

Department of Chemistry, College of Basic Science and Humanities
3rd Year Honours

Course Code: CHC3511

Course Title: Inorganic Chemistry – IV

Lesson Plan

| Unit No | Name of the Chapter | Topic Title | No. of Lectures | Name of the Faculty |
|--|--------------------------|--|-----------------|---------------------|
| 1 | Acids and Bases | Concept of acid-base, Bronsted-Lowry, Lewis acid-base concept, classification of Lewis acids | 2 | Dr (Mrs.) S. Jena |
| | | relative strength of acids, type of acid-base reactions, | 2 | |
| | | solvated proton , levelling solvents, | 2 | |
| | | Hard and Soft Acids and Bases, application of HSAB principle. | 2 | |
| | Inorganic polymers | Types of inorganic polymers, comparison with organic polymers, | 2 | |
| | | synthesis, structural aspects and applications of silicones and siloxanes. borazine | 2 | |
| synthesis, structural aspects and applications of silicates, phosphazenes and polysulphates. | | 2 | | |
| 2 | Organometallic Chemistry | Introduction to Organometallic Chemistry | 4 | Dr. H. S. Sahoo |
| | | Metal carbonyls | 8 | |
| | | Metal alkyls and ferrocene | 1 | |
| 3 | Catalysis | Introduction and catalytic action | 1 | Mr. S. R. Panda |
| | | Catalysis by different reagents. | 3 | |
| | Bioinorganic Chemistry | Metals ions in biological system | 3 | Dr. H. S. Sahoo |
| | | Role of iron in bio-system and toxicity of metal ions | 6 | |
| 4 | Group Theory | Basic idea about group theory | 2 | Mr. S. R. Panda |
| | | Types of symmetry elements: | 4 | |
| | | Determination of point group | 2 | |

Course Break Up

Unit – 1

Chapter Name: Acids and Bases

Name of the Faculty: Dr (Mrs.) S. Jena

| Lecture No. | Details of the topic to be covered |
|-------------|---|
| 1. | Bronsted-Lowry Concept of acid-base, conjugate acid base pairs, |
| 2. | solvated proton, the solvent system concept |
| 3. | relative strength of acids, type of acid-base reactions, levelling solvents |
| 4. | levelling solvents on the basis of solvent system concept |
| 5. | Lewis acid-base concept |
| 6. | classification of Lewis acids, limitations |
| 7. | Hard and Soft Acids and Bases, hard-hard and soft-soft interactions, HSAB principle |
| 8. | Application of HSAB principle, symbiosis |

Unit – 1

Chapter Name: Inorganic Polymers

Name of the Faculty: Dr (Mrs.) S. Jena

| Lecture No. | Details of the topic to be covered |
|-------------|---|
| 1. | Definitions of inorganic polymers, types |
| 2. | comparison with organic polymers, |
| 3. | synthesis, structural aspects and applications of silicones and siloxanes |
| 4. | synthesis, structural aspects and applications of Borazine |
| 5. | synthesis, structural aspects and applications of silicates, phosphazenes |
| 6. | synthesis, structural aspects and applications of polysulphates |

Unit – 2**Chapter Name: Organometallic Chemistry****Name of the Faculty: Dr. H. S. Sahoo**

| Lecture No. | Details of the topic to be covered |
|-------------|---|
| 1. | Definition and classification of organometallic compounds on the basis of bond type |
| 2. | concept of hapticity of organic ligands and number of electrons donated |
| 3. | 18 electron rule and EAN |
| 4. | 18 electron rule and electron count of coordination compound and metal carbonyls |
| 5. | Electron count of mononuclear, polynuclear and substituted metal carbonyls of 3d series |
| 6. | General methods of preparation of mono and dinuclear carbonyls of 3d series |
| 7. | General methods of preparation of mono and dinuclear carbonyls of 3d series |
| 8. | Structures of mononuclear and binuclear carbonyls of Cr and Mn, using VBT |
| 9. | Structures of mononuclear and binuclear carbonyls of Fe and Co using VBT |
| 10. | Structures of carbonyls of Ni using VBT |
| 11. | Bonding in of CO molecule: VBT and MOT |
| 12. | Pi-acceptor behaviour of CO (in light of MO of CO), back bonding of metal-CO |
| 13. | Elementary idea of metal alkyls and ferrocene |

Unit – 3**Chapter Name: Catalysis****Name of the Faculty: Mr. S. R. Panda**

| Lecture No. | Details of the topic to be covered |
|-------------|---|
| 1. | Brief idea on catalyst and catalytic action, organometallic compounds as different catalysis reaction |
| 2. | Hydrogenation reaction of alkenes using Wilkinsons catalyst preparation of catalyst and stereochemistry of reaction |
| 3. | hydroformylation reaction and its mechanism |
| 4. | Wacker process and Fischer Tropsch reaction and its mechanism for hydroformylation |

Unit – 3**Chapter Name: Bioinorganic Chemistry****Name of the Faculty: Dr. H. S. Sahoo**

| Lecture No. | Details of the topic to be covered |
|-------------|---|
| 1. | Details of the topic to be covered |
| 2. | Introduction to bioinorganic chemistry, metal ions present in biological system |
| 3. | Sodium and potassium pump, carbonic anhydrase and carboxypeptidase |
| 4. | Iron and its application in bio-systems |
| 5. | Haemoglobin |
| 6. | Haemoglobin: storage and transfer of iron |
| 7. | Excess and deficiency of some trace metals |
| 8. | Toxicity of Hg and Pb metal ions |
| 9. | Toxicity of Cd and As metal ions |

Unit – 4**Chapter Name: Group Theory****Name of the Faculty: Mr. S. R. Panda**

| Lecture No. | Details of the topic to be covered |
|-------------|--|
| 1. | Introduction & Basic idea about group theory |
| 2. | Concept of symmetry, Symmetry operation, symmetry elements |
| 3. | inversion center (i), Identity element (E) examples |
| 4. | Axis of symmetry and its types, its examples |
| 5. | Plane of symmetry and its types, its examples |
| 6. | Improper axis of symmetry, its examples |
| 7. | Flow chart for point group determination |
| 8. | Determination of point group for simple molecules |

Lesson Plan

| Unit No | Name of the Chapter | Topic Title | No. of Lectures | Name of the Faculty |
|---------|---|--|-----------------|---------------------|
| 1 | Nucleic Acids | Components of nucleic acids, Nucleosides and nucleotides; Structure, synthesis and reactions of: Adenine, Guanine, Cytosine, Uracil and Thymine; | 4 | Dr. B. P. Acharya |
| | Amino Acids, Peptides and Protein | Amino acids, Peptides and their classification. α -Amino Acids - Synthesis, ionic properties and reactions. Zwitterions, pK_a values, isoelectric point . | 4 | |
| | Lipids | Lipids | 3 | |
| | Pharmaceutical Compounds: Structure and Importance | Classification, structure, synthesis and therapeutic uses of antipyretics: Paracetamol; Analgesics: Ibuprofen; Antimalarials: Chloroquine. An elementary treatment of Antibiotics and detailed study of chloramphenicol. | 4 | |
| 2 | Pericyclic Reactions | Symmetry control in Pericyclic reaction and, classification. Mechanistic methods of analysis. | 2 | Dr. H. Nayak |
| | | Different types of reactions both by correlation diagram and FMO methods and derivation of selection rules in $4n, 4n+2$ and allyl systems. | 5 | |
| | | Different types of cycloaddition reaction in detail. | 5 | |
| | Photochemistry | General principles of Photochemistry | 2 | |
| | | Photochemistry of carbonyl systems | 3 | |
| | | Photochemistry of Olefins | 3 | |
| 3 | Name Reactions | Name Reactions | 10 | Dr. P. K. Jena |
| | Synthetic Reagents | Introduction | 1 | |
| | | Synthesis and uses some synthetic reagents | 4 | |
| 4 | Protection and deprotection techniques in organic synthesis | Protection and deprotection techniques in organic synthesis | 3 | |
| | Oxidation and Reduction methods | Oxidation | 5 | |
| | | Reduction | 4 | |

Course Break Up

Unit – 1

Chapter Name: Nucleic Acids

Name of the Faculty: Dr. B. P. Acharya

| Lecture No. | Details of the topic to be covered |
|-------------|--|
| 1. | Introduction to nucleic acid, Nucleosides and nucleotides |
| 2. | Structure, synthesis and reactions of: Adenine, Guanine |
| 3. | Structure, synthesis and reactions of Cytosine, Uracil |
| 4. | Structure, synthesis and reactions of Thymine. Question and Answer |

Unit – 1

Chapter Name: Amino Acids, Peptides and Protein

Name of the Faculty: Dr. B. P. Acharya

| Lecture No. | Details of the topic to be covered |
|-------------|---|
| 1. | Introduction to Amino acids, Peptides and their classification |
| 2. | Synthesis of α -Amino Acids (1 st and 2 nd Method) |
| 3. | Synthesis of α -Amino Acids (3 rd and 4 th Method) |
| 4. | ionic properties and reactions. Zwitterions, pKa values, isoelectric point . |

Unit – 1

Chapter Name: Lipids

Name of the Faculty: Dr. B. P. Acharya

| Lecture No. | Details of the topic to be covered |
|-------------|--|
| 1. | Introduction to oils and fats; common fatty acids present in oils and fats, Hydrogenation of fats and oils |
| 2. | Saponification value, acid value |
| 3. | iodine number |

Unit – 1

Chapter Name: Pharmaceutical Compounds: Structure and Importance

Name of the Faculty: Dr. B. P. Acharya

| Lecture No. | Details of the topic to be covered |
|-------------|--|
| 1. | Classification, structure, synthesis and therapeutic uses of antipyretics: Paracetamol |
| 2. | Classification, structure, synthesis and therapeutic uses of Analgesics: Ibuprofen |
| 3. | Classification, structure, synthesis and therapeutic uses of Antimalarial: Chloroquine |
| 4. | An elementary treatment of antibiotics and detail study of chloramphenicol |

Unit – 2

Chapter Name: Pericyclic Reactions

Name of the Faculty: Dr. H. Nayak

| Lecture No. | Details of the topic to be covered |
|-------------|---|
| 1. | Classification of pericyclic reactions |
| 2. | Conservation of molecular orbital symmetry |
| 3. | Electrocyclic reactions: Conrotatory and disrotatory reactions. $4n$, system by Woodward-Hoffmann correlation diagram. |
| 4. | Electrocyclic reactions: Conrotatory and disrotatory reactions. $4n+2$ and allyl system |
| 5. | Electrocyclic reactions: Conrotatory and disrotatory reactions. $4n$, $4n+2$ and allyl system by FMO treatment |
| 6. | Cycloadditions – antarafacial and suprafacial addition. $4n$, $4n+2$ system by correlation diagram |
| 7. | Cycloadditions – antarafacial and suprafacial addition. $4n$, $4n+2$ system by FMO treatment |
| 8. | Cycloreversion and retro cycloaddition, Diel's –Alder reaction with reference to mechanism, stereochemistry, endo-exo selectivity |
| 9. | Diel's –Alder reaction with reference to orientation effects |
| 10. | [2+2] addition of ketenes. |
| 11. | cheletropic reactions |
| 12. | 1,3 dipolar cycloaddition |

Unit – 2 Chapter Name: Photochemistry**Name of the Faculty: Dr. H. Nayak**

| Lecture No. | Details of the topic to be covered |
|-------------|---|
| 1. | Principles of organic photochemistry |
| 2. | Principles of organic photochemistry |
| 3. | Photochemical reactions of carbonyl compounds(Norrish type-I reaction) |
| 4. | Photochemical reactions of carbonyl compounds(Norrish type-II reaction) |
| 5. | Paterno-buchi reaction |
| 6. | Oleifins(di π -methane rearrangement,) |
| 7. | Photo Dimerisation |
| 8. | Photoisomerisation:Rotation about C-C and C=C bonds. |

Unit – 3 Chapter Name: Name Reactions**Name of the Faculty: Dr. P. K. Jena**

| Lecture No. | Details of the topic to be covered |
|-------------|------------------------------------|
| 1. | Michael condensation |
| 2. | Reformatsky reaction |
| 3. | Benzidine rearrangement |
| 4. | Wagner-Meerwien rearrangement |
| 5. | Houben-Hoesch reaction |
| 6. | Vilsmeier-Haack reaction |
| 7. | Lossen rearrangement |
| 8. | Sharplessepoxidation |
| 9. | Demjanov rearrangement |
| 10. | Favorskii rearrangement |

Unit – 3 Chapter Name: Synthetic Reagents**Name of the Faculty: Dr. P. K. Jena**

| Lecture No. | Details of the topic to be covered |
|-------------|--|
| 1. | Brief idea on synthetic reagents. Synthesis and application of Aluminium t-butoxides |
| 2. | Synthesis and application of DCC, OsO ₄ , |
| 3. | Synthesis and application of HIO ₄ , selenium dioxide |
| 4. | Synthesis and application of PCC, diborane |
| 5. | diazomethane |

Unit – 4 Chapter Name: Protection and deprotection techniques in organic synthesis**Name of the Faculty: Dr. P. K. Jena**

| Lecture No. | Details of the topic to be covered |
|-------------|--|
| 1. | Protection and deprotection of carbonyl groups |
| 2. | Protection and deprotection of Amino groups |
| 3. | Protection and deprotection of double bonds |

Unit – 4 Chapter Name: Oxidation and Reduction methods**Name of the Faculty: Dr. P. K. Jena**

| Lecture No. | Details of the topic to be covered |
|-------------|---|
| 1. | Oxidations with Chromium(VI),Manganese(VII) |
| 2. | Oxidation with Peroxides and peracids |
| 3. | Oxidation with ozone,DMSO |
| 4. | Oxidation with NBS |
| 5. | Oxidation with DDQ |
| 6. | Reductions: Catalytic hydrogenation, ,, |
| 7. | hydrides transfer reaction |
| 8. | hydrides transfer reaction |
| 9. | Dissolving metal reduction |

| Unit No | Name of the Chapter | Topic Title | No. of Lectures | Name of the Faculty |
|---------|---|---|-----------------|---------------------|
| 1 | Introduction and history of polymeric materials | Classification and nomenclature | 2 | Dr. P. K. Jena |
| | | Bonding and textures in polymer | 4 | |
| | Functionality and its importance | Polymerization formation and processes and its relationship | 4 | |
| | | Various systems | 2 | |
| 2 | Kinetics of Polymerization | General Introduction | 1 | Dr. (Mrs) N. Swain |
| | | Mechanism and kinetics of polymerization | 6 | |
| | | Polymerization techniques | 1 | |
| | Crystallization and crystallinity | General Introduction | 1 | |
| | | Crystalline melting point and crystallinity. | 2 | |
| | | Morphology of crystalline polymers | 1 | |
| 3 | Nature and structure of polymers | Structure property relationship | 8 | Dr. H. Nayak |
| | | Glass transition temperature | 4 | |
| 4 | Properties of Polymers | Introduction | 1 | Dr. B. P. Acharya |
| | | preparation, structure, properties and application of some polymers | 10 | |

Course Break Up

Unit – 1 Chapter Name: Introduction and history of polymeric materials

Name of the Faculty: Dr. P. K. Jena

| Lecture No. | Details of the topic to be covered |
|-------------|---|
| 1 | Introduction to Polymer, Classification of Polymers |
| 2 | Nomenclature of Polymers |
| 3 | Molecular forces in polymers |
| 4 | Chemical bonding in polymers |
| 5 | Texture of Polymers |
| 6 | Texture of Polymers contd. |

Unit – 1 Chapter Name: Functionality and its importance

Name of the Faculty: Dr. P. K. Jena

| Lecture No. | Details of the topic to be covered |
|-------------|--|
| 1 | Criteria for synthetic polymer formation |
| 2 | Classification of polymerization processes, |
| 3 | Relationships between functionality and extent of reaction |
| 4 | Relationships between functionality and degree of polymerization |
| 5 | Bi-functional systems |
| 6 | Poly-functional systems |

Unit – 2 Chapter Name: Kinetics of Polymerization

Name of the Faculty: Dr. (Mrs) N. Swain

| Lecture No. | Details of the topic to be covered |
|-------------|--|
| 1. | General introduction to polymerization |
| 2. | Mechanism and kinetics of step growth polymerization. |
| 3. | Mechanism and kinetics of radical chain growth polymerization. |
| 4. | Mechanism and kinetics of ionic chain (cationic) polymerization. |
| 5. | Mechanism and kinetics of ionic chain (anionic) polymerization. |
| 6. | Mechanism and kinetics of coordination polymerizations, |
| 7. | Mechanism and kinetics of copolymerization. |

| | |
|----|----------------------------|
| 8. | Polymerization techniques. |
|----|----------------------------|

Unit – 2 Chapter Name: Crystallization and Crystallinity

Name of the Faculty: Dr. (Mrs) N. Swain

| Lecture No. | Details of the topic to be covered |
|-------------|---|
| 1. | General introduction |
| 2. | Determination of crystalline melting point and degree of crystallinity. |
| 3. | Factors affecting crystalline melting point |
| 4. | Morphology of crystalline polymers |

Unit – 3 Chapter Name: Nature and structure of polymers

Name of the Faculty: Dr. H. Nayak

| Lecture No. | Details of the topic to be covered |
|-------------|--|
| 1. | Polymer structures:Introduction |
| 2. | Determination of molecular weight of polymers (M_n , M_m , etc.) by end group analysis. |
| 3. | Determination of molecular weight of polymers viscometry |
| 4. | Determination of molecular weight of polymers osmotic pressure methods |
| 5. | Determination of molecular weight of polymers by light scattering |
| 6. | Molecular weight distribution and its significance; |
| 7. | Polydispersity index |
| 8. | Glass transition temperature (T_g). |
| 9. | determination of T_g |
| 10. | Free volume theory |
| 11. | WLF equation |
| 12. | Factors affecting glass transition temperature(T_g). |

Unit – 4 Chapter Name: Properties of Polymers

Name of the Faculty: Dr. B. P. Acharya

| Lecture No. | Details of the topic to be covered |
|-------------|--|
| 1. | Brief introduction to preparation, structure, properties and application of the following polymers: polyolefins, polystyrene |
| 2. | preparation, structure, properties and application of the styrene copolymers, poly vinyl chloride and related polymers |
| 3. | preparation, structure, properties and application of the poly vinyl acetate and related polymers, |
| 4. | preparation, structure, properties and application of the acrylic polymersfluoro polymers |
| 5. | preparation, structure, properties and application of the polyamides and related polymers |
| 6. | preparation, structure, properties and application of the Phenol formaldehyde resins – Bakelite, Novalac, |
| 7. | preparation, structure, properties and application of the polyurethanes, silicone polymers |
| 8. | preparation, structure, properties and application of thepolydienes. Polycarbonates,. |
| 9. | preparation, structure, properties and application of the Conducting Polymers – polyacetylene, polyaniline |
| 10. | preparation, structure, properties and application of the poly paraphenylenesulphide, |
| 11. | preparation, structure, properties and application of thepolypyrrole, polythiophene: |

Course Code: CHD3502 Course Title: Industrial Chemistry and Environment**Lesson Plan**

| Unit No | Name of the Chapter | Topic Title | No. of Lectures | Name of the Faculty |
|---------|--|---|-----------------|---------------------|
| 1 | Industrial Gases and Inorganic Chemicals | Large scale production, uses, storage and hazards in handling of Industrial Gases | 6 | Mr. S. R. Panda |
| | | Manufacture, application, analysis and hazards in handling of Inorganic Chemicals | 6 | |
| 2 | Industrial Metallurgy, Environment Energy & Biocatalysis | Industrial Metallurgy | 3 | Dr. H. Nayak |
| | | Energy & Environment | 6 | |
| | | Biocatalysis | 3 | |
| 3 | Environment and its segments – I – Air Pollution | Environment and ecosystem | 4 | Ms. S. Sahoo |
| | | Air pollution and its control | 6 | |
| | | Effects of air pollution | 4 | |
| 4 | Environment and its segments – II – Water Pollution | Introduction | 1 | Dr. B. P. Acharya |
| | | Water pollution and its measurement & control | 4 | |
| | | Industrial water pollution and its remedial | 6 | |

Course Break Up**Unit – 1****Chapter Name: Industrial Gases and Inorganic Chemicals****Name of the Faculty: Dr S. R. Panda**

| Lecture No. | Details of the topic to be covered |
|-------------|--|
| 1. | Large scale production, uses, storage and hazards in handling of oxygen, nitrogen |
| 2. | Large scale production, uses, storage and hazards in handling of argon, neon |
| 3. | Large scale production, uses, storage and hazards in handling of helium, hydrogen |
| 4. | Large scale production, uses, storage and hazards in handling of acetylene, carbon monoxide |
| 5. | Large scale production, uses, storage and hazards in handling of chlorine, fluorine |
| 6. | Large scale production, uses, storage and hazards in handling of sulphur dioxide and phosgene |
| 7. | Manufacture, application, analysis and hazards in handling of Inorganic Chemicals hydrochloric acid, nitric acid,. |
| 8. | Manufacture, application, analysis and hazards in handling of Inorganic Chemicals sulphuric acid, caustic soda, |
| 9. | Manufacture, application, analysis and hazards in handling of Inorganic Chemicals common salt; borax, |
| 10. | Manufacture, application, analysis and hazards in handling of Inorganic Chemicals bleaching powder, sodium thiosulphate, |
| 11. | Manufacture, application, analysis and hazards in handling of Inorganic Chemicals hydrogen peroxide, potash alum, |
| 12. | Manufacture, application, analysis and hazards in handling of Inorganic Chemicals chrome alum, potassium dichromate and potassium permanganate |

Unit – 2**Chapter Name: Industrial Metallurgy, Energy & Environment and Biocatalysis****Name of the Faculty: Dr. H. Nayak**

| Lecture No. | Details of the topic to be covered |
|-------------|---|
| 1. | Preparation of ferrous metals |
| 2. | Preparation of nonferrous metals |
| 3. | Ultrapure metals for semiconductor technology |
| 4. | Sources of energy: Coal, petrol and natural gas. |
| 5. | Nuclear Fusion and Fission |
| 6. | Numerical on nuclear fusion and fission |
| 7. | Solar energy, Hydrogen energy |
| 8. | Geothermal, Tidal and Hydel energy |
| 9. | Nuclear Pollution: Disposal of nuclear waste, nuclear disaster and its management |
| 10. | Biocatalysis: Introduction |
| 11. | Reactions of biocatalyst and green chemistry |
| 12. | Green chemistry in chemical industry |

Unit – 3**Chapter Name: Environment and its segments – I – Air Pollution****Name of the Faculty: Ms. S. Sahoo**

| Lecture No. | Details of the topic to be covered |
|-------------|--|
| 1. | Introduction on environment and ecosystem |
| 2. | Biogeochemical cycles of carbon, nitrogen and sulphur |
| 3. | Major regions of atmosphere and its importance. |
| 4. | Chemical and photochemical reactions in atmosphere. |
| 5. | Air pollutants, types, sources, particle size and chemical nature. |
| 6. | Photochemical smog: its constituent. |
| 7. | Environmental effects of ozone |
| 8. | Pollution by SO ₂ , CO ₂ , CO, NO _x , and H ₂ S. |
| 9. | Methods of estimation of CO, NO _x , SO _x |
| 10. | Control procedures of above gases |
| 11. | Effect of air pollution on living organisms and vegetation. |
| 12. | Greenhouse effect and Global warming |
| 13. | Ozone depletion by oxides of nitrogen, chlorofluorocarbons |
| 14. | Ozone depletion by halogen and revision |

Unit – 4**Chapter Name: Environment and its segments – II – Water Pollution****Name of the Faculty: Dr. B. P. Acharya**

| Lecture No. | Details of the topic to be covered |
|-------------|---|
| 1. | Introduction, Hydrological cycle, water resources |
| 2. | Aquatic system, Source and nature of water pollutants |
| 3. | Technique for measuring water pollutions |
| 4. | Impacts of water pollution on hydrological and ecosystems |
| 5. | Water purification methods. Effluent treatment plants – primary, secondary and tertiary treatment |
| 6. | Industrial effluents from electroplating, textile industries and their treatment |
| 7. | Industrial effluents from tannery, dairy, industries and their treatment |
| 8. | Industrial effluents from petroleum and petrochemicals |
| 9. | Sludge disposal. Industrial waste management, incineration of waste. |
| 10. | Water treatment and purification, reverse osmosis, electro dialysis |
| 11. | Water quality parameters for wastage water; industrial water and domestic water, revision |