<i>Arvind 3/6/22</i>
2. Smt. Priyanka Tiwari, Assistant Professor, Govt. J.P. Verma P.G. College, Bilaspur	- Member	<i>Priyanka 3/6/22</i>
3. Mr. Vijay Kumar Lahare, Assistant Professor, Govt. Lahiri P.G. College Chirimiri(C.G.)	- Member	<i>Vijay 03.6.22</i>
4. Dr. Rajmani Patel, Assistant Professor, Hemchand Yadav University, Durg	- Member	<i>Rajmani 03.6.22</i>
5. Dr. A.K. Singh, Professor, Govt. V.Y.T. P.G. College Durg	- Member	<i>A.K.S. 03.6.22</i>
6. Dr. P.K. Singh, Assistant Professor, Govt. T.C.L. P.G. College Janjgir(C.G.)	- Member	<i>P.K.S. 03.6.22</i>
7. DR. P.K. Agnihotri, Professor, Govt. Yukanandam Chhattisgarh College Raipur(C.G.)	- Member	<i>P.K.A. 03.6.22</i>
8. Dr. B.D. Diwan, Professor, Govt. M.M.R. P.G. College Champa(C.G.)	- Member	<i>B.D.D. 03.6.22</i>
9. Dr. Sandhya Patre, Assistant Professor, Sant Shiromani Guru Ravidas Govt. College Sargaon, Mungeli(C.G.)	- Member	<i>Sandhya 03.6.22</i>
10. Mrs. Mousami Lahare, Assistant Professor, Govt. G.N.A. P.G. College	- Member	<i>Mousami 03.6.22</i>
11. Dr. Alka Shukla, Assistant Professor, Mohan Lal Jain(Mohan Bhaiya) Govt. College Khursipar, Bhilai(C.G.)	- Member	<i>Alka Shukla 03.6.22</i>
12. Dr. Arti Gupta, Professor, Govt. Dr. W.W.P. Girlas P.G. College Durg (C.G.)	- Member	<i>Arti Gupta 03.6.22</i>
13. Dr. Deepti Tikariha, Assistant Professor, APSGMNS Govt. P.G. College Kawardha(C.G.)	- Member	<i>Deepti Tikariha 03.6.22</i>
14. Dr. Seema Negi, Assistant Professor, Govt. J.M.P. College, Takhatpur (C.G.)	- Member	<i>Seema Negi 03.6.22</i>
15. Dr. Vikesh Kumar Jha, Assistant Professor, Govt. R.R.M. P.G. College Surajpur (C.G.)	- Member	<i>Vikesh Kumar Jha 03.6.22</i>
16. Dr. Ashish Tiwari, Assistant Professor, Dr. Bhimrao Ambedkar Govt. College Pamgarh(C.G.)	- Member	<i>Ashish Tiwari 03.6.22</i>
17. Mr. Laxmi Chand Manwani, Assistant Professor, Government Vivekand PG College Manedragarh(C.G.)	- Member	<i>Laxmi Chand Manwani 03.6.22</i>

Part A: Introduction				
Program: Certificate Course	Class: B.Sc. I Year	Year: 2022	Session: 2022-23	
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)	<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"> • To analyse the given mixture for anions (acid radicals) and cations (basic radicals). • Titrations • Qualitative Analysis • Surface tension measurements. • Viscosity measurement • Chemical Kinetics 			
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		
LABATORY COURSE		No. of Lectures
Tentative list of Practical	<p>A. Inorganic chemistry Semi-micro qualitative analysis (using H_2S or other methods) of mixtures - not more than four ionic species (two anions and two cations, excluding interfering, insoluble salts) out of the following: Cations : NH_4^+, Pb^{2+}, Bi^{3+}, Cu^{2+}, Cd^{2+}, Fe^{3+}, Al^{3+}, Co^{2+}, Ni^{2+}, Mn^{2+}, Zn^{2+}, Ba^{2+}, Sr^{2+}, Ca^{2+}, Na^+ Anions : CO_3^{2-}, S^{2-}, SO_3^{2-}, NO_2^-, CH_3COO^-, Cl^-, Br^-, I^-, NO_3^-, SO_4^{2-} (Spot tests may be carried out wherever feasible)</p> <p>B. Acid-Base Titrations</p> <ul style="list-style-type: none"> • Standardization of sodium hydroxide by oxalic acid solution. • Determination of strength of HCl solution using sodium hydroxide as intermediate. • Estimation of carbonate and hydroxide present together in mixture. • Estimation of carbonate and bicarbonate present together in a mixture. • Estimation of free alkali present in different soaps/detergents 	10

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	<p>C. Redox Titrations</p> <ul style="list-style-type: none"> • Standardization of KMnO_4 by oxalic acid solution. • Estimation of Fe(II) using standardized KMnO_4 solution. • Estimation of oxalic acid and sodium oxalate in a given mixture. • Estimation of Fe(II) with $\text{K}_2\text{Cr}_2\text{O}_7$ using internal (diphenylamine, anthranilic acid) and external indicator. 	
	<p>Organic chemistry</p> <ol style="list-style-type: none"> 1. Demonstration of laboratory Glassware's and Equipments. 2. Calibration of the thermometer. $80^\circ - 82^\circ$ (Naphthalene), $113.5^\circ - 114^\circ$ (Acetanilide), $132.5^\circ - 133^\circ$ (Urea), 100° (Distilled Water.) 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. 4. Determination of the melting points of organic compounds. Naphthalene $80^\circ - 82^\circ$, Benzoic acid $121.5^\circ - 122^\circ$, Urea $132.5^\circ - 133^\circ$ Succinic acid $184.5^\circ - 185^\circ$, Cinnamic acid $132.5^\circ - 133^\circ$, Salicylic acid $157.5^\circ - 158^\circ$, Acetanilide $113.5^\circ - 114^\circ$, m-Dinitrobenzene 90°, p-Dichlorobenzene 52°, Aspirin 135°. 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). 6. Determination of boiling point of liquid compounds. (boiling point lower than and more than 100°C by distillation and capillary method). Ethanol 78°, Cyclohexane 81.4°, Toluene 110.6°, Benzene 80°. <ul style="list-style-type: none"> i. Distillation (Demonstration) Simple distillation of ethanol-water mixture using water condenser. Distillation of nitrobenzene and aniline using air condenser. ii. Sublimation Camphor, Naphthalene, Phthalic acid and Succinic acid. 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. 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. 8. Preparation and characterization of biodiesel from vegetable oil. 9. Preparation of soap. 	10
	<p>Physical chemistry</p> <ol style="list-style-type: none"> 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. 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. 	10


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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 & H₂SO₄ 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>Keywords: 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).
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

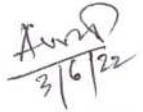
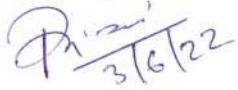
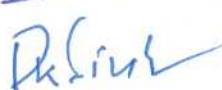
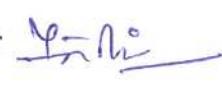
Maximum Marks: 50

Arvind
2016

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

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	- Chairman  3/6/22
2. Smt. Priyanka Tiwari, Assistant Professor, Govt. J.P. Verma P.G. College, Bilaspur	- Member  3/6/22
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4. Dr. Rajmani Patel, Assistant Professor, Hemchand Yadav University, Durg	- Member  03-6-22
5. Dr. A.K. Singh, Professor, Govt. V.Y.T. P.G. College Durg	- Member  3/6/22
6. Dr. P.K. Singh, Assistant Professor, Govt. T.C.L. P.G. College Janjgir(C.G.)	- Member  3/6/22
7. DR. P.K. Agnihotri, Professor, Govt. Yukanandam Chhattisgarh College Raipur(C.G.)	- Member  3/6/22
8. Dr. B.D. Diwan,	- Member  3/6/22

Professor,
Govt. M.M.R. P.G. College Champa(C.G.)

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Sant Shiromani Guru Ravidas Govt. College Sargaon,
Mungeli(C.G.)

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(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 Manedragarh(C.G.)

- Member *Rajesh*
03/06/2022

- Member *Shivani*
03.06.2022

- Member *Alka*
03/06/2022

- Member *Deepa*
3/6/22

- Member *Deepti*
03/6/22

- Member *Seema Negi*
3/6/22

- Member *W.*

- Member *Ashish*
3/6/22

- Member *Manwani*

Part A: Introduction			
Program: Diploma Course	Class: B.Sc. II Year	Year: 2023	Session: 2023-24
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)	<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"> Understand the general characteristics of transition elements. Explain the chemistry of Coordination Compounds. Analyze water and coal. Basic concepts of thermodynamics. Basic concepts of Chemical and Ionic Equilibrium 		
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	<p>Chemistry of transition series elements: Transition elements- Position in periodic table, electronic configuration, General characteristics, <i>viz.</i>, atomic and ionic radii, variable oxidation states, ability to form complexes, formation of colored ions, magnetic moment μ_{so} (spin only) and μ_{eff} 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>Chemistry of lanthanides and actinides: 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>Concepts of acids and bases: Arrhenius theory, Bronsted-Lowry concepts, conjugate acids and bases, relative strength of acids and bases, Lewis concepts of acids and bases,</p> <p>Hard and soft acids and bases (HSAB): 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>Non- aqueous solvents: 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	Coordination chemistry: Werner's theory and its experimental verification, IUPAC nomenclature of coordination compounds, Chelates, polynuclear complexes, Isomerism in coordination compound, stereochemistry of complexes 4 & 6 coordination compounds.	15

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8/16*

	Valence bond theory (inner and outer orbital complexes) : Limitations of valence bond theory, electroneutrality principle and back bonding. Crystal field theory, Crystal field splitting and stabilization energy, measurement of $10 Dq (\Delta_0)$, CFSE in weak and strong fields, pairing energies, factors affecting the magnitude of $10 Dq (\Delta_0, \Delta_1)$. Octahedral vs. tetrahedral coordination.	
IV	Chemistry of water analysis: 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. Coal analysis: Classification of coal, Proximate and Ultimate analysis of coal, Carbonization of coal, Coal gas-composition and uses.	15
V	Thermodynamics: 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. Second law of thermodynamics: 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	Chemical equilibrium: 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. Ionic equilibrium: 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
Keywords: Transition Elements, Lanthanides and Actinides, Coordination Compounds, Redox potential, Water Analysis, Coal Analysis, Non-aqueous solvents, Carnot's theorem, Fugacity, Salt hydrolysis .		

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

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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. Albery, 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/#>

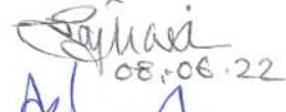
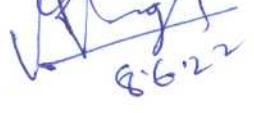
Fundamental Chemistry related topics on SWAYAM platform and E-pathshala

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.

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- Member *Dr. Ashish Tiwari*
- Member *Mr. Laxmi Chand Manwani*
- Member *Dr. K. Indira*

Part A: Introduction			
Program: Diploma Course	Class: B.Sc. II Year	Year: 2023	Session: 2023-24
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)	<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"> • Reactions of the alcohols and phenols. • Reactivity of carbonyl compounds • Carboxylic acid and its derivatives • Organic compounds containing nitrogen • Phase Equilibrium • Electrochemistry 		
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	<p>Chemistry of organic halides: Alkyl halides: Methods of preparation, nucleophilic substitution reactions – S_N1, S_N2 and S_Ni mechanisms with stereochemical aspects and effect of solvent etc.; nucleophilic substitution, elimination reactions.</p> <p>Aryl halides: Preparation, including preparation from diazonium salts, Nucleophilic Aromatic Substitution; S_NAr, Benzyne mechanism. Relative reactivity of alkyl, allyl/benzyl, vinyl and aryl halides towards nucleophilic substitution reactions.</p> <p>Alcohols: Dihydric alcohols – methods of formation, chemical reactions of vicinal glycols, oxidative cleavage $[Pb(OAc)_4$ and HIO_4] and pinacol-pinacolone rearrangement.</p> <p>Trihydric alcohols - Nomenclature, methods of formation, chemical reactions of glycerol.</p> <p>Phenols: 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>Aldehydes and ketones : Nomenclature, structure and reactivity of carbonyl group. General methods of preparation of aldehydes and ketones.</p> <p>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, $LiAlH_4$ and $NaBH_4$ reduction. Halogenation of enolizable</p>	15

A. A. S.

	ketones, An introduction to α , β -unsaturated aldehydes and Ketones. (Michael Addition reaction)	
III	Carboxylic acids : 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. Dicarboxylic acids : Methods of formation and effect of heat and dehydrating agents, Hydroxyacids. Carboxylic acid derivatives : 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.	15
IV	Organic compounds of nitrogen : 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.	15
V	Phase equilibrium : 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	15
VI	Electrochemistry : Ostwald dilution law and its limitations, Elementary ideas of Debye-Hückel-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 ΔG , and equilibrium constant. Conductometric, pH metric and potentiometric titration.	15

Keywords: 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-Hückel-Onsager's theory, Electrochemical Cells, Electrode Potential, Nernst Equation, Conductometric Titration, pH Metric Titration, Potentiometric Titration.

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/#>

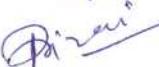
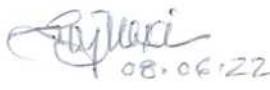
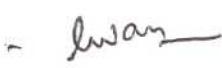
Fundamental Chemistry related topics on SWAYAM platform and E-pathshala

Part D: Assessment and Evaluation

Maximum Marks: 50

DECLARATION

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7. Dr. P.K. Agnihotri, Professor, Govt. Yuganandam Chhattisgarh College Raipur(C.G.)	- Member	
8. Dr. B.D. Diwan, Professor, Govt. M.M.R. P.G. College Champa(C.G.)	- Member	

9. Dr. Sandhya Patre, Assistant Professor, Sant Shiromani Guru Ravidas Govt. College Sargaon, Mungeli(C.G.)	- Member	<i>Patre</i> 8/6/22
10. Mrs. Mousami Lahare, Assistant Professor, Govt. G.N.A. P.G. College Bhatapara, (C.G.)	- Member	<i>Mousami</i>
11. Dr. Alka Shukla, Assistant Professor, Mohan Lal Jain(Mohan Bhaiya) Govt. College Khursipar, Bhilai(C.G.)	- Member	<i>Alka Shukla</i>
12. Dr. Arti Gupta, Professor, Govt. Dr. W.W.P. Girl's P.G. College Durg (C.G.)	- Member	<i>Arti Gupta</i> 8/6/22
13. Dr. Deepti Tikariha, Assistant Professor, APSGMNS Govt. P.G. College Kawardha(C.G.)	- Member	<i>Deepti Tikariha</i>
14. Dr. Seema Negi, Assistant Professor, Govt. J.M.P. College, Takhatpur (C.G.)	- Member	<i>Seema Negi</i> 8/6/22
15. Dr. Vikesh Kumar Jha, Assistant Professor, Govt. R.R.M. P.G. College Surajpur (C.G.)	- Member	<i>Vikesh Kumar Jha</i> 8/6/22
16. Dr. Ashish Tiwari, Assistant Professor, Dr. Bhimrao Ambedkar Govt. College Pamgarh(C.G.)	- Member	<i>Ashish Tiwari</i> 8/6/22
17. Mr. Laxmi Chand Manwani, Assistant Professor, Government Vivekanand PG College Manendragarh(C.G.)	- Member	<i>Laxmi Chand Manwani</i> 8/6/22
18. Dr. K. Indira Professor, Government K. PG College Jagadalpur (C.G.)	- Member	<i>Indira</i> 08-06-2022

Part A: Introduction				
Program: Diploma Course		Class: B.Sc. II Year	Year: 2023	Session: 2023-24
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)	<p>By the end of this course students will learn the following aspects of Laboratory exercises in Chemistry :</p> <ul style="list-style-type: none"> • To analyze the given mixture for anions (acid radicals) and cations (basic radicals). • Titrations • Qualitative Analysis • Transition Temperature. • Thermochemistry. • Water Analysis. • Phase Equilibrium 		
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	<p>Inorganic chemistry : 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: CO_3^{2-}, NO_3^{2-}, S^{2-}, SO_3^{2-}, $\text{S}_2\text{O}_3^{2-}$, CH_3COO^-, F^-, Cl^-, Br^-, I^-, NO_3^-, BO_3^{3-}, $\text{C}_2\text{O}_4^{2-}$, PO_4^{3-}, NH_4^+, K^+, Pb^{2+}, Cu^{2+}, Cd^{2+}, Bi^{3+}, Sn^{2+}, Sb^{3+}, Fe^{3+}, Al^{3+}, Cr^{3+}, Zn^{2+}, Mn^{2+}, Co^{2+}, Ni^{2+}, Ba^{2+}, Sr^{2+}, Ca^{2+}, Mg^{2+}. Mixtures should preferably contain one interfering anion, or insoluble component (BaSO_4, SrSO_4, PbSO_4, CaF_2 or Al_2O_3) or combination of anions e.g. CO_3^{2-} and SO_3^{2-}, NO_2^- and NO_3^-, Cl^-, Br^-, and I^-.</p> <p>Volumetric analysis</p> <ol style="list-style-type: none"> 1. Determination of acetic acid in commercial vinegar using NaOH. 2. Determination of alkali content-antacid tablet using HCl. 3. Estimation of calcium content in chalk as calcium oxalate by permanganometry. 4. Estimation of hardness of water by EDTA. 5. Estimation of ferrous & ferric by dichromate method. 6. Estimation of copper using thiosulphate. <p>Chromatographic separations</p> <p>Paper chromatographic separation of following metal ions: a) Ni (II) and Co (II) b) Fe (III) and Al (III)</p> <p>Paper chromatographic separation of mixture of dyes</p> <p>Water Analysis</p> <ol style="list-style-type: none"> 1. Determine chemical oxygen demand (COD) of given Water sample. 2. Determine Dissolved oxygen (DO) of given Water Sample. <p>Organic chemistry</p>	10

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	<ol style="list-style-type: none"> 1. Detection of elements (X, N, S). 2. Qualitative analysis of unknown organic compounds containing simple functional groups (alcohols, carboxylic acids, phenols, nitro, amine, amide, and carbonyl compounds, carbohydrates) <p>Preparation of Organic Compounds: (i) m-dinitrobenzene, (ii) Acetanilide, (iii) Bromo/Nitro-acetanilide, (iv) Oxidation of primary alcohols-Benzoic acid from benzyl alcohol, (v) azo dye.</p>	
	<p>Physical chemistry</p> <p>Transition Temperature</p> <p>Determination of the transition temperature of the given substance by thermometric/ dialometric method (e.g. $\text{MnCl}_2 \cdot 4\text{H}_2\text{O}/\text{SrBr}_2 \cdot 2\text{H}_2\text{O}$).</p> <p>Thermochemistry</p> <ol style="list-style-type: none"> 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). 2. Determination of heat capacity of the calorimeter and enthalpy of neutralization of hydrochloric acid with sodium hydroxide. 3. To determine the solubility of benzoic acid at different temperature and to determine ΔH of the dissolution process. 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. 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. <p>Phase Equilibrium</p> <ol style="list-style-type: none"> 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. 7. To construct the phase diagram of two component system (e.g. diphenylamine– benzophenone) by cooling curve method. 8. Distribution of acetic/ benzoic acid between water and cyclohexane. 9. Study the equilibrium of at least one of the following reactions by the distribution method: (i) $\text{I}_2(\text{aq}) + \text{I}^- \rightarrow \text{I}_3(\text{aq})^{2+}$ (ii) $\text{Cu}^{2+}(\text{aq}) + \text{nNH}_3 \rightarrow \text{Cu}(\text{NH}_3)_n$ <p>Molecular Weight Determination</p> <ol style="list-style-type: none"> 10. Determination of molecular weight by Rast Camphor and Landsburger method. 	10

Keywords: Qualitative semimicro analysis. Paper chromatographic Water Analysis. Transition Temperature Thermochemistry Molecular Weight.

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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5. 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
Three Experiments are to be performed. 1. Inorganic – Qualitative semimicro analysis of mixtures (5 radicals) including interfering/insoluble radicals. OR One experiment from synthesis and analysis by preparing the standard solution. OR • Determine chemical oxygen demand (COD) of given Water sample . • Determine Dissolved oxygen (DO) of given Water Sample.	12 marks
2. Organic (a) Identification of the given organic compound & determine its M.Pt./B.Pt. (b) Determination of Rf value and identification of metal ions/organic compounds by paper chromatography.	6 marks
3. Any one physical experiment that can be completed in two hours including calculations.	6 marks
4. Viva	12 marks
5. Sessional	10 marks
In case of Ex-Students one marks will be added to each of the experiment.	04 marks

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,

- Chairman

- Member




1. Assistant Professor,
Govt. J.P. Verma P.G. College, Bilaspur (C.G.)

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. Yukanandam Chhattisgarh College Raipur(C.G.)

8. Dr. B.D. Diwan,
Professor,
Govt. M.M.R. P.G. College Champa(C.G.)

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18. Dr. K. Indira
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Government K. PG College Jagadalpur (C.G.)

- Member *Shail 08/06/2022*

- Member *Rajesh 08.6.22*

- Member *AK Singh*

- Member *DK Singh*

- Member *Partho*

- Member *Devansh*

- Member *Balaji 8/6/22*

- Member *Reyeshael*

- Member *Dhruv 8/6/2022*

- Member *Alka 8/6/22*

- Member *Arti 8/6/22*

- Member *Deepika 8/6/22*

- Member *Seema 8/6/22*

- Member *Vikesh 8/6/22*

- Member *Ashish 8/6/22*

- Member *Laxmi 8/6/22*

- Member *Indira 8/6/22*

- Member *Indira 08-06-2022*

Part A: Introduction				
Program: Degree Course		Class: B.Sc. III Year	Year: 2024	Session: 2024-2025
1.	Course Code	CHEM-5T		
2.	Course Title	Inorganic & Physical Chemistry		
3.	Course Type	Core Course		
4.	Pre-requisite (if any)	To Study this course our students must have had the diploma in chemistry 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"> • Metal-ligand bonding and stability of the metal complexes. • Spectroscopic and magnetic properties of transition metal complexes. • Fundamentals and catalytic and industrial applications of organometallic compounds. • Applications of bioinorganic chemistry, acid-base principles and inorganic polymers. • Fundamentals and applications of electromagnetic spectrum, microwave infrared, Raman and electronic spectroscopy' • Basic concepts and theories of photochemistry and learn about the various aspects of its applications. • Problems and principles/concepts in electric, magnetic and optical properties of molecules. 		
6.	Credit Value	Theory: 4		
7.	Total Marks	Max. Marks: 50	Min Passing Marks: 17	

Part B: Content of the Course		
Total No. of Lecturer (in hours per week):		Total Lecturer: 90
Unit	Topics	No. of Lectures
I	Metal- Ligand Bonding in Transition Metal Complexes -Limitation of Crystal Field Theory, Tetragonal distortions from octahedral geometry, Jahn-Teller distortion, square planar geometry. Qualitative aspect of Ligand field and MO Theory, MO diagrams of representative coordination complexes of octahedral geometry.	15
	Thermodynamic and kinetic aspects of metal complexes. A brief outline of thermodynamic stability of metal complexes and factors affecting the stability. Substitution reactions of square planar complexes. Trans-effect, theories of trans-effect. Mechanism of substitution reactions of Square planar complexes.	
II	Magnetic Properties of Transition Metal Complexes: Types of magnetic behavior, method of determining magnetic susceptibility by Gouy method, spin only formula, L-S coupling, correlation of μ_s (spin only) and μ_{eff} . Values, Orbital contribution to magnetic moments, Application of magnetic moment data for 3d metal complexes.	15
	Electronic spectra of Transition Metal Complexes: Types of electronic transitions, selection rules for d-d transitions, spectroscopic ground states, spectro-chemical series. Orgel-energy level diagram for d^1 and d^2 states,	



	Discussion of the Electronic spectrum of $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$ complex ion.	
III	<p>Organometallic chemistry: Definition and classification of organometallic compounds based on nature of metal-carbon bond. Concept of hapticity of organic ligands. Structures of mononuclear and binuclear carbonyls of Cr, Mn, Fe, Co and Ni using VBT. π-acceptor behavior of CO (MO diagram of CO to be discussed), Zeise's salt: Preparation and structure of Metal carbonyls : 18 electron rule , Electron count of mononuclear, polynuclear and substituted metal carbonyls of 3d series. General methods of preparation (direct combination, reductive carbonylation, thermal and photochemical decomposition) of mono and binuclear carbonyls of 3d series.</p> <p>Catalysis by Organometallic Compounds—Study of the following industrial processes and their mechanism: Alkene hydrogenation (Wilkinson's Catalyst), Polymerization of ethane (Ziegler–Natta Catalyst)</p>	15
IV	<p>Bioinorganic chemistry: Classification of elements according to their action in biological system. Essential and trace elements in biological processes, carbonic anhydrase and carboxypeptidase. Excess and deficiency of some trace metals, Metal ions present in biological systems, Toxicity of some metal ions (Hg, Pb, Cd and As), metalloporphyrins with special reference to hemoglobin and myoglobin and their structure and biological functions. Biological role of alkaline earth metals with special reference to Ca^{2+} and Mg^{2+}, nitrogen fixation.</p> <p>Inorganic polymers: Types of inorganic polymers, comparison with organic polymers, synthesis, structural aspects and applications of silicones and siloxanes. Silicates, phosphazenes and polyphosphate</p>	15
V	<p>Spectroscopy-I Introduction: Characterization of Electromagnetic radiation, regions of the spectrum, interaction of radiation with matter, types of spectrums, types of spectroscopy studied in different regions of electromagnetic radiation. Born-Oppenheimer Approximation. Basic idea of instrumentation of simple photometer, atomic absorption and emission spectrophotometers.</p> <p>Photochemistry: Difference between thermal and photochemical processes. Laws of photochemistry: Grothus-Drapper law, Lambert-Beer's law, Stark- Einstein law, quantum yield, examples of low and high quantum yields, Photochemical equilibrium and the differential rate of photochemical reactions, Quenching, Role of photochemical reaction in biochemical process. Jablonski diagram depicting various process occurring in the excited state, qualitative description of fluorescence, phosphorescence, non-radiative processes (internal conversion, intersystem crossing), photosensitized reactions, energy transfer processes (simple examples), photostationary states, Chemiluminescence.</p> <p>Electronic Spectroscopy: Basic principles, Electronic Spectra of diatomic molecule, Franck- Condon principle, types of electronic transition, application of electronic spectra.</p>	15
VI	<p>Spectroscopy-II Rotational Spectroscopy: Rotational Spectrum of Diatomic molecules. Energy levels of a rigid rotor, selection rules, determination of bond length, qualitative description of non-rigid rotator, isotopic effect.</p> <p>Vibrational Spectroscopy: Theory of IR Spectroscopy, vibrating diatomic molecule, energy levels of simple harmonic oscillator, selection rules, pure vibrational spectrum, rotational-vibrational Spectra, determination of force constant, anharmonic oscillator</p> <p>Raman Spectroscopy: Instrumentation of Raman spectrophotometer, Concept of polarizability, quantum theory of Raman spectra, stokes and</p>	15

Ans

antistokes lines, pure rotational and pure vibrational Raman spectra.
selection rule, Applications of Raman Spectra.

Keywords: Crystal field theory, transition metal complexes, magnetic properties, electronic spectra, organometallic compounds, carbonylation, inorganic polymers, electromagnetic radiations, photochemistry, rotational and vibrational spectroscopy, raman spectroscopy

Part C: Learning Resource

Text Books, Reference Books, Other Resources

Suggested Reading :

1. Lippard, S.J. & Berg, J.M. Principles of Bioinorganic Chemistry Panima Publishing Company 1994.
2. Cotton, F.A. & Wilkinson, G, Advanced Inorganic Chemistry Wiley-VCH, 1999.
3. Malik W.U. & et Al., Selected Topics in Inorganic Chemistry, S Chand Publication (2010). Puri, B.R. , Sharma, L.R., KaliaK.C. , Principles of Inorganic Chemistry, Vishal Publishing Co. (2021).
4. Gurtu, J.N., Gurtu, A., Advanced Physical Chemistry, Pragati Prakashan, Meerut, Edition IV, 2017
5. Dogra, S.K.,Physical Chemistry through problems, Wiley Eastern.
6. Khera, H.C., Gurtu, J.N., Singh, J., Chemistry for B.Sc. Ist Year, Pragati Prakashan
7. Ball, D.W., Physical Chemistry, Thomson Press, India, 2007
8. Castellan, G. W., Physical Chemistry, 4th Edition, Narosa, 2004
9. Bariyar, A. & Goyal, S., B.Sc. Chemistry Combined (in Hindi), Krishna Educational Publishers Year 2019
10. Levine, I.N., Physical Chemistry, 6th Edition, Tata McGraw-Hill, 2010
11. Metz, C.R., 2000 Solved Problems in Chemistry, Sahaun Series, 2006
12. Puri, B.R., Pathania, M.S., Sharama, L.R., Principles of Physical Chemistry, Vishal Publishing Company 2020
13. Negi, A.S. & Anand, S.C., A Text Book of Physical Chemistry, 3rd Edition, New Age International Publication
14. Bajpai, D.N., Advanced Physical Chemistry, S. Chand, 2019
15. Bahal & Tuli, Essential of Physical Chemstry, 2020
16. Greenwood, N.N. & Earnshaw A. Chemistry of the Elements, Butterworth-Heinemann, 1997.
17. Purcell, K.F & Kotz, J.C. Inorganic Chemistry W.B. Saunders Co, 1977.
18. Huheey, J.E., Inorganic Chemistry, Prentice Hall, 1993.
19. Lee, J.D. Concise Inorganic Chemistry, ELBS, 1991
20. Atkins, P. W and Shriver D. N. Atkins' Inorganic Chemistry 5th Ed. Oxford University Press (2010).
21. Engel, T. and Reid, P., Physical Chemistry, 3rd Edition, Prentice Hall, 2012
22. Mortimer, R.G., Physical Chemistry, 3rd Edition, Elsevier, Noida, UP, 2009
23. Atkins' Physical Chemistry, 10th Edition, Oxford University Press, 2014
24. Barrow, G.M., Physical Chemistry Tata McGraw-Hill, 2007
25. Physical Chemistry, A Modern Introduction, 2nd Edition, William M. Davis, CRC Press, 2018.
26. Chemical Kinetics, Stochastic Processes and irreversible Thermodynamics, Santillan Moises, Springer, 2014.
27. Physical Chemistry, Madan R.L., McGraw Hill, 2021.
28. Physical Chemistry, 3rd Edition, Robert G. Mortimer, Elsevier, 2021.

E-learning resources:

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

Ans

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	- Chairman	<i>Arad 08/6/22</i>
2. Smt. Priyanka Tiwari, Assistant Professor, Govt. J.P. Verma P.G. College, Bilaspur (C.G.)	- Member	<i>Priyani 08/6/2022</i>
3. Mr. Vijay Kumar Lahare, Assistant Professor, Govt. Lahiri P.G. College Chirimiri(C.G.)	- Member	<i>Vijay 08/6/2022</i>
4. Dr. Rajmani Patel, Assistant Professor, Hemchand Yadav University, Durg (C.G.)	- Member	<i>Rajmani 08/6/22</i>
5. Dr. A.K. Singh, Professor, Govt. V.Y.T. P.G. College Durg (C.G.)	- Member	<i>A.K. Singh 08/6/22</i>
6. Dr. P.K. Singh, Assistant Professor, Govt. T.C.L. P.G. College Janjgir(C.G.)	- Member	<i>P.K. Singh 08/6/22</i>
7. Dr. P.K. Agnihotri, Professor, Govt. Yuganandam Chhattisgarh College Raipur(C.G.)	- Member	<i>P.K. Agnihotri 08/6/22</i>
8. Dr. B.D. Diwan, Professor, Govt. M.M.R. P.G. College Champa(C.G.)	- Member	<i>B.D. Diwan 08/6/22</i>
9. Dr. Sandhya Patre, Assistant Professor, Sant Shiromani Guru Ravidas Govt. College Sargaon, Mungeli(C.G.)	- Member	<i>Sandhya Patre 08/6/22</i>
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15. Dr. Vikesh Kumar Jha,	- Member	<i>Vikesh Kumar Jha 08/6/22</i>

Assistant Professor, Govt. R.R.M. P.G. College Surajpur
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Professor,
Government K. PG College Jagadalpur (C.G.)

- Member

A. Tiwari
8/6/22

- Member

L. Manwani
8/6/22

- Member

K. Indira
8-6-22

Part A: Introduction

Program: Degree Course		Class: B.Sc. III Year	Year: 2024	Session: 2024-2025
1.	Course Code	CHEM-6T		
2.	Course Title	Organic & Physical Chemistry		
3.	Course Type	Core Course		
4.	Pre-requisite (if any)	To Study this course our students must have had the diploma in chemistry 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"> • Fundamental theoretical knowledge about the heterocyclic chemistry. • Common organometallic reactions and draw reasonable reaction mechanisms. • Various synthetic dyes and their structures. • Chemical structure of proteins, amino acids and nucleic acids. • To acquire knowledge about different mechanisms involved in polymerization, useful polymers and their structures. • Basic principles of UV-Visible, IR and NMR spectra and their applications. • Fundamentals/concepts/principles/postulates of quantum mechanics and need for development of quantum mechanics. • Applications of quantum mechanics in the study of black body radiation, photoelectric effect, simple quantum mechanical models, bonding in molecules and molecular spectroscopy. 		
6.	Credit Value	Theory: 4		
7.	Total Marks	Max. Marks: 50	Min Passing Marks: 17	

Part B: Content of the Course

Total No. of Lecturer (in hours per week): 4		Total Lecturer: 90
Unit	Topics	No. of Lectures
I	Heterocyclic Compounds : Classification and Nomenclature of Heterocyclic Compounds, Five Membered Heterocyclic Compounds, Furan or Furfuran C ₄ H ₄ O, Pyrrole (C ₄ H ₅ N), Thiophene (C ₄ H ₄ S), 1,4 dicarbonyl compound, Six membered Heterocyclic Compounds Pyridine (C ₅ H ₅ N), Orientation in Pyridine and Substitution Reactions, Comparison of Basicity of Pyridine, Piperidine and Pyrrol, Condensed Five and Six Membered Heterocyclic, Indole (2,3 Benzopyrrole) C ₈ H ₇ N, Quinoline or α , β - Benzopyridine; (C ₉ H ₇ N), Isoquinoline (C ₉ H ₇ N).	15
II	Carbohydrates: Classification of Carbohydrates, Biological Importance of Carbohydrates, Monosaccharides, Relative and Absolute Configuration of Glucose and Fructose, Epimers and Anomers, Mutarotation, Determination of Ring size of Glucose and Fructose, Haworth Projections and Conformational Structure, Mutual Transformations or Inter Conversion among Monosaccharides, Disaccharides, Polysaccharides.	15

Ausd

	Biomolecules: Amino acids, Proteins and Nucleic acids: Amino Acids, Isoelectric Point, Proteins, Difference between Globular Proteins and Fibrous Proteins, Peptide and Peptide Bond, Nucleic acid, structure and functions of RNA and DNA.	
III	Infra-red and Ultraviolet –Visible Spectroscopy: Infra-red Spectroscopy: Basics of Infra-red Spectroscopy, Fundamental vibrations and their symmetry, Instrumentation, Measurement of IR Spectra, Regions and Interpretation of IR Spectra of organic molecules and its applications. Ultra-violet and Visible Spectroscopy: Absorption Laws and Molar Absorptivity, Presentation of <i>UV</i> - Spectra of conjugated enes, UV Spectra of conjugated enones, applications of Ultra-violet spectroscopy. Effect of conjugation on λ_{\max} .	15
IV	NMR and Mass Spectroscopy: NMR Spectroscopy: Principle of NMR Spectroscopy, Instrumentation of NMR Spectroscopy, Nuclear Shielding and Deshielding, The Chemical Shift, Signal Splitting : Spin-Spin Coupling, Interpretation of PMR, Spectra, Structural Elucidation using UV, IR and NMR, Anisotropy and Anisotropic Effect, Coupling constant and signal resolution, ^{13}C -NMR Spectroscopy. Mass Spectroscopy: Principle of mass Spectroscopy, Instrumentation of mass Spectroscopy, fragmentation process. The <i>m/z</i> value of the molecular ion to calculate the molecular formula. Isotope Effect.	15
V	Quantum Mechanics-I : Historical background of quantum mechanics, Black-body radiation, Planck's radiation law, photoelectric effect, Compton effect. Operator: Hamiltonian operator, angular momentum operator, Laplacian operator, postulate of quantum mechanics, eigen values, eigen function, Schrodinger time independent wave equation, physical significance of ψ & ψ^2 , application of Schrodinger wave equation to particle in a one-dimensional box, hydrogen atom (separation into three equations) radial and angular wave functions.	15
VI	Quantum Mechanics-II : Quantum Mechanical approach of Molecular orbital theory, basic ideas-criteria for forming M.O. from A.O., LCAO approximation, formation of H_2^+ ion, calculation of energy levels from wave functions, bonding and antibonding wave functions, Concept of σ , σ^* , π , π^* orbitals and their characteristics, Hybrid orbitals-sp, sp^2 , sp^3 Calculation of coefficients of A.O.'s used in these hybrid orbitals. Introduction to valence bond model of H_2 , comparison of M.O. and V.B. models.	15

Part C: Learning Resource

Suggested Readings :

1. Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd.(Pearson Education).
2. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3. Finar, I. L. Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
4. Puri, B.R., Pathania, M.S., Sharama, L.R., Principles of Physical Chemistry, Vishal Publishing Company 2020
5. Gurtu, J.N., Gurtu, A., Advanced Physical Chemistry, Pragati Prakashan, Meerut, Edition IV, 2017
6. Dogra, S.K.,Physical Chemistry through problems, Wiley Eastern.

Ans

7. Khera, H.C., Gurtu, J.N., Singh, J., Chemistry for B.Sc. Ist Year, Pragati Prakashan
8. Ball, D.W., Physical Chemistry, Thomson Press, India, 2007
9. Castellan, G.W., Physical Chemistry, 4th Edition, Narosa, 2004
10. Bariyar, A. & Goyal, S., B.Sc. Chemistry Combined (in Hindi), Krishna Educational Publishers Year 2019
11. Levine, I.N., Physical Chemistry, 6th Edition, Tata McGraw-Hill, 2010
12. Metz, C.R., 2000 Solved Problems in Chemistry, Sahaun Series, 2006
13. Bahal & Tuli, Essential of Physical Chemistry, 2020
14. Negi, A.S. & Anand, S.C., A Text Book of Physical Chemistry, 3rd Edition, New Age International Publication
15. Bajpai, D.N., Advanced Physical Chemistry, S. Chand, 2019
16. Engel, T. and Reid, P., Physical Chemistry, 3rd Edition, Prentice Hall, 2012
17. Eliel, E. L. & Wilen, S. H. Stereochemistry of Organic Compounds, Wiley: London, 1994
18. Kalsi, P. S. Organic spectroscopy, New Age International, 2005.
19. Dyer, J.R., Introduction to spectroscopy, PHI
20. McMurry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013.
21. Mortimer, R.G., Physical Chemistry, 3rd Edition, Elsevier, Noida, UP, 2009
22. Atkins' Physical Chemistry, 10th Edition, Oxford University Press, 2014
23. Barrow, G.M., Physical Chemistry Tata McGraw-Hill, 2007

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/#>
7. <https://nptel.ac.in/courses>

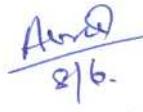
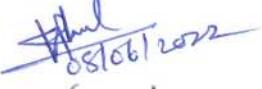
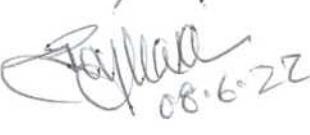
Fundamental Chemistry related topics on SWAYAM platform and E-pathshala

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.

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- Member 

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6. Dr. P.K. Singh,
Assistant Professor,
Govt. T.C.L. P.G. College Janjgir(C.G.)

7. Dr. P.K. Agnihotri,
Professor,
Govt. Yukanandam Chhattisgarh College Raipur(C.G.)

8. Dr. B.D. Diwan,
Professor,
Govt. M.M.R. P.G. College Champa(C.G.)

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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
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(C.G.)

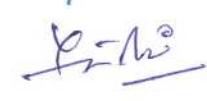
16. Dr. Ashish Tiwari,
Assistant Professor,
Dr. Bhimrao Ambedkar Govt. College Pamgarh(C.G.)

17. Mr. Laxmi Chand Manwani,
Assistant Professor,
Government Vivekanand PG College Manendragarh(C.G.)

18. Dr. K. Indira
Professor,
Government K. PG College Jagadalpur (C.G.)

- Member  08/06/22

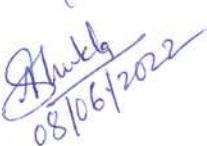
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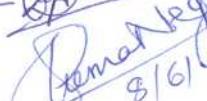
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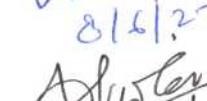
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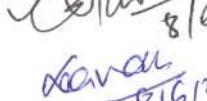
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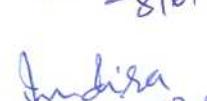
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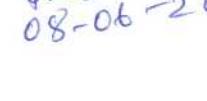
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- Member  08/06/22

- Member  08/06/22

- Member  08/06/2022

Part A: Introduction				
Program: Degree Course		Class: B.Sc. III Year	Year: 2024	Session: 2024-25
1	Course Code	CHEM-3P		
2	Course Title	LAB. 3: GENERAL CHEMISTRY 3		
3	Course Type	Chemistry Practical		
4	Pre-requisite (if any)	To study this course our students must have had the diploma in chemistry or equivalent		
5	Course Learning Outcomes (CLO)	At the end of this course, the students will learn the following aspects of laboratory exercises : <ul style="list-style-type: none"> Preparation of inorganic complexes Preparation of organic compounds Explain/define different terms in conductometry Explain/define different terms in colorimetry Understand the theoretical principles with the help of practicals 		
6	Credit Value	Practical : 02		
7	Total Marks	Max. Marks: 50	Min. Passing Marks: 17	

Part B: Content of the Course		
Total No. of Lectures: 30		
	LABORATORY COURSE	No. of Lectures
Tentative list of practical	Inorganic Chemistry Gravimetric analysis: Estimation of nickel (II) using dimethylglyoxime (DMG), estimation of copper as CuSCN, estimation of iron as Fe ₂ O ₃ by precipitating iron as Fe(OH) ₃ , estimation of Al (III) by precipitating with oxine and weighing as Al(oxine) ₃ (aluminium oxinate), estimation of Barium as BaSO ₄ . Inorganic Preparations: • Tetraamminecopper (II) sulphate, [Cu(NH ₃) ₄]SO ₄ .H ₂ O • Cis and trans K[Cr(C ₂ O ₄) ₂ . (H ₂ O) ₂] Potassium dioxalatodiaquachromate(III) • Tetraamminecarbonatocobalt (III) ion • Potassium tris(oxalate)ferrate(III)/ Sodium tris(oxalate)ferrate(III) • Cu(I) thiourea complex, bis (2,4-pentanedionate) zinc hydrate; Double salts (Chrome alum/ Mohr's salt)	10
	Organic chemistry 1. Preparation of organic Compounds: Synthesis of oxalic acid from cane sugar. Acetylation of one of the following compounds: amines (aniline, o-, m-, p-toluidines and o-, m-, p-anisidine) and phenols (β -naphthol, vanillin, salicylic acid) Benzoylation of one of the following amines (aniline, o-, m-, p-toluidines and o-, m-, p-anisidine) and one of the following phenols (β -naphthol, resorcinol, p cresol) by Schotten-Baumann reaction. Bromination of any one of the following: a. Acetanilide by conventional methods b. Acetanilide using green approach (Bromate-bromide method)	10

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- Nitration of any one of the following:
 - a. Acetanilide/nitrobenzene by conventional method
 - b. Salicylic acid by green approach (using ceric ammonium nitrate).
 - Reduction of p-nitrobenzaldehyde by sodium borohydride.
 - Hydrolysis of amides and esters.
 - Semicarbazone of any one of the following compounds: acetone, ethyl methyl ketone, cyclohexanone, benzaldehyde.
 - Benzylisothiouronium salt of one each of water soluble and water insoluble acids (benzoic acid, oxalic acid, phenyl acetic acid and phthalic acid)
 - Aldol condensation using either conventional or green method.
 - Benzil-Benzilic acid rearrangement.
 - Preparation of sodium polyacrylate.
 - Preparation of urea formaldehyde.
 - Preparation of methyl orange.

The above derivatives should be prepared using 0.5-1g of the organic compound. The solid samples must be collected and may be used for recrystallization, melting point and TLC.

1. Qualitative Analysis: Qualitative analysis of an organic mixture containing two solid components using water, NaHCO_3 , NaOH for separation and preparation of suitable derivatives.
2. Extraction of caffeine from tea leaves.
3. Analysis of Carbohydrate: aldoses and ketoses, reducing and non-reducing sugars.
4. Identification of simple organic compounds by IR spectroscopy and NMR spectroscopy. (Spectra to be provided).
5. Estimation of glycine by Sorenson's formalin method.
6. Study of the titration curve of glycine.
7. Estimation of proteins by Lowry's method.
8. Study of the action of salivary amylase on starch at optimum conditions
9. Effect of temperature on the action of salivary amylase.

Physical chemistry

Conductometry

- Determination of cell constant
- Determination of equivalent conductance, degree of dissociation and dissociation constant of a weak acid.
- Perform the following conductometric titrations:
 - i. Strong acid vs. strong base
 - ii. Weak acid vs. strong base
 - iii. Mixture of strong acid and weak acid vs. strong base
 - iv. Strong acid vs. weak base
 - To determine the strength of the given acid conductometrically using standard alkali solution.
 - To determine the solubility and solubility product of a sparingly soluble electrolyte conductometrically
 - To study the saponification of ethyl acetate conductometrically.

Potentiometry/pH metry:

- Perform the following potentio/pH metric titrations:
 - i. Strong acid vs. strong base
 - ii. Weak acid vs. strong base

10

Aud

<p>iii. Dibasic acid vs. strong base iv. Potassium dichromate vs. Mohr's salt v. Determination of pKa of monobasic acid</p> <p>UV/ Visible spectroscopy:</p> <ul style="list-style-type: none"> Verify Lambert-Beer's law and determine the concentration of $\text{CuSO}_4/\text{KMnO}_4/\text{K}_2\text{Cr}_2\text{O}_7$ in a solution of unknown concentration Determine the concentrations of KMnO_4 and $\text{K}_2\text{Cr}_2\text{O}_7$ in a mixture. Study the kinetics of iodination of propanone in acidic medium. Determine the amount of iron present in a sample using 1,10-phenanthroline. Determine the dissociation constant of an indicator (phenolphthalein). Study the kinetics of interaction of crystal violet/ phenolphthalein with sodium hydroxide. Study of pH-dependence of the UV-Vis spectrum (200-500 nm) of potassium dichromate. Spectral characteristics study (UV) of given compounds (acetone, acetaldehyde, acetic acid, etc.) in water. Absorption spectra of KMnO_4 and $\text{K}_2\text{Cr}_2\text{O}_7$ (in 0.1 M H_2SO_4) and determine λ_{max} values. <p>Note: Experiments may be added/deleted subject to availability of time and facilities</p>	
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Keywords: Gravimetric analysis, Inorganic complex preparation, Organic compounds, Conductometry, Potentiometric, pH metry, Spectroscopy.

Part C : LEARNING RESOURCES

Suggested Readings:

1. Vogel, A.I. Quantitative Organic Analysis, Part 3, Pearson (2012).31
2. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009)
3. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry, 5th Ed., Pearson (2012)
4. Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry:
5. Preparation and Quantitative Analysis, University Press (2000).
6. Ahluwalia, V.K. & Dhingra, S. Comprehensive Practical Organic Chemistry: Qualitative Analysis, University Press (2000),
7. Manual of Biochemistry Workshop, 2012, Department of Chemistry, University of Delhi
8. Green Chemistry, Theory and Practice, P.T. Anastas and J.C. Warner
9. Green Chemistry, Environmental friendly alternatives, R.S. Sanghli and M.M. Srivastava, Narosa Publications.
10. Gupta, A., Unified Chemistry Practical, Navbodh Publications.

E-Learning Resources:

1. <http://vlab.amrita.edu/index.php>
2. <http://www.chemguide.co.uk/>

Fundamental Chemistry related topics on SWAYAM platform and E-pathshala

Ans

Part D: Assessment and Evaluation

Maximum Marks: 50

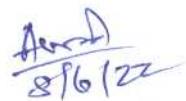
Experiments	08 hours / M.M. 50
Five Experiments to be performed	
Inorganic chemistry – Two experiments to be performed . a) Gravimetric Estimation compulsory. b) Anyone experiment from synthesis and analysis.	08 marks 04 marks
Organic chemistry – Two experiments to be performed. a) Qualitative analysis of organic mixture containing two solid components.	08 marks (03 marks for each compound and 02 marks for separation)
b) One experiment from synthesis of organic compound	04 marks
Physical chemistry – one experiment from physical chemistry	12 marks
Sessional	04 marks
Viva	10 marks
[Note ; In case of Ex-student , one mark each will be added to gravimetric analysis and qualitative analysis of organic mixture and two marks in experiment in physical chemistry].	

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Assistant Professor,
Govt. Lahiri P.G. College Chirimiri(C.G.)

- Chairman


08/06/22

- Member



- Member


08/06/22

4.	Dr. Rajmani Patel, Assistant Professor, Hemchand Yadav University, Durg	- Member	<i>Patel 8.6.22</i>
5.	Dr. A.K. Singh, Professor, Govt. V.Y.T. P.G. College Durg	- Member	<i>A.K. Singh 8.6.22</i>
6.	Dr. P.K. Singh, Assistant Professor, Govt. T.C.L. P.G. College Janjgir(C.G.)	- Member	<i>P.K. Singh 8.6.22</i>
7.	DR. P.K. Agnihotri, Professor, Govt. Yuganandam Chhattisgarh College Raipur(C.G.)	- Member	<i>P.K. Agnihotri 8.6.22</i>
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9.	Dr. Sandhya Patre, Assistant Professor, Sant Shiromani Guru Ravidas Govt. College Sargaon, Mungeli(C.G.)	- Member	<i>Sandhya Patre 8.6.22</i>
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13.	Dr. Deepti Tikariha, Assistant Professor, APSGMNS Govt. P.G. College Kawardha(C.G.)	- Member	<i>Deepti Tikariha 8.6.22</i>
14.	Dr. Seema Negi, Assistant Professor, Govt. J.M.P. College, Takhatpur (C.G.)	- Member	<i>Seema Negi 8.6.22</i>
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17.	Mr. Laxmi Chand Manwani, Assistant Professor, Government Vivekand PG College Manedragarh(C.G.)	- Member	<i>Laxmi Chand Manwani 8.6.22</i>
18.	Dr. K. Indira Professor, Government K. P. G. College Jagadalpur (C.G.)	- Member	<i>Indira 8-6-22</i>