

**DBF DAYANAND COLLEGE OF ARTS AND SCIENCE, SOLAPUR**

**Name of Department: CHEMISTRY**

**Program Outcome [M.Sc. Chemistry]**

- Obtain knowledge with facts and findings related to chemistry
- Understands the fundamental concept, principles and working of theories related to scientific phenomena
- Gain enough skill in handling instruments, planning and execution of innovative experiments
- Obtain the observations and drawing logical answers from the conducted experiments.
- Able to do creative thinking and put the conclusions based on scientific findings.
- Develop the critical thinking ability and analytical mindset.
- Realize the knowledge of the subject and utilize it for the benefit of the human mankind.

# D.B.F. Dayanand College of Arts and Science, Solapur

## COURSE OUTCOME

Name of Department: Chemistry

| B.A. / B.Sc. / M.A. / M.Sc.  | : M.Sc. I   |  |
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| NAME OF SUBJECT  | : Inorganic Chemistry   |  |
| SEM I / II / III / IV / V / VI   | : Sem. I  |  |
| COURSE NUMBER ( PAPER NUMBER)  | : HCP-101   |  |
| TITLE OF COURSE (NAME OF PAPER) : <b>Inorganic Chemistry</b>   |   |  |
| COURSE CONTENT   | OBJECTIVES  | OUTCOME  |
| <p><b>Unit-I: Wave Mechanics</b><br/>                     Origin of quantum theory, black body radiation, atomic spectra, photoelectric effect, matter waves, wave nature of the electron, the wave equation, the particle in one dimensional box, the particle in three dimensional box, the hydrogen atom, transformations of coordinates, separation of variables and their significance, the <math>\Phi</math> equation, the <math>\Theta</math> equation and the Radial equation.</p> | <p>To study the Origin of quantum theory, black body radiation, atomic spectra, photoelectric effect,<br/>                     To understand the matter waves, wave nature of the electron, the wave equation,<br/>                     To derive the expression for the particle in one dimensional box, the particle in three dimensional box, the hydrogen atom, transformations of coordinates, separation of variables and their significance, the <math>\Phi</math> equation, the <math>\Theta</math> equation and the Radial equation.</p> | <p>Able to understand the Origin of quantum theory, black body radiation, atomic spectra, photoelectric effect,<br/>                     Understands the matter waves, wave nature of the electron, the wave equation,<br/>                     Able to derive the expression for the particle in one dimensional box, the particle in three dimensional box, the hydrogen atom, transformations of coordinates, separation of variables and their significance, the <math>\Phi</math> equation, the <math>\Theta</math> equation and the Radial equation.</p> |
| <p><b>Unit-II: Chemistry of Transition Elements</b><br/>                     General characteristic properties of transition elements, co-ordination chemistry of transition metal ions, ligand field theory, ligand field energy parameters (Racah parameters B and C, Slater Condon Parameters, Slater Condon Shortley Parameters), splitting of d orbitals in low symmetry environment, Jahn-Teller effect, interpretation of</p>   | <ol style="list-style-type: none"> <li>1. Enable students to understand characteristic of transition elements</li> <li>2. To help students to understand various ligand field theories, ligand field parameters</li> <li>3. To help students to understand d- orbital splitting, Jahn-Teller distortion, electromagnetic spectra, magnetism</li> </ol>  | <ol style="list-style-type: none"> <li>1. Students understood various characteristic of transition elements</li> <li>2. Students understood various ligand field theories</li> </ol>   |

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| <p>electronic spectra including charge transfer spectra, spectrochemical series, nephelauxetic effect and nephelauxetic series. Dia-para-ferro and antiferromagnetism, quenching of orbital angular moments, spin orbit coupling, metal clusters, metal carbonyls.</p>   |   |  |
| <p><b>Unit-III: A)</b><br/><b>Stereochemistry and Bonding</b><br/>VSEPR theory, Walsh diagrams (tri and penta-atomic molecules) <math>d\pi - p\pi</math> bonds, Bent's rule and energetics of hybridization, some simple reactions of covalently bonded molecules.</p>   | <p>To get knowledge of structure and bonding in inorganic covalent compounds.</p>   | <p>Students understood the, VSEPR theory, Walsh diagram, Bent rule, Hybridization concepts and the structure and bonding in inorganic covalent compounds on the basis of these concepts.</p>   |
| <p><b>Unit-III: B) Inorganic Materials</b><br/>Insulators and semiconductors, electronic structure of solids, band theory, intrinsic and extrinsic semiconductors, doping of semiconductors and conduction mechanism, semiconductor devices, rectifiers, transistors, photoconductors, photovoltaic cell.</p>                            | <p>To get knowledge of conduction mechanism in Inorganic materials and their application.</p>   | <p>Students understood the, Types of inorganic solids as insulator, semiconductors and conductors. Also they understood the doping of semiconductors and conduction mechanism, semiconductor devices, rectifiers, transistors, photoconductors, photovoltaic cell</p>  |
| <p><b>Unit-IV: Nuclear Chemistry</b><br/>Radioactive decay and equilibrium, Nuclear reactions, Q values, cross sections, types of reactions. Chemical effects of nuclear transformations, fission and fusion, fission products and fission yields. Radio active techniques, tracer techniques, neutron activation analysis, counting</p> | <ol style="list-style-type: none"> <li>1. To help the students to understand nuclear reactions</li> <li>2. To help the students to understand difference between chemical reactions and nuclear reactions</li> <li>3. To help the students to understand various types of nuclear reactions</li> <li>4. To help the students to understand applications of nuclear reactions in energy</li> </ol> | <ol style="list-style-type: none"> <li>1. Students understood nuclear reactions, difference between chemical and nuclear reactions</li> <li>2. Students understood various types of chemical reactions and their beneficial characteristic</li> <li>3. Students understood application of nuclear reactions</li> </ol> |

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| techniques such as G.M., ionization and proportional counters. | production<br>5. To help the students to understand applications of radioactivity in various fields<br>Enable students to understand various counting techniques | 4. Students can apply radioactive techniques in various fields |
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| <b>M.Sc. I</b>   |   |  |
| <b>NAME OF SUBJECT: Organic Chemistry-I</b>  |   |  |
| <b>SEM I</b>   |   |  |
| <b>COURSE NUMBER ( PAPER NUMBER) HCT-102</b>   |   |  |
| <b>TITLE OF COURSE (NAME OF PAPER): Instrumental Methods of Analysis</b>   |   |  |
| <b>COURSE CONTENT</b>  | <b>OBJECTIVES</b>   |  |
| <b>Unit –I</b><br><b>(a) Reaction mechanism: Structure and reactivity (7)</b><br>Types of reactions, strength of acids and bases. Generation, structure, stability and reactivity of reaction intermediates: Carbocations, carbanions, free radicals, carbenes, nitrenes, benzyne and ylides. Effect of structure on reactivity: resonance, steric, hyperconjugation effects<br><b>(b) Aliphatic Nucleophilic substitutions: (8)</b><br>The SN <sub>2</sub> , SN <sub>i</sub> and SN <sub>i</sub> with respect to mechanism and stereochemistry. Nucleophilic substitutions at an allylic, aliphatic trigonal, benzylic, aryl and vinylic carbons. Reactivity effect of substrate structure, effect of attacking nucleophiles, leaving groups and reaction medium. SN reactions at bridged head carbon, competition between SN <sub>1</sub> and SN <sub>2</sub> , ambident nucleophiles, Neighbouring Group Participation. | <b>To study,</b><br><b>Reaction mechanism: Structure and reactivity</b><br>Types of reactions, strength of acids and bases. Generation, structure, stability and reactivity of reaction intermediates: Carbocations, carbanions, free radicals, carbenes, nitrenes, benzyne and ylides. Effect of structure on reactivity: resonance, steric, hyperconjugation effects<br><br><b>To study,</b><br><b>Aliphatic Nucleophilic substitutions</b><br>The SN <sub>2</sub> , SN <sub>i</sub> and SN <sub>i</sub> with respect to mechanism and stereochemistry. Nucleophilic substitutions at an allylic, aliphatic trigonal, benzylic, aryl and vinylic carbons. Reactivity effect of substrate structure, effect of attacking nucleophiles, leaving groups and reaction medium. SN reactions at bridged head carbon, competition between SN <sub>1</sub> and SN <sub>2</sub> , ambident nucleophiles, Neighbouring Group Participation. | <b>Students got unde</b><br>Types of reactions, Generation, structure, reaction intermediates, free radicals, carbenes, ylides. Effect of steric, hyperconjugation effects<br><br><b>Students got unde</b><br>The SN <sub>2</sub> , SN <sub>i</sub> and SN <sub>i</sub> stereochemistry. Nu at an allylic, aliphatic vinylic carbons. Re structure, effect of a groups and reaction medium. SN <sub>1</sub> and SN <sub>2</sub> , ambident nucleophiles, Neighbouring Group Participation. |
| <b>Unit - II</b>   |   |  |

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| <p><b>(a) Aromatic Electrophilic Substitutions:</b><br/>Introduction, the arenium ion mechanism, orientation and reactivity in Nitration, Sulphonation, Friedel-Crafts and Halogenation in monosubstituted aromatic systems, energy profile diagrams.<br/>The ortho / para ratio, ipso attack, orientation in other ring systems (naphthalene, anthracene, 5 and 6 membered aromatic heterocyclic compounds). Diazo-coupling, Vilsmeier reaction, Gatterman-Koch reaction. Nucleophilic aromatic substitution reactions <math>SN_1</math>, <math>SN_2</math> and Arynes.</p> <p><b>(b) Addition to Carbon–Carbon Multiple Bonds (7)</b><br/>Mechanism and stereochemical aspects of the addition reactions involving electrophiles, nucleophiles and free radicals, regio- and chemo – selectivity, orientation and reactivity.<br/>Hydrogenation of double, triple bonds and aromatic rings. Michael reaction. Sharpless asymmetric epoxidation.</p> | <p><b>To study,</b><br/>Introduction, the arenium ion mechanism, orientation and reactivity in Nitration, Sulphonation, Friedel-Crafts and Halogenation in monosubstituted aromatic systems, energy profile diagrams.<br/>The ortho / para ratio, ipso attack, orientation in other ring systems (naphthalene, anthracene, 5 and 6 membered aromatic heterocyclic compounds). Diazo-coupling, Vilsmeier reaction, Gatterman-Koch reaction. Nucleophilic aromatic substitution reactions <math>SN_1</math>, <math>SN_2</math> and Arynes.</p> <p><b>To study,</b><br/><b>Addition to Carbon–Carbon Multiple Bonds</b><br/>Mechanism and stereochemical aspects of the addition reactions involving electrophiles, nucleophiles and free radicals, regio- and chemo – selectivity, orientation and reactivity.<br/>Hydrogenation of double, triple bonds and aromatic rings. Michael reaction. Sharpless asymmetric epoxidation.</p> | <p><b>Students got under</b><br/>The arenium ion mechanism, orientation and reactivity in Nitration, Sulphonation, Friedel-Crafts and Halogenation in monosubstituted aromatic systems, energy profile diagrams.<br/>The ortho / para ratio, ipso attack, orientation in other ring systems (naphthalene, anthracene, 5 and 6 membered aromatic heterocyclic compounds). Diazo-coupling, Vilsmeier reaction, Gatterman-Koch reaction. Nucleophilic aromatic substitution reactions <math>SN_1</math>, <math>SN_2</math> and Arynes.</p> <p><b>Students got under</b><br/><b>Addition to Carbon–Carbon Multiple Bonds (7)</b><br/>Mechanism and stereochemical aspects of the addition reactions involving electrophiles, nucleophiles and free radicals, regio- and chemo – selectivity, orientation and reactivity.<br/>Hydrogenation of double, triple bonds and aromatic rings. Michael reaction. Sharpless asymmetric epoxidation.</p> |
| <p><b>Unit - III</b></p> <p><b>(a) Elimination Reactions:</b><br/>The <math>E_1</math>, <math>E_2</math> and <math>E_{1cB}</math> mechanisms. Orientation in Elimination reactions. Hofmann versus Saytzeff elimination. Reactivity: effects of substrate structures, attacking base, the leaving group, the nature of medium on elimination reactions, competition between substitution and elimination reactions, pyrolytic elimination reactions.</p> <p><b>(b) Rearrangements:</b><br/>Study of following rearrangements with mechanism and stereochemistry: Beckmann, Fries, Hoffman, Schmidt, Curtius, Lossen, Claisen, Benzilic acid, Wolff, Stevens' and Sommelet-</p>  | <p><b>To study,</b><br/><b>Elimination Reactions</b><br/>The <math>E_1</math>, <math>E_2</math> and <math>E_{1cB}</math> mechanisms. Orientation in Elimination reactions. Hofmann versus Saytzeff elimination. Reactivity: effects of substrate structures, attacking base, the leaving group, the nature of medium on elimination reactions, competition between substitution and elimination reactions, pyrolytic elimination reactions.</p> <p><b>To study,</b><br/><b>Rearrangements:</b><br/>Study of following rearrangements with mechanism and stereochemistry: Beckmann, Fries, Hoffman, Schmidt, Curtius, Lossen, Claisen, Benzilic acid, Wolff, Stevens' and Sommelet-</p>   | <p><b>Students got under</b><br/><b>Elimination Reactions</b><br/>The <math>E_1</math>, <math>E_2</math> and <math>E_{1cB}</math> mechanisms. Orientation in Elimination reactions. Hofmann versus Saytzeff elimination. Reactivity: effects of substrate structures, attacking base, the leaving group, the nature of medium on elimination reactions, competition between substitution and elimination reactions, pyrolytic elimination reactions.</p> <p><b>Students got under</b><br/><b>Rearrangements:</b><br/>Study of following rearrangements with mechanism and stereochemistry: Beckmann, Fries, Hoffman, Schmidt, Curtius, Lossen, Claisen, Benzilic acid, Wolff, Stevens' and Sommelet-Hauser.</p>  |

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| <b>Unit – IV<br/>Stereochemistry:</b><br>Isomerism, classification of isomers (constitutional and stereoisomers). Concept of Chirality:<br>Recognition of symmetry elements and chiral structures, Prochiral relationship. Racemic modifications and their resolution. R and S nomenclature. Geometrical isomerism E and Z omenclature., Erythro and Threo nomenclature, Conformational analysis of mono and isubstitutedcyclohexanes ( stability and reactivity ), representation of conformational isomers. | <b>To study,<br/>Stereochemistry:</b><br>Isomerism, classification of isomers (constitutional and stereoisomers). Concept of Chirality:<br>Recognition of symmetry elements and chiral structures, Prochiral relationship. Racemic modifications and their resolution. R and S nomenclature. Geometrical isomerism E and Z omenclature., Erythro and Threo nomenclature, Conformational analysis of mono and isubstitutedcyclohexanes ( stability and reactivity ), representation of conformational isomers. | <b>Students got unde<br/>Stereochemistry:</b><br>Isomerism, classific<br>and stereoisomers).<br>Recognition of sym<br>structures, Prochira<br>modifications and t<br>nomenclature. Geom<br>omenclature., Eryth<br>Conformational ana<br>isubstitutedcyclohe<br>representation of co |

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| <b>M.Sc.I</b>  |  |  |
| <b>NAME OF SUBJECT: Physical Chemistry</b>   |  |  |
| <b>SEM I</b>   |  |  |
| <b>COURSE NUMBER ( PAPER NUMBER) HCT-103</b>   |  |  |
| <b>TITLE OF COURSE (NAME OF PAPER): Physical Chemistry-I</b>   |  |  |
| <b>COURSE CONTENT</b>  | <b>OBJECTIVES</b>  |  |
| <b>Chemical Thermodynamics</b><br>Review of Thermodynamics laws,<br>Derivations of Maxwells Relations,<br>Thermodynamic equation of state,<br>Entropy and Third law of<br>thermodynamics, residual entropy.<br>Concept of fugacity and determination of<br>fugacity, Activity and activity<br>coefficients of solute and solvent, their<br>determination by freezing point<br>depression and vapour pressure<br>measurement, criteria for equilibrium<br>between phases, Derivation of phase rule,<br>application of phase rule to three | To Review of Thermodynamics laws,<br>To derive Maxwells Relations,<br>Thermodynamic equation of state,<br>To study Entropy and Third law of<br>thermodynamics, residual entropy.<br>To know about the fugacity and determination<br>of fugacity, Activity and activity coefficients<br>of solute and solvent, their determination by<br>freezing point depression and vapour pressure<br>measurement, criteria for equilibrium between<br>phases,<br>To derive phase rule and apply it to three<br>component system. | Able to know the T<br>Able to derive Ma<br>Thermodynamic eq<br>Understands Entro<br>thermodynamics, r<br>Able to know abou<br>of fugacity, Activi<br>solute and solvent,<br>point depression an<br>measurement, crite<br>phases,<br>Able to derive pha<br>component system |

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| component system.  |  |   |
| Unit-2B:Fast Reactions: [10]<br>Study of kinetics by stop-flow technique, relaxation method, flash photolysis and magnetic resonance method, pressure jump method.<br>(More stress should be given in solving the numerical problems). | Study of kinetics of stop flow technique, relaxation, flash photolysis method temperature jump, pressure jump methods. | Student should understand and be satisfied. Solve the problems. |
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**Class: M.Sc. – I**

**Name of the subject: Chemistry**

**Sem- I**

**Course number –I (HCT-104)**

**TITLE OF THE COURSE: ANALYTICAL CHEMISTRY**

| <b>COURSE CONTENT</b>   | <b>OBJECTIVES</b>   |   |
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| Electro-analytical Techniques:<br>Polarography and Amperometry:<br>Polarography: - Introduction, Instrumentation, Ilkovic equation and its application in quantitative analysis. Half wave potential. Derivation of wave equation, Determination of half wave potential, qualitative and quantitative applications<br>Amperometry: - Principles, instrumentation, nature of titration curves, analytical applications.                                      | Polarography: - Introduction, Instrumentation, Ilkovic equation and its application in quantitative analysis. Half wave potential. Derivation of wave equation, Determination of half wave potential, qualitative and quantitative applications<br>Amperometry: - Principles, instrumentation, nature of titration curves, analytical applications. | The students can understand and be satisfied. Solve the problems.   |
| <b>Chromatographic Methods</b><br>General principles, Classification of Chromatographic methods. Nature of partition forces,<br>Chromatographic behavior of solutes, column efficiency and resolution. Gas Chromatography:<br>Theory and Instrumentation, column types, solid-liquid stationary phases, column switching techniques, basic and specialized detectors.<br>High Performance Liquid Chromatography: Theory and instrumentation, adsorption and | <b>To study the :</b><br><br>General study of chromatographic techniques<br>Chromatographic behavior of solutes, column efficiency and resolution. Gas Chromatography Theory and Instrumentation, column types, solid-liquid stationary phases, column switching techniques   | <b>Students gain in understanding</b><br><br>Knowledge of instrumental techniques<br>Also to study the principles of instruments<br>Study the industrial applications of chromatographic techniques, basic and specialized detectors. |

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| applications.   |   |  |
| <p><b>Unit – III</b></p> <p><b>(a) Study of Organometallic compounds:</b><br/>Organo-magnesium, Organo-zinc, Organo-lithium, organo-copper and organo-tin reagents.<br/>Addition reactions: Additions to carbonyl and unsaturated carbonyl compounds, Witting reaction.</p> <p><b>(b) Methodologies in organic synthesis:</b><br/>Ideas of synthons and retrones, functional group transformation and interconversions of Simple functionalities.</p> | <p>To understand,</p> <p><b>(a) Organometallic compounds like,</b><br/>Organo-magnesium, Organo-zinc, Organo-lithium, organo-copper and organo-tin reagents.<br/>Additions of organometallic reagents to carbonyl and unsaturated carbonyl compounds, Witting reaction.</p> <p><b>(b) Different kinds of Methodologies in organic synthesis</b><br/>Ideas of synthons and retrones,<br/>Functional group transformation,<br/>Interconversions of Simple functionalities</p> | <p>Student got unders<br/>Organo-magnesium<br/>organo-copper and<br/>Additions of organo<br/>unsaturated carbony<br/>Witting<br/>reaction.</p> <p>Student got unders<br/>Methodologies in o<br/>Ideas of synthons a<br/>Functional group tr<br/>Interconversions o</p> |
| <p><b>Unit – IV</b></p> <p>(a) Hydroboration: Mechanism and synthetic applications</p>  | <p><b>(a) Hydroboration</b><br/>Introduction of Hydroboration,<br/>Mechanism,<br/>Synthetic applications</p>  | <p>Student got unders<br/>Hydroboration, Me<br/>applications</p>   |

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| B.A. / B.Sc. / M.A. / M.Sc.  | : <b>M.Sc. I</b>   |   |
| NAME OF SUBJECT  | : Inorganic Chemistry  |   |
| SEM I / II / III / IV / V / VI   | : <b>Sem. II</b>   |   |
| COURSE NUMBER ( PAPER NUMBER)  | : HCP-201  |   |
| TITLE OF COURSE (NAME OF PAPER)  | : <b>Inorganic Chemistry</b>   |   |
| <b>COURSE CONTENT</b>  | <b>OBJECTIVES</b>  | <b>OUTCOME</b>  |
| <p><b>Unit-I: Chemistry of Non-transition Elements</b><br/>           General discussion of the properties of non- transition elements, special features of the individual elements, synthesis, properties and structure of their halides and oxides, polymorphism of carbon, phosphorous, sulphur. Synthesis, structure and properties of boranes, carboranes, borazines, silicates, carbides, silicones, phosphazenes, sulphur nitrogen compounds, oxyacids of nitrogen, phosphorous, sulphur and halogen, interhalogens, pseudohalides and noble gas compounds.</p> | <ol style="list-style-type: none"> <li>To help the students to understand properties of non transition elements, individual element,</li> <li>To help students to understand polymorphism</li> <li>To help the students to understand synthesis, structure, and properties of various compounds</li> </ol> | <ol style="list-style-type: none"> <li>Students understood properties of non transition elements, individual element, students to understand polymorphism</li> <li>students understood synthesis, structure, and properties of various compounds</li> </ol> |
| <p><b>Unit-II: Organometallic Chemistry of Transition Elements</b><br/>           Synthesis, structure and bonding, organometallic reagents in organic synthesis and in homogenous catalytic reactions (hydrogenation,</p>   | <ol style="list-style-type: none"> <li>To help the students to understand organometallic compounds</li> <li>To help the students to understand synthesis of organometallic compounds</li> </ol>  | <ol style="list-style-type: none"> <li>Students understand concept of organometallic compounds</li> <li>Students understand</li> </ol>  |

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| <p>hydroformylation, isomerization, Monsanto acetic acid process, synthesis gas, Wacker Process), Ziegler and Natta catalysis, pi-metal complexes, activation of small molecules by coordination.</p>   | <p>3. To help students to understand various reactions including organometallic compounds as catalyst</p>   | <p>synthesis of organometallic compounds<br/>3. students understood various reactions including organometallic compounds as catalyst</p>  |
| <p><b>Unit-III: A) Metal- Ligand Equilibria in Solution</b><br/>Stepwise and overall formation constants and their interaction, trends in stepwise constants, factors affecting the stability of metal complexes with reference to the metal ion and ligand, chelate effect and its thermodynamic origin, determination of formation constants by pH-metry and spectrophotometry.</p>   | <p>To get knowledge about stability of complexes</p>  | <p>Student understood the meaning of complex and factors affecting the stability of complex and also how to determine the stability of complex</p>  |
| <p><b>Unit-III: B) Chemistry of Lanthanides and Actinides</b><br/>Lanthanides: Introduction, spectral and magnetic properties. Classical methods of separation of lanthanides: (i) precipitation (ii) thermal reaction, (iii) fractional crystallization, (iv) complex formation, (v) solvent extraction and (vi) ion exchange. Use of lanthanide compounds as shift reagent. Applications of lanthanides. Actinides: Introduction, spectral and magnetic properties. Methods of separation of actinides. Preparation of trans-uranic elements. Applications of actinides. Further extension of periodic table.</p> | <p>1. To help the students to understand about lanthanide and actinide<br/>2. To help the students to understand electronic configuration, occurrence separation techniques of lanthanides<br/>3. To help the students to understand electronic configuration, methods of preparation of trans uranic element</p> | <p>1. Students understand lanthanide and actinides<br/>2. Students understand electronic configuration, separation techniques of lanthanide<br/>3. Students understand preparation techniques of actinide</p> |
| <p>Unit-IV: Metallurgy<br/>Occurance, extraction, properties and applications of copper, silver, gold, zinc, tin and lead.</p>  | <p>Students should get knowledge about;<br/>The concept of Metallurgy, occurrence of metals and their separation methods.</p>   | <p>Students understood the existence of metallic elements and the types of their compounds in the nature. They also learn</p>   |

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|  |  | the principle and methodology of separation techniques of metals. |
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| M.Sc. I   |  |   |
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| NAME OF THE SUBJECT- CHEMISTRY  |  |   |
| SEM- II (CBCS)  |  |   |
| COURSE NUMBER (PAPER NUMBER) - II   |  |   |
| TITLE OF COURSE (NAME OF PAPER)- Organic Chemistry  |  |   |
| COURSE CONTENT  | OBJECTIVES   |   |
| <b>Unit-I</b><br><b>(a) Study of following reactions with mechanism:</b><br>Dieckmann, Benzoin, Favorskii reaction, Reimer-Tieman, Stobbe, Diels-Alder, Robinson annulation, Chichibabin, Simon-Smith, Uhlmann, Mc. Murry and Dakin.  | <ul style="list-style-type: none"> <li>To understand the various name reactions, steps, intermediates, their mechanism and applications, with different examples.</li> </ul>   | <ul style="list-style-type: none"> <li>Students easily identify mechanism steps and name reactions.</li> </ul>  |
| <b>(b) Reagents in organic syntheses:</b><br>Complex metal hydrides, LDA, dicyclohexylcarbodiimide(DCC), PTC, crown ethers, Merrifield resin, Peterson's synthesis, 1,3-dithiane, diazomethane, DDQ.  | <ul style="list-style-type: none"> <li>Students must be able to use various reagents used for reactions and their properties.</li> </ul>   | <ul style="list-style-type: none"> <li>Students use the reagents according to the requirement of reactions and their properties.</li> </ul>   |
| <b>Unit – II</b><br><b>(a) Reduction:</b><br>Study of following reductions: Catalytic hydrogenation using homogeneous and heterogeneous catalysts. Study of following reactions: Wolff-Kishner, MeerweinPondorffVerley, Birch, Clemmensen, Sodium borohydride, Lithium Aluminium hydride (LAH) and Sodium in alcohol. | <ul style="list-style-type: none"> <li>Study of following reductions: Catalytic hydrogenation using homogeneous and heterogeneous catalysts. Study of following reactions: Wolff-Kishner, MeerweinPondorffVerley, Birch, Clemmensen, Sodium borohydride, Lithium Aluminium hydride (LAH) and Sodium in alcohol.</li> </ul> | <ul style="list-style-type: none"> <li>Students able to identify Catalytic hydrogenation using homogeneous and heterogeneous catalysts. Study of following reactions: Wolff-Kishner, MeerweinPondorffVerley, Birch, Clemmensen, Sodium borohydride, Lithium Aluminium hydride (LAH) and Sodium in alcohol.</li> </ul> |

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| <p><b>(b) Oxidation:</b><br/>Application of following oxidizing agents: <math>\text{KMnO}_4</math>, chromium trioxide (Jones's reagent, PCC, PDC), Manganese dioxide, Osmium tetroxide, Oppenauer oxidation and Lead tetra-acetate., Hydrogen peroxide, Baeyer-Villiger oxidation, Prevost-Woodward hydroxylation by silver oxide.</p> | <ul style="list-style-type: none"> <li>Students must know how to Apply the following oxidizing agents: <math>\text{KMnO}_4</math>, chromium trioxide (Jones's reagent, PCC, PDC), Manganese dioxide, Osmium tetroxide, Oppenauer oxidation and Lead tetra-acetate., Hydrogen peroxide, Baeyer-Villiger oxidation, Prevost-Woodward hydroxylation by silver oxide.</li> </ul> | <ul style="list-style-type: none"> <li>Students able to Apply the following oxidizing agents: <math>\text{KMnO}_4</math>, chromium trioxide (Jones's reagent, PCC, PDC), Manganese dioxide, Oppenauer oxidation and Lead tetra-acetate., Hydrogen peroxide, Baeyer-Villiger oxidation, Prevost-Woodward hydroxylation by silver oxide.</li> </ul> |
| <p><b>Unit – III</b><br/><b>(a) Study of Organometallic compounds:</b><br/>Organo-magnesium, Organo-zinc, Organo-lithium, organo-copper and organo-tin reagents.<br/>Addition reactions: Additions to carbonyl and unsaturated carbonyl compounds, Wittig reaction.</p>  | <ul style="list-style-type: none"> <li>Students should study the metals and organic compounds like Organo-magnesium, Organo-zinc, Organo-lithium, organo-copper and organo-tin reagents.<br/>Addition reactions: Additions to carbonyl and unsaturated carbonyl compounds, Wittig reaction.</li> </ul>   | <ul style="list-style-type: none"> <li>Students able to study the metals and organic compounds like Organo-zinc, Organo-lithium, organo-copper and organo-tin reagents.<br/>Addition reactions: Additions to carbonyl and unsaturated carbonyl compounds, Wittig reaction.</li> </ul>   |
| <p><b>(b) Methodologies in organic synthesis:</b><br/>Ideas of synthons and retrones, functional group transformation and interconversions of Simple functionalities.</p>  | <ul style="list-style-type: none"> <li>Students should know the Ideas of synthons and retrones, functional group transformation and interconversions of Simple functionalities.</li> </ul>   | <ul style="list-style-type: none"> <li>Students understand the Ideas of synthons and retrones, functional group transformation and interconversions of Simple functionalities.</li> </ul>   |
| <p><b>Unit – IV</b><br/>(a) Hydroboration: Mechanism and synthetic applications<br/>(b) Enamines :Formation and reactivity of enamines<br/>(c) Protection of functional group: Principle of protection of alcohol, amine, carbonyl and carboxyl group.</p>   | <ul style="list-style-type: none"> <li>To understand the reactions like hydroboration, enamines and during desired reactions and desired product formation protection of functional group for alcohols, amines, carbonyl, carboxyl.</li> </ul>   | <ul style="list-style-type: none"> <li>Students understand the reactions like hydroboration, enamines and know the mechanism and synthetic applications protection of functional group for alcohol, amine, carbonyl, carboxyl.</li> </ul>   |

Signature of HOD

**M.Sc.I**

**NAME OF SUBJECT: Physical Chemistry**

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| <b>SEM II</b>  |  |  |
| <b>COURSE NUMBER ( PAPER NUMBER) HCT-203</b>   |  |  |
| <b>TITLE OF COURSE (NAME OF PAPER): Physical Chemistry-II</b>  |  |  |
| <b>COURSE CONTENT</b>  | <b>OBJECTIVES</b>  |  |
| <b>Chemical Kinetics</b><br>Rate determining step, steady state approximation. fractional order kinetics, Higher order kinetics and their examples.<br>Reaction mechanism: Thermal decomposition of acetaldehyde, ethane, reaction between hydrogen and halogens, reaction between NO <sub>2</sub> and F <sub>2</sub> , Decomposition of Ozone. Ionic reactions: Primary and secondary salt effect, Effect of ionic strength and dielectric constant of medium on the rate of ionic reactions in solution. | To know about the Rate determining step, steady state approximation. fractional order kinetics, Higher order kinetics and their examples.<br>To study the Reaction mechanism: Thermal decomposition of acetaldehyde, ethane, reaction between hydrogen and halogens, reaction between NO <sub>2</sub> and F <sub>2</sub> , Decomposition of Ozone. Ionic reactions:<br>To understand the Primary and secondary salt effect, Effect of ionic strength and dielectric constant of medium on the rate of ionic reactions in solution. | Understands the R<br>state approximation<br>Higher order kinet<br>Able to study the F<br>decomposition of a<br>between hydrogen<br>NO <sub>2</sub> and F <sub>2</sub> , Deco<br>reactions:<br>Understands the Pr<br>Effect of ionic stre<br>medium on the rate |
| Photochemistry<br>Introduction, Absorption of light and nature of absorption spectra, electronic transitions,<br>Franck–Condon principle, electronic excitation, photodissociation and Predissocition,<br>photoreduction, photooxidation, photochemistry in environment (Green house effect, ozone depletion).   | To know the basic concept of<br>Introduction, Absorption of light and nature of absorption spectra, electronic transitions, Franck–Condon principle, electronic excitation, photodissociation and Predissocition,<br>photoreduction, photooxidation, photochemistry in environment (Green house effect, ozone depletion).  | Students should k<br>Introduction, Absc<br>absorption spectra,<br>Franck–Condon pr<br>photodissociation a<br>photoreduction, ph<br>environment (Gree<br>depletion).  |

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| <b>M.Sc. I</b>  |  |   |
| <b>NAME OF SUBJECT: Instrumental Methods of Analysis</b>  |  |   |
| <b>SEM II</b>   |  |   |
| <b>COURSE NUMBER ( PAPER NUMBER) OET-204A</b>   |  |   |
| <b>TITLE OF COURSE (NAME OF PAPER): Instrumental Methods of Analysis</b>  |  |   |
| <b>COURSE CONTENT</b>   | <b>OBJECTIVES</b>  |   |
| <b>Unit-1: A) Ultraviolet and visible Spectrophotometry</b><br>Introduction, Beer Lambert's law. Instrumentation, calculation of absorption | <b>To know</b> the Beer Lambert's law. Instrumentation, calculation of absorption maxima of dienes, dienones and polyenes, Qualitative and Quantitative applications | <b>Students are able</b><br>Beer Lambert's law<br>absorption maxima<br>Qualitative and Qu |

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| maxima of dienes, dienones and polyenes, Qualitative and Quantitative applications  |   |   |
| <b>Unit-1: B) Infra-red spectroscopy</b><br>Introduction, instrumentation, sampling technique, selection rules, types of bonds, absorption of common functional groups. Factors affecting frequencies, applications   | <b>To know</b> instrumentation, sampling technique, selection rules, types of bonds, absorption of common functional groups. Factors affecting frequencies, applications  | <b>Students are gain</b><br>Instrumentation, sampling technique, selection rules, types of bonds, absorption of common functional groups. Factors affecting frequencies, applications   |
| <b>Unit-2: Nuclear Magnetic Resonance</b><br>NMR: Introduction, principle, magnetic and nonmagnetic nuclei, precessional motion, Larmor frequency, absorption of radio frequency, Instrumentation (FT-NMR). Sample preparation, shielding and deshielding effects, chemical shift, internal standards, factor influencing chemical shifts, solvent used, peak area and proton ratio, anisotropic effect, spin-spin coupling, coupling constant and application to simple structure problem. | <b>To know</b> the principle of NMR, magnetic and nonmagnetic nuclei, precessional motion, Larmor frequency, absorption of radio frequency, Instrumentation (FT-NMR). Sample preparation, shielding and deshielding effects, chemical shift, internal standards, factor influencing chemical shifts, solvent used, peak area and proton ratio, anisotropic effect, spin-spin coupling, coupling constant and application to simple structure problem. | <b>Students are gain</b><br>Principle of NMR, precessional motion, Larmor frequency, absorption of radio frequency, Instrumentation (FT-NMR). Sample preparation, shielding and deshielding effects, chemical shift, internal standards, factor influencing chemical shifts, solvent used, peak area and proton ratio, anisotropic effect, spin-spin coupling, coupling constant and application to simple structure problem. |
| <b>Unit-3: A) Mass spectroscopy</b><br>Principle, working of mass spectrometer (double beam). Formation of different types of ions, McLafferty rearrangements, fragmentation of alkanes, alkyl aromatics, alcohols and ketones in brief simple applications.  | <b>To know the</b> Principle, working of mass spectrometer (double beam). Formation of different types of ions, McLafferty rearrangements, fragmentation of alkanes, alkyl aromatics, alcohols and ketones in brief simple applications.  | <b>Students are able</b><br>The Principle, working of mass spectrometer (double beam). Formation of different types of ions, McLafferty rearrangements, fragmentation of alkanes, alkyl aromatics, alcohols and ketones in brief simple applications.   |
| <b>Unit-3: B) Simple structural problems based on IR, UV, NMR and MS.</b>   | <b>To solve the</b> Simple structural problems based on IR, UV, NMR and MS.   | <b>Students are able</b><br>Simple structural problems based on IR, UV, NMR and MS.   |
| <b>Unit-4: A) Atomic Absorption Spectroscopy</b><br>Introduction, principle, difference between AAS and FES. Advantages of AAS over FES, Disadvantages of AAS, Instrumentation, Single and double beam AAS, Detection limits and sensitivity, Interference, Applications.   | <b>To know the</b> principle, difference between AAS and FES. Advantages of AAS over FES, Disadvantages of AAS, Instrumentation, Single and double beam AAS, Detection limits and sensitivity, Interference, Applications.  | <b>Students are gain</b><br>Principle, difference between AAS and FES. Advantages of AAS over FES, Disadvantages of AAS, Instrumentation, Single and double beam AAS, Detection limits and sensitivity, Interference, Applications.   |
| <b>Unit-4: B) Inductively Coupled Plasma Spectroscopy</b><br>Introduction, nebulization, torch, plasma, instrumentation, interferences, Applications.   | <b>To know the</b> nebulization, torch, plasma, instrumentation, interferences, Applications.   | <b>Students are gain</b><br>Nebulization, torch, plasma, instrumentation, interferences, Applications.  |

Signature of HOD

## D.B.F. Dayanand College of Arts and Science, Solapur

### COURSE OUTCOME

Name of Department: Chemistry

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| <b>M.Sc.</b>   |   |  |
| <b>NAME OF SUBJECT: Physical Chemistry</b>   |   |  |
| <b>SEM III</b>   |   |  |
| <b>COURSE NUMBER ( PAPER NUMBER) HCT-301</b>   |   |  |
| <b>TITLE OF COURSE (NAME OF PAPER): Quantum Chemistry</b>  |   |  |
| <b>COURSE CONTENT</b>  | <b>OBJECTIVES</b>   | <b>OUTCOME</b>   |
| Failure of classical mechanics. Postulates of Quantum Mechanics, Eigen function and Eigen values. Acceptability of wave functions, Normalized and orthogonal wave functions. Operators and operator algebra, Schmidt Orthogonalisation. Hermitian operators. Theorems related to commutator operations, Concept of angular momentum, angular momentum operators. Ladder operators. | To know the basis of classical mechanics.<br>To understand the origin of Quantum Mechanics<br>To know the basic mathematical formalism of quantum mechanics<br>To understand the concepts like operators, types of operators, | <b>Students will gain the understanding of</b><br>the limitations of classical mechanics at molecular length scales<br>the differences between classical and quantum mechanics<br>the connection of quantum mechanical operators to observables<br>Acquire the fundamentals of quantum mechanics for atomic and molecular systems.<br>Hermitian and unitary operators in quantum mechanical derivations.<br>describe in detail the time evolution of quantum systems, and the Schrödinger and Heisenberg pictures.<br>know the path integral formulation of quantum mechanics. |
| Practical in a box; One / two / Three dimensional Box. Degeneracy in multidimensional box. Tunneling effect, Rigid rotator, Linear harmonic oscillator,  | To study the motions of a particle viz;<br>Translational motion through particle in a box model<br>Rotational motion through- rigid rotor model   | Able to calculate the expectation value of various physical quantities and how the measurement process works in quantum mechanics.<br>solve the Schrödinger equation for various   |

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| <p>the formal solutions, energy levels, degeneracy, properties of wave functions and selection rules. The hydrogen and hydrogen like atoms: Schrodinger equation for hydrogen atom (in polar coordinates) and its complete solution. The radial distribution function and its significance, shapes of atomic orbitals. Application to hydrogen like atoms and molecules (e.g <math>H^{2+}</math>, <math>He^+</math>, <math>Li^{2+}</math> etc)</p> | <p>Vibrational motion through harmonic oscillator model<br/>To understand the concepts like atomic orbitals, shapes of atomic orbitals etc.<br/>To study the simple chemical systems like hydrogen and hydrogen like atoms:<br/>Schrodinger equation for hydrogen atom (in polar coordinates) and its complete solution.</p>                                       | <p>problems, such as the rigid rotator, harmonic oscillator using algebraic methods.<br/>Solve the Schrodinger equation for simple chemical systems like hydrogen and hydrogen like atoms.</p>  |
| <p>Secular equation and secular determinants, Assumptions and formalism of Hückel molecular Orbital Theory, origin of aromatic stability and calculation of delocalization energy. Brief introduction to hetero-nuclear systems. Use of symmetry based linear combination to simplify the problem of Hückel theory calculations for larger aromatic molecules (like butadiene).</p>  | <p>To construct Secular equation and secular determinants,<br/>To know the basic assumptions and formalism of Hückel molecular Orbital Theory,<br/>To study the use of symmetry based linear combination to simplify the problem of Hückel theory calculations for larger aromatic molecules (like butadiene).</p>   | <p>Underrstands the molecular phenomena, interpretation of spectra<br/>the connection between common approximation methods and standard chemical frameworks<br/>Huckel approximations,<br/>HMOT approach for estimation of virial coefficients, pi-electron energies, various parameters like bond order, electron density, charge density, free valence index etc.</p>           |
| <p>Schrödinger wave equation and Hamiltonian for Multi-electron systems. An introduction to ab initio and semi-empirical approximate methods: Variation principle, Perturbation theory, Self-consistent field (SCF) theory, Hertree-Fock (HF) method, Basis sets, Slater and Gaussian type atomic orbitals (STO's and GTO's).</p>  | <p>To derive the Schrödinger wave equation and Hamiltonian for Multi-electron systems.<br/>To introduce the ab initio and semi-empirical approximate methods like Variation method, Perturbation theory, Self-consistent field (SCF) theory, Hertree-Fock (HF) method,<br/>To form the basis sets, Slater and Gaussian type atomic orbitals (STO's and GTO's).</p> | <p>Able to understand different aspects of the angular momentum and spin, for example, addition of angular momentum.<br/>apply the main approximation methods for stationary and time-dependent quantum mechanical problems.<br/>Advanced computational calculations for estimating electrostatic potential, charge density etc.<br/>molecular-level critical thinking skills</p> |

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| <b>M.Sc.II</b>   |  |  |
| <b>NAME OF SUBJECT: Physical Chemistry</b>   |  |  |
| <b>SEM III</b>   |  |  |
| <b>COURSE NUMBER ( PAPER NUMBER) HCT-302 Electrochemistry</b>  |  |  |
| <b>COURSE CONTENT</b>  | <b>OBJECTIVES</b>  | <b>OUTCOMES</b>  |
| <p><b>Electrochemistry : Unit – I Electrolytic conductance: (15)</b><br/> Debye – Huckel theory of inter – ionic attraction, ionic atmosphere, time of relaxation, relaxation and electrophoretic effects, Debye-Huckel –Onsagar equation and its validity for dilute solutions and at appreciably concentrated solutions. Debye- Falkenhagen and Wein effects. Abnormal ionic conductance of hydroxyl and hydrogen ions – Grotthuss mechanism.<br/> Activity coefficients: forms of activity coefficients and their interrelationship. Debye-Huckel limiting law and its applications to concentrated solutions. Debye-Huckel Bronsted equations.<br/> Qualitative and quantitative verification of Debye-Huckel limiting law, ion association,</p> | <p>To study the Debye – Huckel theory of inter – ionic attraction, ionic atmosphere, time of relaxation,<br/> Debye-Huckel limiting law and its applications to concentrated solutions. Debye-Huckel</p> | <p>At the end of this unit student should be able to i) understand the basic concepts and satisfied. ii) To Solve the problems. Iii) describe electrolytic conductance, , Ion solvent interaction and electrolysis, electrode reactions, fuel cells, electroplating etc.</p> |

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| Bjerrum theory, problems  |   |  |
| <b>Unit - II Ion solvent interactions: (15)</b><br>The Born Model and expression for the free energy of ion solvent interactions. Thermodynamic parameters for the ion solvent interactions. Calculations of heats of hydration of ions and the concept of hydration number (Van Arkel, de Boer's and Bernal- Fowler method etc.).  | To study the Born Model and expression for the free energy of ion solvent interactions. Thermodynamic concept of hydration number (Van Arkel, de Boer's and Bernal- Fowler method etc.).                                | At the end of this unit student should be able to i) understand the basic concepts and satisfied. ii) To Solve the problems. iii) describe Born Model and expression for the free energy of ion solvent interactions. Thermodynamic Calculations of heats of hydration of ions |
| <b>Unit- III Electrolysis: (15)</b><br>Decomposition potentials: calculations and determinations. Polarization: types of polarization, overvoltage, hydrogen and oxygen overvoltage, Laws of electrolysis, role of electrolysis in electrometallurgy. Electroforming: process, advantages and disadvantages, Electrotyping: technique, description, electrotyping in printing and in art. | To study the Decomposition potentials, overvoltage Electrotyping: technique, description, electrotyping in printing and in art.   | At the end of this unit student should be able to i) understand the basic concepts and satisfied. ii) To Solve the problems. iii) describe electrolytic conductance, , Ion solvent interaction and electrolysis, electrode reactions, fuel cells, electroplating etc.          |
| <b>Unit – IV : Electrode reactions. (15)</b><br>Tafel equations, kinetics of discharge of hydrogen ions. Diffusion overpotentials, theory of diffusion overpotential and its importance. Fuel cells: significance of fuel cells: hydrogen –   | To study the Tafel equations, kinetics of discharge of hydrogen ions. Diffusion overpotentials ,Fuel cells Corrosion ,Pourbaix diagrams, Electro-osmosis, electrophoresis. Streaming and Sedimentation potentials, Zeta | At the end of this unit student should be able to i) understand the basic concepts and satisfied. ii) To Solve the problems. iii) describe overpotentials ,Fuel cells Pourbaix diagrams, Electro-osmosis, electrophoresis. Streaming and Sedimentation potentials, Zeta        |

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| <p>oxygen, phosphoric acid, molten carbonate, solid polymer electrolytes, hydrocarbon – air, natural gas and carbon monoxide- air fuel cells. Corrosion: concept and importance, classification, mechanism and kinetics of corrosion, Pourbaix diagrams, methods of corrosion prevention. Electrical double layer concept, Electrokinetic and electro-capillary phenomena, electrocapillary curve. Electro-osmosis, electrophoresis. Streaming and Sedimentation potentials, Zeta potentials and its determination by electrophoresis, Influence of ions on Zeta potential</p> |  | etc. |
| <b>TITLE OF COURSE (NAME OF PAPER): Quantum Chemistry</b>  |  |      |

## D.B.F. Dayanand College of Arts and Science, Solapur

### COURSE OUTCOME

Name of Department: Chemistry

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| <b>M.Sc.II</b>  |   |  |
| <b>NAME OF SUBJECT: Physical Chemistry</b>  |   |  |
| <b>SEM III</b>  |   |  |
| <b>COURSE NUMBER ( PAPER NUMBER) PCH –303</b>   |   |  |
| <b>TITLE OF COURSE (NAME OF PAPER): Molecular structure-I</b>   |   |  |
| <b>COURSE CONTENT</b>   | <b>OBJECTIVES</b>   | <b>OUTCOME</b>   |
| <p><b>Introduction of Molecular spectroscopy and Rotational Spectra</b><br/>                     Characterization of electromagnetic radiation. The quantification of energy, Regions of Spectrum, transition probability, the width and intensity of spectral transitions. Classification of molecules according to their moment of inertia. Rotational spectra of rigid and non-rigid diatomic molecules. Selection rules. The intensities of spectral lines. The effect of isotopic substitution. Polyatomic molecules. The Stark effect. Calculations of rotational constant B for real spectrum eg CO, HCl, NO etc. Instrumentation, source, waveguide and</p> | <p><b>To Review of the knowledge of spectroscopy,</b><br/>                     Characterization of electromagnetic radiation. The quantification of energy, Regions of Spectrum, transition probability, the width and intensity of spectral transitions. Classification of molecules according to their moment of inertia. Rotational spectra of rigid and non-rigid diatomic molecules. Selection rules. The intensities of spectral lines. The effect of isotopic substitution. Polyatomic molecules. The Stark effect. Calculations of rotational constant B for real spectrum eg CO, HCl, NO etc. Instrumentation, source, waveguide and detectors</p> | <p><b>Students should review of the knowledge of spectroscopy,</b><br/>                     Characterization of electromagnetic radiation. The quantification of energy, Regions of Spectrum, transition probability, the width and intensity of spectral transitions. Classification of molecules according to their moment of inertia. Rotational spectra of rigid and non-rigid diatomic molecules. Selection rules. The intensities of spectral lines. The effect of isotopic substitution. Polyatomic molecules. The Stark effect. Calculations of rotational constant B for real spectrum eg CO, HCl, NO etc. Instrumentation, source, waveguide and detectors</p> |

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| detectors   |  |   |
| <p><b>Infra-Red Spectroscopy and Raman Spectroscopy:</b><br/> Diatomic molecules: molecules as harmonic oscillator Morse potential energy function, vibrational spectrum, fundamental vibrational frequencies. Force constant, zero point energy, isotope effect. The anharmonic oscillator, the diatomic vibrating rotator, the interaction of rotation and vibration, selection rule. Analysis of one real spectrum.</p> <p>Polyatomic molecules: Fundamental vibrations and their symmetry. Overtone and combination frequencies. The influence of rotations and molecular spin on the spectra of polyatomic molecules. Analysis by infrared techniques.</p> <p>Raman Spectroscopy: Rayleigh scattering. Raman scattering, classical and quantum theories of Raman effect. Rotational Raman spectra. For linear and symmetric top molecules. Vibrational Raman spectra, rotational fine structure. Polarization of light and the Raman effect. Structure determination from Raman and Infrared spectroscopy. Selection rules. Mutual exclusion effect.</p> | <p>. Diatomic molecules: as harmonic oscillator vibrational spectrum, fundamental vibrational frequencies.</p> | <p>To study the spectroscopic methods like, Infra-Red Spectroscopy and Raman Spectroscopy<br/> The study of modes of vibrations in Diatomic and poly atomic molecules</p> |
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**D.B.F. Dayanand College of Arts and Science, Solapur**

**COURSE OUTCOME**

**Name of the Department : Chemistry**

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| <b>B.Sc. I/II/III/M.Sc. I/II : M.Sc. II</b>   |   |   |
| <b>NAME OF THE SUBJECT : Physical Chemistry</b>   |   |   |
| <b>SEM : III</b>  |   |   |
| <b>COURSE NUMBER ( PAPER NUMBER ) : PCH 304</b>   |   |   |
| <b>TITLE OF THE COURSE (TITLE OF THE PAPER ) : Solid State and Nuclear Chemistry</b>  |   |   |
| <b>COURSE CONTENT</b>   | <b>OBJECTIVES</b>   | <b>OUTCOME</b>  |
| <b>Unit II : Solid State Reactions</b><br>General principle, types of reactions: Additive, structure sensitive, decomposition and phase transition reactions, material transport in solid state reactions, Kirkendall effect, kinetics of solid state reactions, factors affecting the reactivity of solid state reactions. | To make students know difference between mode of reactions in solid and liquid state, to get knowledge about factors affecting the solid state reactions. | Students will learn the way reactions take place in solids. |

## D.B.F. Dayanand College of Arts and Science, Solapur

### COURSE OUTCOME

Name of Department: Chemistry

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| <b>M.Sc.II</b>   |  |   |
| <b>NAME OF SUBJECT: Physical Chemistry</b>   |  |   |
| <b>SEM IV</b>  |  |   |
| <b>COURSE NUMBER ( PAPER NUMBER) HCT-401</b>   |  |   |
| <b>TITLE OF COURSE (NAME OF PAPER): Statistical Mechanics and Thermodynamics</b>   |  |   |
| <b>COURSE CONTENT</b>  | <b>OBJECTIVES</b>  | <b>OUTCOME</b>  |
| Exact and inexact differential expressions in two variables. Total differentials. Techniques of partial differentiations. Transformation of variables. Maxima and minima. Integrating Factors, Paff differential equations, Caratheodory's theory. Legendre transformations. Derivation of thermodynamic identities. The second law of thermodynamics, classical formulations, mathematical consequences of second law. Entropy changes, Clausius inequality. Free energy concept. General condition of equilibrium. | To know the Exact, inexact, total and Paff differential expressions in two variables.<br>To transform the variables.<br>To understand the Maxima and minima.<br>To know about Legendre transformations.<br>Derivation of thermodynamic identities.<br>To study the second law of thermodynamics, classical formulations, mathematical consequences of second law. Entropy changes, Clausius inequality.<br>To understand the Free energy concept.<br>General condition of equilibrium. | Understands the Exact, inexact, total and Paff differential expressions in two variables.<br>Able to transform the variables.<br>Understand the Maxima and minima.<br>Does the Legendre transformations.<br>Able to derive the thermodynamic identities.<br>Able to interpret the second law of thermodynamics, classical formulations, mathematical consequences of second law.<br>Entropy changes, Clausius inequality.<br>Understands the Free energy concept. General condition of equilibrium. |
| Configuration and weights, the most probable configuration. Statistical Equilibrium. Postulates of equal probabilities. Ensembles. Ensemble average and time average of property. The classical Boltzmann Distribution   | To know about the Configuration and weights, the most probable configuration. Statistical Equilibrium.<br>To study the Postulates of equal probabilities.<br>Ensembles. Ensemble average and time average of property.   | Understands the Configuration and weights, the most probable configuration. Statistical Equilibrium.<br>Knew the Postulates of equal probabilities.<br>Ensembles. Ensemble average and time average of property.  |

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| <p>law. Principle of the equi-partition of energy, Quantum Statistics : Bose-Einstein, Fermi-Dirac and Maxwell–Boltzmann statistics, comparison of three statistics, Fermi- Dirac systems. Thermodynamics of electromagnetic radiations using BE statistics, Calculation of thermodynamic properties for boson and fermion gases using quantum statistics. Fermi energy. Electron gas in metals.</p>   | <p>To derive the classical Boltzmann Distribution law.<br/>To know the Principle of the equi-partition of energy,<br/>To study Quantum Statistics : Bose-Einstein, Fermi-Dirac and Maxwell–Boltzmann statistics, comparison of three statistics, Fermi-Dirac systems. Thermodynamics of electromagnetic radiations using BE statistics, Calculation of thermodynamic properties for boson and fermion gases using quantum statistics. Fermi energy. Electron gas in metals.</p>  | <p>Able to derive the classical Boltzmann Distribution law.<br/>Understands the Principle of the equi-partition of energy,<br/>Able to solve the Quantum Statistics : Bose-Einstein, Fermi-Dirac and Maxwell–Boltzmann statistics, comparison of three statistics, Fermi-Dirac systems. Thermodynamics of electromagnetic radiations using BE statistics, Calculation of thermodynamic properties for boson and fermion gases using quantum statistics. Fermi energy. Electron gas in metals.</p>   |
| <p>Expressions for translational, rotational, vibrational and electronic partition functions, relation between the partition function and thermodynamic properties. Free energy functions, ortho- and para-hydrogen, use of spectroscopic and structural data to calculate thermodynamics functions. Molecular and statistical interpretation of entropy, third law of thermodynamics and equilibrium constant. Heat capacity of solids, Einstein and Debye specific heat theories. Characteristic temperatures.</p> | <p>To derive the Expressions for translational, rotational, vibrational and electronic partition functions,<br/>To relate the partition function and thermodynamic properties. Free energy functions,<br/>To study ortho- and para- hydrogen, use of spectroscopic and structural data to calculate thermodynamics functions. Molecular and statistical interpretation of entropy, third law of thermodynamics and equilibrium constant.<br/>To study Heat capacity of solids, Einstein and Debye specific heat theories. Characteristic temperatures.</p> | <p>Able to derive the Expressions for translational, rotational, vibrational and electronic partition functions,<br/>Establish the relationship between partition function and thermodynamic properties. Free energy functions,<br/>Able to know ortho- and para- hydrogen, use of spectroscopic and structural data to calculate thermodynamics functions. Molecular and statistical interpretation of entropy, third law of thermodynamics and equilibrium constant.<br/>Understands the Heat capacity of solids, Einstein and Debye specific heat theories. Characteristic temperatures.</p> |
| <p>Conservation of mass in closed and open systems. Conservation of energy in closed and open systems. Law of increasing entropy. Non- adiabatic process and clausius inequality, steady</p>   | <p>To know about Conservation of mass in closed and open systems. Conservation of energy in closed and open systems. Law of increasing entropy.<br/>To study Non- adiabatic process and clausius</p>   | <p>Understands the Conservation of mass in closed and open systems. Conservation of energy in closed and open systems. Law of increasing entropy.<br/>Able to know Non- adiabatic process and clausius</p>  |

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| <p>state. Thermodynamic equations of motion. Entropy production in closed and open systems. Entropy production due to heat flow. Chemical potentials. Generalized fluxes, forces and their transformation. Phenomenological equations and coefficients, concepts of reciprocity relations and Onsager theorem of microscopic reversibility. Diffusion, electromotive force and other reactions involving cross relations e.g. thermoelectric and electrokinetic effects. Saxen's relations. Oscillatory reactions.</p> | <p>inequality, steady state. Thermodynamic equations of motion. Entropy production in closed and open systems. Entropy production due to heat flow. Chemical potentials. Generalized fluxes, forces and their transformation. To understand the Phenomenological equations and coefficients, concepts of reciprocity relations and Onsager theorem of microscopic reversibility. Diffusion, electromotive force and other reactions involving cross relations e.g. thermoelectric and electrokinetic effects. Saxen's relations. Oscillatory reactions.</p> | <p>inequality, steady state. Thermodynamic equations of motion. Entropy production in closed and open systems. Entropy production due to heat flow. Chemical potentials. Generalized fluxes, forces and their transformation. Understands the Phenomenological equations and coefficients, concepts of reciprocity relations and Onsager theorem of microscopic reversibility. Diffusion, electromotive force and other reactions involving cross relations e.g. thermoelectric and electrokinetic effects. Saxen's relations. Oscillatory reactions.</p> |
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Signature of HOD

Sem- IV

Course number – Hard core HCT-402

TITLE OF THE COURSE: CHEMICAL KINETICS.

| COURSE CONTENT  | OBJECTIVES  | OUTCOMES  |
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| <b>Unit – I : Theories of reaction rates: (15)</b><br>Equilibrium and rate of reaction, Partition functions and activated complex, Transition state theory (Thermodynamic and partition function approach), Reaction between polyatomic molecules, calculation of activation parameters of a reaction. Collision theory, energy factor, orientation factor, rate of reaction, Lindemann's mechanism of unimolecular reaction, weakness of the collision theory. | Theories of reaction rates, chemical kinetics, chain reactions, homogeneous catalysis                         | At the end of this unit student should be able to i) Explain Theories of reaction rates, chain reactions, ii) understand the basic concepts and satisfied. Ii) To Solve the problems. |
| <b>Unit – II : Chemical kinetics: (15)</b><br>Kinetics of complex reactions: Opposing reactions, derivation of rate law for first order opposed by first order, second order opposed by first order, sequential reactions: expression for the rate law, maximum concentration of intermediate, time for maximum concentration of intermediate. Kinetics of parallel reactions and their rate law, ratio of products and examples, Numerical problems.           | To study Kinetics of complex reactions: In detail opposing reactions, parallel reactions, Numerical problems. | At the end of this unit student should be able to i) Explain kinetics of complex reactions, ii) understand the basic concepts and satisfied. Ii) To Solve the problems.               |
| <b>Unit-III: Chain reactions: (15)</b><br>Chain reactions. General aspects of chain reactions, chain  | Chain reactions potential energy surfaces (semi-  | At the end of this unit student should be able to i) Explain chain reactions,   |

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| <p>length, reaction between H<sub>2</sub>-Br<sub>2</sub>, H<sub>2</sub>-Cl<sub>2</sub>, H<sub>2</sub>-I<sub>2</sub> and their comparison, thermal decomposition of acetaldehyde, Kinetics of branching chain reactions &amp; explosion limits. Potential energy surfaces: construction of multidimensional potential energy surfaces (semi-empirical treatment), saddle point, reaction co-ordinate, example of tunneling effect, reaction H+H<sub>2</sub></p>   | <p>empirical treatment), saddle point, reaction co-ordinate, example of tunneling effect, reaction H+H<sub>2</sub></p>   | <p>ii) understand the basic concepts and satisfied. Ii) To Solve the problems.</p>  |
| <p><b>Unit – III: Homogeneous catalysis: (15)</b><br/>Kinetics of homogeneous catalysis, general catalytic mechanism, equilibrium and steady- state treatment, activation energies for catalyzed reactions. General acid-base catalysis, mechanisms of acid-base catalysis (Arrhenius and van't Hoff intermediates), catalytic activity and acid base strength, Acidity functions, autocatalysis and oscillatory reactions. Mechanism of enzyme catalyzed reactions and rate law for single substrate, Lineweaver-Burk plot, effect of pH and temperature.</p> | <p>Kinetics of homogeneous catalysis Acidity functions, autocatalysis and oscillatory reactions. Mechanism of enzyme catalyzed reactions and rate law for single substrate, Lineweaver-Burk plot, effect of pH</p> | <p>At the end of this unit student should be able to i) Explain kinetics of homogeneous catalysis ii) understand the basic concepts of autocatalysis and oscillatory reactions. Mechanism of enzyme catalyzed reactions and rate law for single substrate, Lineweaver-Burk plot, effect of pH and satisfied. Ii) To Solve the problems.</p> |

**Head of Department**

**D.B.F. Dayanand College of Arts and Science, Solapur**

**COURSE OUTCOME**

Name of Department: Chemistry

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| <b>M.Sc.II</b>   |   |   |
| <b>NAME OF SUBJECT: Physical Chemistry</b>   |   |   |
| <b>SEM IV</b>  |   |   |
| <b>COURSE NUMBER ( PAPER NUMBER) 403</b>   |   |   |
| <b>TITLE OF COURSE (NAME OF PAPER): Molecular structure-II</b>   |   |   |
| <b>COURSE CONTENT</b>  | <b>OBJECTIVES</b>   | <b>OUTCOME</b>  |
| <p><b>Electrical Properties of Molecules</b><br/>                     Electric dipole moment of molecule, polarization of a dielectric, polarizability of molecules, Clausius-Mossotti equation. Debye equation, Limitation of the Debye theory, determination of dipole moment from dielectric measurements in pure liquids and in solutions. Dipole moment and ionic character, Bond moment, Group moment, vector addition of moments, bond angles, the energies due to dipole-dipole, dipole-induced dipole and induced dipole-induced dipole interaction. Lennard-Jones potential.</p> <p><b>The Magnetic properties of Molecules:</b><br/>                     Diamagnetism and paramagnetism. Volume and mass susceptibilities. Lengevins classical theory of diamagnetism and</p> | <p><b>To Review of the knowledge of</b><br/>                     Electric dipole moment of molecule, polarization of a dielectric, polarizability of molecules, Clausius-Mossotti equation. Debye equation, Limitation of the Debye theory, determination of dipole moment from dielectric measurements in pure liquids and in solutions. Dipole moment and ionic character, Bond moment, Group moment, vector addition of moments, bond angles, the energies due to dipole-dipole, dipole-induced dipole and induced dipole-induced dipole interaction. Lennard-Jones potential.</p> <p><b>To Review of the knowledge of</b><br/>                     Diamagnetism and paramagnetism. Volume and mass susceptibilities. Lengevins classical theory of diamagnetism and paramagnetism. Atomic and ionic susceptibility. Pascal constants,</p> | <p><b>Students should understand.</b><br/>                     Electric dipole moment of molecule, polarization of a dielectric, polarizability of molecules, Clausius-Mossotti equation. Debye equation, Limitation of the Debye theory, determination of dipole moment from dielectric measurements in pure liquids and in solutions. Dipole moment and ionic character, Bond moment, Group moment, vector addition of moments, bond angles, the energies due to dipole-dipole, dipole-induced dipole and i interaction. Lennard-Jones</p> <p><b>Students should understand</b><br/>                     Diamagnetism and paramagnetism. Volume and mass susceptibilities. Lengevins classical theory of diamagnetism and paramagnetism. Atomic and ionic susceptibility. Pascal constants,</p> |

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| <p>paramagnetism. Atomic and ionic susceptibility. Pascal constants, Curie- Weiss law. Van Vleck general equation of magnetic susceptibility. Determination of magnetic susceptibility, Gouy method. Ferro and ferri magnetism, application to coordination complexes and complex ions of transition metals.</p>   | <p>Curie- Weiss law. Van Vleck general equation of magnetic susceptibility. Determination of magnetic susceptibility, Gouy method. Ferro and ferri magnetism, application to coordination complexes and complex ions of transition metals.</p>                | <p>Curie- Weiss law. Van Vleck general equation of magnetic susceptibility. Determination of magnetic susceptibility, Gouy method. Ferro and ferri magnetism, application to coordination complexes and complex ions of transition metals.</p> |
| <p>Nuclear Magnetic Resonance Spectroscopy:<br/>The nature of spinning particles, interaction between spin and magnetic field. Population of energy levels and signal to noise ratio, the Larmour precession, relaxation times, the meaning of resonance, selection rules and the resonance condition. NMR experiment and instrumentation, significance of shielding constants and chemical shift, chemical analysis by NMR. Simple and complex splitting patterns. Fourier Transformer and FT NMR. Exchange phenomena, <sup>13</sup>C NMR spectroscopy, double resonance and Nuclear-Overhauser effect.</p> | <p>The nature of spinning particles, interaction between spin and magnetic field. Population of energy levels and signal to noise ratio, the Larmour precession, relaxation times, the meaning of resonance, selection rules and the resonance condition.</p> | <p>To understand principle of NMR Spectroscopy and splitting pattern, exchange phenomenon, <sup>13</sup>C NMR and NOE etc.</p>   |
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COURSE OUTCOME

Name of the Department : Chemistry

| <b>M.Sc. II</b>  |   |  |
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| <b>NAME OF THE SUBJECT : Physical Chemistry</b>  |   |  |
| <b>SEM : IV</b>  |   |  |
| <b>COURSE NUMBER ( PAPER NUMBER ) : PCH 404</b>  |   |  |
| <b>TITLE OF THE COURSE (TITLE OF THE PAPER ) : Surface Chemistry</b>   |   |  |
| <b>COURSE CONTENT</b>  | <b>OBJECTIVES</b>   | <b>OUTCOME</b>   |
| <b>Unit II : Liquid-Gas interfaces</b><br>Types of interfaces, Surface and interfacial tension, Young and Laplace equation for vapor pressure at curved , plane and spherical interfaces , Kelvin equation for Vapor<br>Pressure inside and outside the liquid droplet, methods of determination of surface tension. | To make students know about surface tension between liquid-gas interfaces and methods of determination.   | Students will learn surface tension between liquid-gas interfaces. |
| <b>Unit III: Liquid-Liquid interfaces:</b><br>Surface spreading, spreading coefficient, cohesion and adhesion energy, surface energy and spreading coefficient, Langmuir–Adam surface pressure balance, formation of insoluble monomolecular films, Langmuir-Blodget films, physical states of film, $\pi$ -A        | To make students know about surface tension between liquid-liquid interfaces and methods of determination. To also get knowledge about emulsion and nano-particles. |  |

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| <p>isotherm and its comparison with P-V isotherm, derivation <math>\pi A = kT</math> equation, gaseous, liquid expanded and condensed films. Emulsion, identification of emulsion, types of emulsion, emulsion stability, emulsifier, theories of emulsification, preparation of nanoparticles by using reprecipitation and emulsion method.</p> |  |  |
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