

# Maharaja Ranjit Singh College of Professional Sciences, Indore

Department of Biosciences

Lesson Plan - B. Sc. I Semester (July 2016 - Dec 2016)

**Subject - Chemistry - I**

**Teacher - Prof. Deepanshu Pandey**

| Day/Lecture | Unit   | Topic                                                                                            |
|-------------|--------|--------------------------------------------------------------------------------------------------|
| 1           | Unit 1 | <b>A. Mathematical Concept :</b>                                                                 |
| 2           | Unit 1 | Logarithm relations (rules & types)                                                              |
| 3           | Unit 1 | Use of log table and antilog table in calculation                                                |
| 4           | Unit 1 | Curve sketching (Straight line and linear graphs), Calculation of slopes                         |
| 5           | Unit 1 | Differentiation of functions like $Kx, \sin x, \log x$                                           |
| 6           | Unit 1 | Multiplication and division in differentiation                                                   |
| 7           | Unit 1 | maxima and minima                                                                                |
| 8           | Unit 1 | partial differentiation, Integration of some useful/ relevant functions                          |
| 9           | Unit 1 | Factorials                                                                                       |
| 10          | Unit 1 | Probability                                                                                      |
| 11          | Unit 1 | Revision of chapter after completion of unit                                                     |
| 12          | Unit 1 | <b>B. Gaseous States and Molecular Velocities :</b>                                              |
| 13          | Unit 1 | Critical Phenomenon: PV isotherm of ideal gases                                                  |
| 14          | Unit 1 | Andrew's experiment                                                                              |
| 15          | Unit 1 | Continuity of state                                                                              |
| 16          | Unit 1 | Isotherms of van der waal's equation                                                             |
| 17          | Unit 1 | relationship between critical constants and vander waals constants                               |
| 18          | Unit 1 | Root mean square, average & most probable velocities                                             |
| 19          | Unit 1 | Qualitative discussion of the Maxwell's distribution of molecular velocities                     |
| 20          | Unit 1 | collision numbers, mean free path and collision diameter                                         |
| 21          | Unit 2 | <b>A. Liquid States :</b> Intermolecular forces , structure of liquids, Liquid crystals          |
| 22          | Unit 2 | Difference between liquid crystal, solid & liquid                                                |
| 23          | Unit 2 | classification, structure of nematics and cholestric phases                                      |
| 24          | Unit 2 | Thermography, & seven segment cell                                                               |
| 25          | Unit 2 | <b>B. Solid State :</b> Defination of space lattice, Unit cell                                   |
| 26          | Unit 2 | Laws of crystallography : (a) Law of constancy of interfacial angles,                            |
| 27          | Unit 2 | (b) law of rationality of indices (c) law of symmetry                                            |
| 28          | Unit 2 | Symmetry elements in crystal, ionic solid structures, Radius Ratio effect                        |
| 29          | Unit 2 | Coordination number, limitation of radius rule lattice defects                                   |
| 30          | Unit 2 | Revision of chapter after completion of unit                                                     |
| 31          | Unit 3 | <b>(a) Elementary Quantum Mechanics :</b> Dual Nature of matter, idea of de Broglie matter waves |
| 32          | Unit 3 | Heisenberg uncertainty principle, atomic orbital                                                 |
| 33          | Unit 3 | Schrodinger wave equation, Significance of $\Psi$ and $\Psi^2$                                   |
| 34          | Unit 3 | quantum numbers, radial and angular wave functions                                               |
| 35          | Unit 3 | probability distribution curves, shapes of s, p, d, orbitals                                     |
| 36          | Unit 3 | Aufbau and pauli exclusion principles, Hund's multiplicity rule                                  |
| 37          | Unit 3 | Electronic configuration of the elements, effective nuclear charge                               |
| 38          | Unit 3 | <b>(b) Periodic Properties :</b> Atomic and ionic radii , ionization energy                      |
| 39          | Unit 3 | electron affinity , electronegativity- defination, methods of determination or evaluation        |
| 40          | Unit 3 | trends in periodic table and applications in predicting and explaining chemical behaviour        |
| 41          | Unit 3 | Revision after the completion of the unit.                                                       |
| 42          | Unit 3 | <b>(c) Chemical Bonding :</b> Covalent Bond- Valence bond theory and its limitations             |
| 43          | Unit 3 | directional characteristic of covalent bond                                                      |
| 44          | Unit 3 | various types of hybridization and shapes of simple inorganic molecules and ions                 |
| 45          | Unit 3 | Valence shell electron pair repulsion (VSEPR) theory to $NH_3$                                   |
| 46          | Unit 3 | Valence shell electron pair repulsion (VSEPR) theory to $H_2O, SF_4, ClF_3$ and $H_2O$           |
| 47          | Unit 3 | Revision of chapter after completion of unit                                                     |
| 48          | Unit 4 | <b>(a) S-Block Elements :</b> Comparative study Li and Mg                                        |
| 49          | Unit 4 | diagonal relationships, silent features of hydrides, solvation and complexation                  |
| 50          | Unit 4 | trends including their function in biosystems an introduction to alkyls and aryls                |
| 51          | Unit 4 | <b>(b) P-Block Elements I :</b> Comparative study Be and Al                                      |
| 52          | Unit 4 | diagonal relationship of groups 13-17 elements                                                   |
| 53          | Unit 4 | Compounds like hydrides, oxides                                                                  |
| 54          | Unit 4 | oxyacids of groups 13-16                                                                         |

|    |        |                                                                                                   |
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| 55 | Unit 4 | halide of groups 13-16                                                                            |
| 56 | Unit 4 | Hydrides of boron-diborane and higher boranes                                                     |
| 57 | Unit 4 | Hydrides of boron-diborane and higher boranes                                                     |
| 58 | Unit 4 | borazine borohydrides                                                                             |
| 59 | Unit 5 | <b>(a) Bond lengths and bond angles, bond energy</b> : Defination                                 |
| 60 | Unit 5 | localized and delocalized chemical bond                                                           |
| 61 | Unit 5 | inclusion compounds, clathrates                                                                   |
| 62 | Unit 5 | charge transfer complexes                                                                         |
| 63 | Unit 5 | resonance, hyperconjugation                                                                       |
| 64 | Unit 5 | inductive, electromeric, mesomeric and steric effect                                              |
| 65 | Unit 5 | Hydrogen bonding                                                                                  |
| 66 | Unit 5 | <b>(b) Types of Reagents:</b> homolytic and heterolytic bond fission                              |
| 67 | Unit 5 | Types of reagents- electrophiles and nucleophiles                                                 |
| 68 | Unit 5 | Types of organic reaction, energy consideration                                                   |
| 69 | Unit 5 | Homolytic and heterolytic cleavage                                                                |
| 70 | Unit 5 | Reactive intermediates- Carbocations                                                              |
| 71 | Unit 5 | Carboanions, free radicals                                                                        |
| 72 | Unit 5 | Carbenes\ Benzynes                                                                                |
| 73 | Unit 5 | <b>(c) Stereochemistry</b> : Concept of Stereoisomerism, types of stereoisomerism                 |
| 74 | Unit 5 | element of symmetry, Chiral and Achiral compounds                                                 |
| 75 | Unit 5 | Fischer projection formulae; optical isomerism of lactic and tartaric acids                       |
| 76 | Unit 5 | enantiomerism and diastereoisomerism                                                              |
| 77 | Unit 5 | configuration (relative and absolute); conformation of ethane and n-butane and cyclohexane        |
| 78 | Unit 5 | D, L & R,S notation of compounds containing chiral centers                                        |
| 79 | Unit 5 | projection formulae- Fischer, Newman and Sawhorse of compounds containing adjacent chiral centers |
| 80 | Unit 5 | meso and dl- isomers                                                                              |
| 81 | Unit 5 | erythro and threo isomers; racemization and resolution                                            |
| 82 | Unit 5 | geometrical isomer ; E & Z notation                                                               |
| 83 | Unit 5 | Revision after the completion of the unit.                                                        |

**Maharaja Ranjit Singh College of Professional Sciences, Indore**

Department of Biosciences

Lesson Plan - B. Sc. I Semester (July 2016 - Dec 2016)

**Subject - Chemistry Practical****Teacher - Prof. Deepanshu Pandey**

| Day/Lecture | Unit | Topic                                                                                                            |
|-------------|------|------------------------------------------------------------------------------------------------------------------|
| 1           |      | <b>Physical Chemistry : An introduction</b>                                                                      |
|             |      | <b>(A) Any one experiment :</b>                                                                                  |
| 2           |      | (i) Calibration of thermometer                                                                                   |
| 3           |      | (ii) Determination of melting point                                                                              |
| 4           |      | (iii) Determination of boiling point                                                                             |
| 5           |      | (iv) Preparation of solution of various concentration NaOH,HCl, H <sub>2</sub> SO <sub>4</sub>                   |
| 6           |      | <b>(B) Any one experiment :</b>                                                                                  |
| 7           |      | (i) Determination of surface tension/percentage composition of given liquid mixture using surface tension method |
| 8           |      | (ii) Determination of viscosity/ percentage composition of given liquid mixture using viscosity method.          |
|             |      | <b>Organic Chemistry (Any two)</b>                                                                               |
| 9           |      | (i) Distillation                                                                                                 |
| 10          |      | (ii)crystallization                                                                                              |
| 11          |      | (iii) Decolorisation and crystallization using charcoal                                                          |
| 12          |      | (iv) sublimation                                                                                                 |
| 13          |      | (v) Detection of elements and functional groups                                                                  |
| 14          |      | (vi) Organic molecules through models with special reference to optical and geometrical isomerism                |
|             |      |                                                                                                                  |
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**Maharaja Ranjit Singh College of Professional Sciences, Indore**

Department of Biosciences

Lesson Plan - B. Sc. II Semester (Jan 2017 - June 2017)

**Subject - Chemistry - I      Paper : Physical Chemistry**

**Teacher - Prof. Deepanshu Pandey**

| Day/Lecture | Unit   | Topic                                                                                            |
|-------------|--------|--------------------------------------------------------------------------------------------------|
| 1           | Unit 1 | <b>Chemical Kinetics</b> : Chemical kinetics and its scope, rate of a reaction                   |
| 2           | Unit 1 | Factors affecting rate : Conc, temp., solvent, light, catalyst, pressure                         |
| 3           | Unit 1 | Dependence of rate on concentration,                                                             |
| 4           | Unit 1 | Mathematical characteristic of simple chemical reaction: Zero order, First order, Second, Pseudo |
| 5           | Unit 1 | half life and mean life, Determination of the order of reaction                                  |
| 6           | Unit 1 | Differential method, half life method                                                            |
| 7           | Unit 1 | Determination of the order of reaction by integration method                                     |
| 8           | Unit 1 | study of chemical kinetics by polarimetry                                                        |
| 9           | Unit 1 | study of chemical kinetics by spectrophotometry                                                  |
| 10          | Unit 1 | Effect of temperature on rate of reaction                                                        |
| 11          | Unit 1 | Arrhenius equation, Concept of activation energy                                                 |
| 12          | Unit 1 | Simple collision theory, transition state theory                                                 |
| 13          | Unit 1 | Revision of chapter after completion of unit                                                     |
| 14          | Unit 2 | <b>(a) Thermodynamics</b> : definition of thermodynamics                                         |
| 15          | Unit 2 | terms: system, surrounding, Types of systems                                                     |
| 16          | Unit 2 | intensive and extensive properties                                                               |
| 17          | Unit 2 | state and path function and their differential                                                   |
| 18          | Unit 2 | thermodynamic process                                                                            |
| 19          | Unit 2 | concept of heat and work                                                                         |
| 20          | Unit 2 | <b>(b) Molecular Orbital Theory</b> : homonuclear and heteronuclear diatomic molecules           |
| 21          | Unit 2 | multicenter bonding in electron deficient molecules                                              |
| 22          | Unit 2 | bond strength and bond energy                                                                    |
| 23          | Unit 2 | calculation of percentage ionic character from dipole moment and electronegativity difference    |
| 24          | Unit 2 | (c) Ionic Solids : semiconductor, lattice energy and Born-Haber cycle                            |
| 25          | Unit 2 | Solvation energy and solubility of ionic solids                                                  |
| 26          | Unit 2 | polarizing power and polarizability of ions                                                      |
| 27          | Unit 2 | Fajan's rule, metallic bond                                                                      |
| 28          | Unit 2 | Free electron, Valence bond                                                                      |
| 29          | Unit 2 | Band theories                                                                                    |
| 30          | Unit 2 | Revision of chapter after completion of unit                                                     |
| 31          | Unit 3 | <b>(a) Acids and Bases</b> : Arrhenius, Bronsted-Lowry,                                          |
| 32          | Unit 3 | Solvent system, Lewis Concepts                                                                   |
| 33          | Unit 3 | <b>(b) Chromatographic Techniques</b> : Definition, classifications and principle                |
| 34          | Unit 3 | separation of inorganic ions, amino acids                                                        |
| 35          | Unit 3 | separation of carbohydrates ( Paper chromatography & TLC methods)                                |
| 36          | Unit 3 | separation of carbohydrates ( Paper chromatography & TLC methods)                                |
| 37          | Unit 3 | Revision of chapter after completion of unit                                                     |
| 38          | Unit 4 | <b>Alkanes and cycloalkanes</b> : IUPAC nomenclature of branched and unbranched alkanes          |
| 39          | Unit 4 | classification of alkanes, isomerism in alkanes                                                  |
| 40          | Unit 4 | methods of formation ( Wurtz rxn, Fittig Rxn, Corey House Rxn, Decarboxylation )                 |
| 41          | Unit 4 | physical and chemical reaction of alkanes                                                        |
| 42          | Unit 4 | conformation of alkanes                                                                          |
| 43          | Unit 4 | mechanism of free radical halogenation of alkanes                                                |
| 44          | Unit 4 | <b>cycloalkanes</b> -nomenclature, methods of formation,                                         |
| 45          | Unit 4 | chemical reaction, Baeyer strain theory and its limitation                                       |
| 46          | Unit 4 | Theory of strainless rings                                                                       |
| 47          | Unit 4 | The case of cyclopropane ring : Banana bonds                                                     |
| 48          | Unit 4 | conformation of cycloalkanes                                                                     |
| 49          | Unit 4 | Revision of chapter after completion of unit                                                     |
| 50          | Unit 5 | <b>Alkene, Cycloalkenes, Dienes</b> : Nomenclature of alkenes                                    |

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| 51 | Unit 5 | methods of formation - mechanism of dehydration of alcohols and dehydrogenation of alkyl halides |
| 52 | Unit 5 | regioselectivity in alcohol dehydration                                                          |
| 53 | Unit 5 | The saytzeff rule                                                                                |
| 54 | Unit 5 | Hofmann elimination                                                                              |
| 55 | Unit 5 | physical properties and relative stabilities of alkenes                                          |
| 56 | Unit 5 | Chemical reaction of alkenes- mechanism involved in hydrogenation                                |
| 57 | Unit 5 | electrophilic and free radical addition                                                          |
| 58 | Unit 5 | Markownikoff's rule                                                                              |
| 59 | Unit 5 | hydroboration- oxidation , oxymercuration reduction                                              |
| 60 | Unit 5 | Epoxidation, ozonolysis                                                                          |
| 61 | Unit 5 | polymerization of alkenes                                                                        |
| 62 | Unit 5 | substitution of allylic and vinylic positions                                                    |
| 63 | Unit 5 | application of ethylene and propene                                                              |
| 64 | Unit 5 | Methods of formation, conformation and chemical reactions of cycloalkanes                        |
| 65 | Unit 5 | Nomenclature and classification of dienes: isolated, conjugated and cumulated dienes             |
| 66 | Unit 5 | structure of allenes and butadiene                                                               |
| 67 | Unit 5 | methods of formation                                                                             |
| 68 | Unit 5 | polymerisation                                                                                   |
| 69 | Unit 5 | Chemical reaction- 1,2 and 1,4 addition                                                          |
| 70 | Unit 5 | Diels- Alder reaction                                                                            |
| 71 | Unit 5 | Revision on completion of the unit                                                               |
| 72 | Unit 5 | <b>Alkynes and Alkyl Halides</b> : Nomenclature, structure and bonding of alkynes                |
| 73 | Unit 5 | Methods of formation, chemical reactions                                                         |
| 74 | Unit 5 | acidity of alkynes, Mechanism of electrophilic and nucleophilic addition reaction                |
| 75 | Unit 5 | hydroboration oxidation , metal- ammonia reduction- oxidation                                    |
| 76 | Unit 5 | polymerization of alkynes                                                                        |
| 77 | Unit 5 | Nomenclature and classification of alkyl halides                                                 |
| 78 | Unit 5 | methods of formation, chemical reactions                                                         |
| 79 | Unit 5 | Mechanism of nucleophilic substitution reaction of alkyl halides                                 |
| 80 | Unit 5 | SN 1 and SN 2 reaction with energy profile diagrams                                              |
| 81 | Unit 5 | Elimination reaction                                                                             |
| 82 | Unit 5 | Polyhalogen compounds : methods of preparation                                                   |
| 83 | Unit 5 | properties of chloroform and carbon tetrachloride                                                |
| 84 | Unit 5 | Revision on completion of the unit                                                               |



**Maharaja Ranjit Singh College of Professional Sciences, Indore**

Department of Chemical Science

Lesson Plan - B.Sc. III sem (July 2016 - Dec 2016)

Subject - Chemistry Paper I (Chemistry)

Teacher - Prof. Seema Shintre

| Day/Lecture | Unit | Topic                                                                                                     |
|-------------|------|-----------------------------------------------------------------------------------------------------------|
|             | 1    | <b>Arenes and Aromaticity</b>                                                                             |
| 1           |      | Structure of Benzene, molecular formula and Kekulé structure.                                             |
| 2           |      | Stability and carbon-carbon bond lengths of benzene, resonance structure.                                 |
| 3           |      | MO picture, Aromaticity, The Huckel rule.                                                                 |
| 4           |      | Aromatic electrophilic substitution, mechanism of nitration                                               |
| 5           |      | mechanism of halogenation, sulphonation                                                                   |
| 6           |      | mercuration and Friedel-Crafts reaction and energy profile diagram.                                       |
|             |      | <b>Aryl Halide</b>                                                                                        |
| 7           |      | Methods of formation and reactions of aryl halide                                                         |
| 8           |      | Mechanism of nucleophilic aromatic substitution, synthesis and uses of DDT                                |
| 9           |      | Synthesis and uses of BHC and Freon.                                                                      |
|             | 2    | <b>(a) Alcohols: classification and nomenclature</b>                                                      |
| 10          |      | Monohydric alcohol: nomenclature, methods of formation by reduction of aldehyde, ketones                  |
| 11          |      | Carboxylic acid and esters, acidic nature                                                                 |
| 12          |      | reaction of alcohols                                                                                      |
| 13          |      | Dihydric alcohol: Nomenclature, methods of formation, chemical reactions of vicinal glycols               |
| 14          |      | Oxidative cleavage and pinacol-pinacolone rearrangement                                                   |
| 15          |      | Trihydric alcohols- Nomenclature and methods of formation                                                 |
| 16          |      | Chemical reaction of glycerol                                                                             |
|             |      | <b>(b) Phenols</b>                                                                                        |
| 17          |      | Nomenclature, structure and methods of formation                                                          |
| 18          |      | Acidic character, comparative acidic strength of alcohols and phenols                                     |
| 19          |      | Stabilization of phenoxide ion by resonance, acylation and carboxylation mechanism of Fries rearrangement |
| 20          |      | Gatterman synthesis, Hauben-Hoesch reaction                                                               |
| 21          |      | Lederer-Manasse reaction and Reimer-Tiemann reaction.                                                     |
|             | 3    | <b>Chemistry of elements of I transition series:</b>                                                      |
| 22          |      | Characteristics properties of d-block elements                                                            |
| 23          |      | Properties of the elements of the first transition series                                                 |
| 24          |      | binary compounds such as carbides, sulphides                                                              |
| 25          |      | binary compounds such as Oxides                                                                           |
| 26          |      | complexes illustrating relative stability of their oxidation states                                       |
| 27          |      | co-ordination number and geometry                                                                         |
|             |      | <b>Chemistry of elements of II and III transition series:</b>                                             |
| 28          |      | General characteristics comparative study of II and III transition series: ionic radii, Oxidation states  |
| 29          |      | Magnetic behavior, Spectral properties                                                                    |
| 30          |      | Stereochemistry                                                                                           |
|             | 4    | <b>Co-ordination compounds</b>                                                                            |
| 31          |      | IUPAC Nomenclature, isomerism                                                                             |
| 32          |      | EAN concept, Chelates                                                                                     |
| 33          |      | VBT of transition metal complexes and its limitation                                                      |
| 34          |      | Crystal field theory, Crystal field stabilization energy                                                  |
| 35          |      | chemical series, limitation of CFT                                                                        |
|             |      | <b>Thermochemistry: Standard state, standard enthalpy of formation</b>                                    |
| 36          |      | Hess's law of heat summation and its application                                                          |
| 37          |      | Heat of reaction at constant pressure and constant volume                                                 |
| 38          |      | Enthalpy of neutralization                                                                                |
| 39          |      | Second law of thermodynamics, Carnot cycle                                                                |

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| 40 |   | Carnot cycle efficiency, Carnot theorem, Thermodynamic scale of temperature.                             |
|    | 5 | <b>Thermodynamics: concept of entropy</b>                                                                |
| 41 |   | entropy, entropy as a function of P & T                                                                  |
| 42 |   | entropy change in physical change, Clausius inequality                                                   |
| 43 |   | entropy as criteria of spontaneity and equilibrium, mixing of gases                                      |
| 44 |   | entropy change in ideal gases                                                                            |
| 45 |   | Third law of thermodynamics: Nernst heat theorem, statement and concept of residual entropy              |
| 46 |   | evaluation of absolute entropy from heat capacity data, Gibbs and Helmholtz function                     |
| 47 |   | Gibbs function and Helmholtz function as a thermodynamic quantities                                      |
| 48 |   | A and G as a criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change |
| 49 |   | relative variation of G&A with P, V, T                                                                   |
| 50 |   | <b>Buffer:</b> Mechanism of buffer action, Henderson-Hassel equation                                     |
| 51 |   | Hydrolysis of salts                                                                                      |

**Maharaja Ranjit Singh College of Professional Sciences, Indore**

Department of Chemical Sciences

Lesson Plan - B.Sc. III Sem (July2016-Dec-2016)

Subject - Chemistry Practical

**Teacher - Prof. Seema Shintre**

| Day/Lecture | Unit | Topic                                                                                                                                           |
|-------------|------|-------------------------------------------------------------------------------------------------------------------------------------------------|
|             |      | <b>Inorganic Chemistry</b>                                                                                                                      |
| 1           |      | Calibration of the fractional weights, pipettes and burettes                                                                                    |
| 2           |      | Preparation of standard solutions. Dilution of 0.1M to 0.01 M solutions                                                                         |
|             |      | <b>Qualitative analysis: Volumetric analysis</b>                                                                                                |
| 3           | a    | Determination of acetic acid in commercial vinegar using NaOH.                                                                                  |
| 4           | b    | Determination of alkali content- antacid tablet using HCl.                                                                                      |
| 5           | c    | Estimation of calcium content in chalk as calcium oxalate by permanganometry.                                                                   |
| 6           | d    | Estimation of hardness of water by EDTA.                                                                                                        |
|             |      | <b>Complex compound preparation:</b>                                                                                                            |
| 7           | 1    | Diaquabis(methyl acetoacetato) nickel (II)                                                                                                      |
| 8           | 2    | Diaquabis(methyl acetoacetato) Cobalt (II)                                                                                                      |
| 9           | 3    | Bis (methyl acetoacetato) copper (II) monohydrate                                                                                               |
| 10          | 4    | Potassium chlorochromate(IV)                                                                                                                    |
| 11          | 5    | Tetraamminecopper(II) sulphate monohydrate                                                                                                      |
| 12          | 6    | Hexaaminenickel(II) chloride                                                                                                                    |
|             |      | <b>Organic chemistry</b>                                                                                                                        |
|             |      | <b>Thin layer chromatography</b>                                                                                                                |
|             |      | Determination of R <sub>f</sub> values and identification of organic compounds                                                                  |
| 13          | a    | Separation of green leaf pigments (spinach leaves may be used)                                                                                  |
| 14          | b    | Preparation and separation of 2,4- dinitrophenylhydrazones of acetone, 2-butanone, hexane-2, and 3-one using toluene and light petroleum (40:6) |
| 15          | c    | Separation of a mixture of dyes using cyclohexane and ethylacetate. (8:5:1.5)                                                                   |
|             |      | <b>Paper chromatography</b>                                                                                                                     |
|             |      | Determination of R <sub>f</sub> values and identification of organic compounds                                                                  |
| 16          | a    | Separation of mixture of phenylalanine and glycine, alanine and aspartic acid. spray reagent ninhydrin                                          |
| 17          | b    | Separation of mixture of DL-alanine, glycine and L-leucine using n-butanol:acetic acid :water(4:1:5)                                            |
| 18          | c    | Separation of monosaccharides- a mixture of D-galactose and D-fructose.                                                                         |

# Maharaja Ranjit Singh College of Professional Sciences, Indore

Department of Chemical Science

Lesson Plan - B.Sc. IV sem (Jan 2017 - June 2017)

Subject - Chemistry Paper I (Chemistry)

Teacher - Prof. Seema Shintre

| Day/Lecture | Unit | Topic                                                                                                           |
|-------------|------|-----------------------------------------------------------------------------------------------------------------|
|             | 1    | <b>Phase Equilibrium</b>                                                                                        |
| 1           |      | Statement and the meaning of terms: phase, component and the degree of freedom                                  |
| 2           |      | Thermodynamic derivation of the Gibbs phase rule                                                                |
| 3           |      | One component system: water system, CO <sub>2</sub> system                                                      |
| 4           |      | Sulphur system                                                                                                  |
| 5           |      | Two component system: solid liquid equilibrium, simple eutectic system: Bi-Cd system                            |
| 6           |      | Pb-Ag system and desilverisation of lead                                                                        |
|             |      | <b>Solid solution</b>                                                                                           |
| 7           |      | Type B system: Zn-Mg system                                                                                     |
| 8           |      | NaCl-H <sub>2</sub> O system, copper sulphate water system                                                      |
|             |      | <b>Liquid liquid mixture</b>                                                                                    |
| 9           |      | Raoult's law and Henry's law                                                                                    |
| 10          |      | Ideal and non-ideal solutions                                                                                   |
| 11          |      | Azeotropes: HCl-H <sub>2</sub> O and ethanol water system                                                       |
|             |      | <b>Partial miscible liquids</b>                                                                                 |
| 12          |      | Phenol-water, trimethylamine-water and nicotine-water system                                                    |
| 13          |      | Lower and upper consolute temperature, steam distillation                                                       |
| 14          |      | Nernst distribution law: thermodynamic derivation, application.                                                 |
|             | 2    | <b>Electrochemistry-I</b>                                                                                       |
| 15          |      | Electrical transport, conduction in metal and electrolyte solutions                                             |
| 16          |      | Resistance, conductance, Specific and equivalent conductivity                                                   |
| 17          |      | Measurement of equivalent conductance, effect of dilution on conductivity                                       |
| 18          |      | Migration of ions and Kohlrausch law and application                                                            |
| 19          |      | Arrhenius theory of electrolyte dissociation and its limitations                                                |
| 20          |      | Weak and strong electrolytes, Ostwald's dilution law                                                            |
| 21          |      | Debye Huckel theory and DHO equation                                                                            |
| 22          |      | Transport number, Hittorf method                                                                                |
| 23          |      | Moving boundary method                                                                                          |
| 24          |      | Types of reversible electrodes: Gas metal ion, metal-metal ion, metal- insoluble salt anion and redox electrode |
| 25          |      | electrode reactions, Nernst equation                                                                            |
| 26          |      | derivation of cell EMF and single electrode potential                                                           |
| 27          |      | Standard hydrogen electrode, standard electrode potential                                                       |
| 28          |      | EMF of cell and its measurements, computation of cell EMF                                                       |
| 29          |      | calculation of thermodynamic quantities of cell reaction (ΔG, ΔH, K)                                            |
| 30          |      | solubility product and activity coefficient                                                                     |
| 31          |      | potentiometric and conductometric titration                                                                     |
| 32          |      | definition of pH and pK, determination of pH using hydrogen, quinhydrone and glass electrode by                 |
| 33          |      | potentiometric methods                                                                                          |
|             | 3    | <b>Aldehydes and Ketones</b>                                                                                    |
| 34          |      | Nomenclature, structure of the carbonyl group                                                                   |
| 35          |      | synthesis of aldehydes and ketones - synthesis of aldehyde from acid chlorides                                  |
| 36          |      | synthesis of aldehyde and ketone from 1,3 dithianes                                                             |
| 37          |      | synthesis of ketones from nitriles and carboxylic acids                                                         |
| 38          |      | physical properties                                                                                             |
| 39          |      | mechanism of reactions- Aldol condensation and benzoin condensation                                             |
| 40          |      | Perkin reaction and Knoevenagel condensations                                                                   |

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| 41 |   | condensation with ammonia and its derivatives                                     |
| 42 |   | Wittig reaction and Mannich reaction                                              |
| 43 |   | Use of acetals as protecting groups, oxidation of aldehydes                       |
| 44 |   | Baeyer-Villiger oxidation of ketones, Cannizzaro reaction                         |
| 45 |   | MPV, Clemmensen, Wolf-Kishner reaction                                            |
| 46 |   | $\text{LiAlH}_4$ and $\text{NaBH}_4$ reduction, Halogenation                      |
|    |   | <b>Carboxylic acids</b>                                                           |
| 47 |   | Nomenclature, structure and bonding                                               |
| 48 |   | physical properties and acidity of carboxylic acids                               |
| 49 |   | effect of substituents on acid strength                                           |
| 50 |   | Preparation and reactions of carboxylic acids                                     |
| 51 |   | HVZ reaction, synthesis of acid chloride, esters and amides                       |
| 52 |   | reduction of carboxylic acids, Mechanism of decarboxylation                       |
|    | 4 | <b>Carboxylic acids derivatives:</b>                                              |
| 53 |   | structure and nomenclature of acid chlorides, esters, amides and acid anhydrides  |
| 54 |   | physical properties                                                               |
| 55 |   | interconversion of acid derivative by nucleophilic acyl substitution              |
| 56 |   | preparation of carboxylic acid derivatives, chemical reactions                    |
| 57 |   | Mechanism of esterification and hydrolysis                                        |
| 58 |   | Co-ordination Chemistry: MOT diagram for tetrahedral, square planar complex       |
| 59 |   | MOT diagram for Octahedral complexes                                              |
| 60 |   | Green Chemistry: principle, 12 tenets                                             |
| 61 |   | description with examples                                                         |
|    | 5 | <b>(a) Chemistry of Lanthanide elements</b>                                       |
| 62 |   | electronic structure, oxidation states                                            |
| 63 |   | ionic radii and lanthanide contraction                                            |
| 64 |   | complex formation occurrence and isolation                                        |
| 65 |   | lanthanide compounds                                                              |
|    |   | <b>(b) Chemistry of Actinides</b>                                                 |
| 66 |   | General features and chemistry of actinides                                       |
| 67 |   | chemistry of Np, Pu and Am from U, Similarities between lanthanides and actinides |

**Maharaja Ranjit Singh College of Professional Sciences, Indore**

Department of Chemical Sciences

Lesson Plan - B.Sc. IV Sem (Jan 2017 - June 2017)

Subject - Chemistry Practical

**Teacher - Prof. Seema Shintre**

| Day/Lecture | Unit | Topic                                                                                                                                                              |
|-------------|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|             |      | <b>Organic Chemistry: Qualitative analysis</b>                                                                                                                     |
| 1           |      | Identification of an organic compound through the functional group analysis, determination of melting point and preparation of suitable derivatives.               |
|             |      | <b>Physical Chemistry</b>                                                                                                                                          |
| 2           | a    | Determination of transition temperature of given substance by thermometric, dilatometric method.                                                                   |
|             | b    | Phase equilibrium:                                                                                                                                                 |
| 3           | 1    | To study the effect of solute on the critical solution temperature of two partially miscible liquid.                                                               |
| 4           | 2    | To construct the phase diagram of two component by cooling curve method.                                                                                           |
|             | c    | Thermochemistry                                                                                                                                                    |
| 5           | 1    | To determine the enthalpy of neutralization of weak acid/weak base versus strong acid/ strong base and determine the enthalpy of ionization of the weak acid/base. |
|             |      | <b>Inorganic Chemistry: Quantitative volumetric analysis</b>                                                                                                       |
| 6           | 1    | Estimation of ferrous and ferric by dichromate method.                                                                                                             |
| 7           | 2    | Estimation of copper using thiosulphate.                                                                                                                           |

**Maharaja Ranjit Singh College of Professional Sciences, Indore**

Department of Chemical Science

Lesson Plan - B.Sc. V Sem Chemistry (July 2016 - Dec 2016)

Subject - Chemistry

**Teacher - Dr. Lal Kumar**

| Day/Lecture | Unit | Topic                                                                                                                                                                                                                                     |
|-------------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1           | I    | <b>Organic Compounds of Nitrogen:</b>                                                                                                                                                                                                     |
| 2           | I    | Preparation, properties and chemical reactions of nitroalkanes and nitroarenes.                                                                                                                                                           |
| 3           | I    | Mechanism of nucleophilic substitution in nitroarenes and their reduction in acidic neutral and alkaline media, picric acids.                                                                                                             |
| 4           | I    | Halonitroarenes; structure and nomenclature, and their activity.                                                                                                                                                                          |
| 5           | I    | Amines structure, and nomenclature, physical properties and stereochemistry, separation of mixture of primary, secondary and tertiary amines.                                                                                             |
| 6           | I    | Structural features affecting basicity of amines. Amine salts as phase transfer catalysts.                                                                                                                                                |
| 7           | I    | Preparation of alkyl and aryl amines (reduction of nitro compounds, nitriles), reductive amination of aldehydic and ketonic compounds,                                                                                                    |
| 8           | I    | Gabriel – phthalamide reaction, Hoffmann bromamide reaction, Reaction of amines, electrophilic aromatic substitution in aryl amines, reaction of amines with nitrous acid synthetic transformation of aryl diazonium salts, azo coupling. |
| 9           | II   | <b>A. Carbohydrates-I</b>                                                                                                                                                                                                                 |
| 10          | II   | Classification and nomenclature                                                                                                                                                                                                           |
| 11          | II   | monosaccharides                                                                                                                                                                                                                           |
| 12          | II   | Mechanism of Osazone formation                                                                                                                                                                                                            |
| 13          | II   | Inter conversion of glucose into fructose                                                                                                                                                                                                 |
| 14          | II   | Ascending and descending series in aldose                                                                                                                                                                                                 |
| 15          | II   | Configuration of monosaccharides                                                                                                                                                                                                          |
| 16          | II   | Stereo isomers of erythro and threo sugars                                                                                                                                                                                                |
| 17          | II   | Conversion of glucose into mannose                                                                                                                                                                                                        |
| 18          | II   | Glycosides, determination of the size of the ring of monosaccharides                                                                                                                                                                      |
| 19          | II   | Ring structure of D(+) glucose                                                                                                                                                                                                            |
| 20          | II   | Mechanism of mutarotation                                                                                                                                                                                                                 |
| 21          | II   | Structure of ribose and deoxyribose                                                                                                                                                                                                       |
| 22          | II   | <b>B. Carbohydrates-II</b>                                                                                                                                                                                                                |
| 23          | II   | Disaccharides introductory idea of maltose, sucrose, and lactose (excluding structure)                                                                                                                                                    |
| 24          | II   | Polysaccharides introductory idea of starch and cellulose(Excluding Structure)                                                                                                                                                            |
| 25          | II   | Reducing and non-reducing sugars                                                                                                                                                                                                          |
| 26          | III  | <b>A. Photochemistry</b>                                                                                                                                                                                                                  |
| 27          | III  | Electromagnetic radiation, range of different regions of the spectrum                                                                                                                                                                     |
| 28          | III  | different expression units for energy                                                                                                                                                                                                     |
| 29          | III  | wavelength and frequency                                                                                                                                                                                                                  |
| 30          | III  | interaction of radiation with matter                                                                                                                                                                                                      |
| 31          | III  | difference between thermal and photochemical process                                                                                                                                                                                      |
| 32          | III  | Law of photochemistry                                                                                                                                                                                                                     |
| 33          | III  | Grothus Draper Law                                                                                                                                                                                                                        |
| 34          | III  | Stark-Einstein Law                                                                                                                                                                                                                        |
| 35          | III  | Beer-Lambert Law                                                                                                                                                                                                                          |
| 36          | III  | Electronic Transition                                                                                                                                                                                                                     |
| 37          | III  | Jablonski Diagram depicting various quantum yield                                                                                                                                                                                         |
| 38          | III  | <b>B. UV Spectroscopy</b>                                                                                                                                                                                                                 |
| 39          | III  | Electronic Excitation                                                                                                                                                                                                                     |
| 40          | III  | Elementary Idea of instrument used                                                                                                                                                                                                        |
| 41          | III  | Application to organic molecules                                                                                                                                                                                                          |
| 42          | III  | Woodward-Fieser rule for determining $\lambda_{max}$ of enes, polyenes and alpha,beta-unsaturated carbonyl compounds                                                                                                                      |
| 43          | IV   | <b>A. Bioinorganic Chemistry-I</b>                                                                                                                                                                                                        |
| 44          | IV   | Essential and trace element in biological processes                                                                                                                                                                                       |
| 45          | IV   | Metalloporphyrins with special reference to haemoglobin and myoglobin                                                                                                                                                                     |
| 46          | IV   | Biological role of alkali and alkaline earth metal ions with special reference of $Ca^{2+}$ .                                                                                                                                             |

|    |    |                                                                               |
|----|----|-------------------------------------------------------------------------------|
| 47 | IV | <b>B. Bioinorganic Chemistry-II</b>                                           |
| 48 | IV | Role of metal ions in biological process, nitrogen fixation                   |
| 49 | IV | oxygen uptake proteins, cytochromes and ferredoxins.                          |
| 50 | V  | <b>A. Hard and Soft Acids and Bases(HSAB)</b>                                 |
| 51 | V  | Classification of acids and bases as hard and soft                            |
| 52 | V  | Pearson's HSAB Concept, Symbiosis                                             |
| 53 | V  | <b>B. Analytical Chemistry</b>                                                |
| 54 | V  | Errors, their classification, minimisation of errors, precision and accuracy, |
| 55 | V  | Gravimetric estimation: concept, method and precautions                       |
| 56 | V  | Gravimetric estimation of barium and copper                                   |
| 57 | V  | <b>C. Inorganic Polymer</b>                                                   |
| 58 | V  | Intoduction, scope of inorganic polymers                                      |
| 59 | V  | special characteristics, Classification and their applications                |
| 60 | V  | Structure and nature of bonding in Silicones and triphosphonitrilic chloride  |

**Maharaja Ranjit Singh College of Professional Sciences, Indore**

Department of Chemical Science

Lesson Plan - B.Sc. V Sem Chemistry (July 2016- Dec 2016)

Subject - Chemistry Practical

**Teacher - Dr. Lal Kumar**

| <b>Day/Lecture</b> | <b>Unit</b> | <b>Topic</b>                                                                                          |
|--------------------|-------------|-------------------------------------------------------------------------------------------------------|
| 1                  | I           | <b>Inorganic Chemistry</b>                                                                            |
| 2                  | I           | To separate and identify inorganic mixture having five radicals with at least one interfering radical |
| 3                  | I           | To separate and identify inorganic mixture having five radicals with at least one interfering radical |
| 4                  | I           | To separate and identify inorganic mixture having five radicals with at least one interfering radical |
| 5                  | I           | <b>Gravimetric Analysis</b>                                                                           |
| 6                  | I           | To estimate barium as a barium sulphate                                                               |
| 7                  | II          | <b>Organic Chemistry Preparation</b>                                                                  |
| 8                  | II          | A. Acetylation                                                                                        |
| 9                  | II          | B. Benzoylation                                                                                       |
| 10                 | II          | C. meta-dinitrobenzene                                                                                |
| 11                 | II          | D. Picric Acid                                                                                        |

**Maharaja Ranjit Singh College of Professional Sciences, Indore**

Department of Chemical Science

Lesson Plan - B.Sc. VI Sem Chemistry (Jan 2017 - June 2017)

Subject - Chemistry

Teacher - Dr. Lal Kumar

| Day/Lecture | Unit | Topic                                                                                                       |
|-------------|------|-------------------------------------------------------------------------------------------------------------|
| 1           | I    | <b>A. Amino Acids</b>                                                                                       |
| 2           | I    | Classification of Amino Acid                                                                                |
| 3           | I    | Structure, stereochemistry of amino acids                                                                   |
| 4           | I    | Acid base behaviour, isoelectric point                                                                      |
| 5           | I    | General methods of preparation and properties of alpha-amino acids                                          |
| 6           | I    | Proteins and peptides. Introduction to peptides linkage,                                                    |
| 7           | I    | End group analysis, classification, properties and structure of proteins (primary, secondary and tertiary). |
| 8           | I    | <b>B. Nucleic acids:</b> Introduction of nucleic acids and constituents of nucleic acid,                    |
| 9           | I    | Ribonucleosides, Ribonucleotides,                                                                           |
| 10          | I    | Double helical structure of DNA                                                                             |
| 11          | I    | <b>C. Elementary idea of Fats, Oils &amp; Detergents:</b>                                                   |
| 12          | I    | Natural fats, edible and industrial oils of vegetable origin, common fatty acids, glycerides,               |
| 13          | I    | Hydrogenation of unsaturated oils,                                                                          |
| 14          | I    | Saponification value, iodine value, acid value.                                                             |
| 15          | II   | <b>A. Organometallic Chemistry:</b>                                                                         |
| 16          | II   | Synthesis; structure and bonding in metal carbonyl complexes,                                               |
| 17          | II   | Metal olefin complexes and metal alkyne complexes.                                                          |
| 18          | II   | Oxidative addition reactions.                                                                               |
| 19          | II   | <b>B. Organometallic Compounds:</b>                                                                         |
| 20          | II   | Organomagnesium Compound -                                                                                  |
| 21          | II   | Grignard Reagent and Organolithium Compounds,                                                               |
| 22          | II   | Methods of preparation, structure and synthetic applications.                                               |
| 23          | III  | <b>Magnetic properties of transition metal complexes:</b>                                                   |
| 24          | III  | Magnetic moment                                                                                             |
| 25          | III  | (spin only and with L-S coupling),                                                                          |
| 26          | III  | orbital contribution magnetic moment.                                                                       |
| 27          | III  | <b>B. Electronic spectra of transition metal complexes:</b>                                                 |
| 28          | III  | Spectroscopic ground and excited states,                                                                    |
| 29          | III  | Types of electronic transitions,                                                                            |
| 30          | III  | Selection rules for d-d transitions,                                                                        |
| 31          | III  | Orgel-energy level diagram for d1 to d9 states.                                                             |
| 32          | III  | <b>C. Water Analysis:</b>                                                                                   |
| 33          | III  | Hardness, types of hardness,                                                                                |
| 34          | III  | Acidity and alkalinity, BOD, COD and DO.                                                                    |
| 35          | IV   | <b>A. Infrared spectroscopy :</b>                                                                           |
| 36          | IV   | Statement of the Born-Oppenheimer approximation,                                                            |
| 37          | IV   | Rotational spectrum of diatomic molecules.                                                                  |
| 38          | IV   | Energy levels of a rigid rotator,                                                                           |
| 39          | IV   | Selection rule, intensity of absorption bands,                                                              |
| 40          | IV   | Maxwell- Boltzmann distribution and                                                                         |
| 41          | IV   | Population of energy levels.                                                                                |
| 42          | IV   | <b>B. Energy levels of simple harmonic oscillator,</b>                                                      |
| 43          | IV   | selection rules,                                                                                            |
| 44          | IV   | Pure vibrational spectrum,                                                                                  |
| 45          | IV   | Intensity and qualitative relation of force constant and bond energies,                                     |
| 46          | IV   | Degree of freedom and                                                                                       |
| 47          | IV   | Modes of vibration,                                                                                         |
| 48          | IV   | vibrational frequencies of different functional groups.                                                     |
| 49          | IV   | <b>C. Raman Spectroscopy:</b>                                                                               |
| 50          | IV   | Concept of polarizability,                                                                                  |
| 51          | IV   | Pure rotational and Pure vibrational Raman spectra of diatomic molecules.                                   |
| 52          | IV   | Selection rules, application of Raman spectrum.                                                             |
| 53          | V    | <b>A. NMR Spectroscopy</b>                                                                                  |

|    |   |                                                           |
|----|---|-----------------------------------------------------------|
| 54 | V | Principle and Instrumentation,                            |
| 55 | V | NMR active nucleus,                                       |
| 56 | V | Chemical shift, spin-spin coupling,                       |
| 57 | V | Spectrum of ethanol and ethanal.                          |
| 58 | V | <b>B. Surface Phenomena and Catalysis:</b>                |
| 59 | V | Adsorption of gases and liquids on solid adsorbent,       |
| 60 | V | Freundlich and Langmuir adsorption isotherms,             |
| 61 | V | Determination of surface area,                            |
| 62 | V | Characteristics and mechanism of heterogeneous catalysis. |

**Maharaja Ranjit Singh College of Professional Sciences, Indore**

Department of Chemical Science

Lesson Plan - B.Sc. VI Sem Chemistry (Jan 2017 - June 2017)

Subject - Chemistry Practical

Teacher - Dr. Lal Kumar

| Day/Lecture | Unit | Topic                                                                                    |
|-------------|------|------------------------------------------------------------------------------------------|
| 1           | I    | <b>Organic Chemistry</b>                                                                 |
| 2           | I    | To separate and identify organic mixture having two solid also prepare their derivatives |
| 3           | I    | To separate and identify organic mixture having two solid also prepare their derivatives |
| 4           | I    | To separate and identify organic mixture having two solid also prepare their derivatives |
| 5           | I    | To separate and identify organic mixture having two solid also prepare their derivatives |
| 6           | II   | <b>Physical Instrumentation</b>                                                          |
| 7           | II   | A. Job's Method                                                                          |
| 8           | II   | B. Mole-ratio method                                                                     |
| 9           | III  | <b>Inorganic Chemistry</b>                                                               |
| 10          | III  | Effluent Analysis: to identify cations and anions in given water samples.                |
| 11          | III  | Water Analysis: To determine the dissolve oxygen in given water sample in ppm units.     |
| 12          | III  | To determine the hardness of water samples.                                              |