# Department of Chemistry

**Semester: II**

**Name of the Course: Organic Chemistry II**

**Subject Code: PG1721**

**Teaching plan**

| Unit | Module | Topics | Lecture Hours | Learning Outcome | Pedagogy | Assessment/ Evaluation |
|---|---|---|---|---|---|---|
| **I** | **Substitution and Elimination Reactions** | | | | | |
| | 1 | Aliphatic nucleophilic substitution: $S_N1$, $S_N2$, $S_Ni$ mechanism. Effect of substrate, nucleophile, leaving group and solvent on aliphatic nucleophilic substitution | 2 | Know the mechanism of nucleophilic substitution reaction | Lecture and group discussion | Evaluation through class test and group discussion Formative assessment I |
| | 2 | $S_N1'$, $S_N2'$ and $S_Ni'$ mechanism for allylic system. Aromatic nucleophilic substitution | 3 | Compare $S_N1'$, $S_N2'$ and $S_Ni'$ mechanism for allylic system | Lecture | |
| | 3 | $S_NAr$, $S_N1$ and $S_N2$. Effect of substrate, structure, nucleophile, leaving group and solvent on aromatic nucleophilic substitution. Ortho-, para- and meta-directing groups in aromatic nucleophilic substitution. | 4 | Distinguish ortho-, para- and meta-directing groups | Lecture and Seminar | |
| | 4 | Neighbouring group participation of alkyl and aryl groups, halogens, carboxylate anion, oxygen, sulphur, C=C bond and C-C bond. Elimination - $E_1$, $E_2$ and $E_{1CB}$ mechanisms. | 3 | Infer neighbouring group participation and elimination reactions | Lecture and group discussion | |
| | 5 | Effect of substrate, base, solvent and the leaving group on elimination reaction. Hofmann, Saytzeff and Bredt's rule. | 2 | Understand Hofmann, Saytzeff and Bredt's rule. | Lecture and Seminar | |
| **II** | **Aromaticity and Novel Ring System** | | | | | |
| | 1 | Aromaticity: Huckel's rule, five, six, seven and eight membered rings, fused six membered aromatic rings. | 4 | Apply Huckel's rule to determine the aromaticity of the organic compounds | | Evaluation through class test and group discussion |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 2 | Aromaticity of fulvene, fulvalene, azulene, tropolones, ferrocene and fullerenes | 2 | Apply Huckel's rule to determine the aromaticity of fulvalene, azulene, tropolones, ferrocene and fullerenes | Seminar and group discussion | Formative assessment II |
| | 3 | .Non-benzenoid aromatics - annulenes, heterocyclic compounds. Craig's rule of aromaticity. | 2 | Infer Huckel's rule and Craig's rule of aromaticity | Lecture and group discussion | |
| | 4 | Concept of antiaromaticity and homoaromaticity. Calculation of energy of aromatic and anti-aromatic systems.Alternant and non-alternant hydrocarbons. | 2 | Calculate the energy of aromatic and anti-aromatic systems | Lecture and group discussion | |
| | 5 | Novel ring system: Nomenclature of bicyclic and tricyclic systems – structure and synthesis of adamantane, congressane, cubane and catanene. | 4 | Predict the nomenclature of novel ring system. | Lecture and group discussion | |
| **III** | **Organic name reactions** | | | | | |
| | 1 | Mechanism and applications: Sharpless asymmetric epoxidation, Stobbe condensation,. | 5 | Recognize the mechanism of various organic name reactions | Lecture | Evaluation through class test and group discussion<br><br>Formative assessment III |
| | 3 | Meerwein-PonndorfVerley reduction, Wolf-Kishner reduction, Clemmensen reduction and Birch reductions, | 2 | Know the mechanism and applications of various organic name reactions | Lecture and group discussion | |
| | 4 | Simmon-Smith, Bischler-Napieralski, Chichibabin, Ziegler alkylation and Vilsmeier-Heck reactions | 3 | Identify the mechanism of various organic name reactions | Lecture | |
| **IV** | **Chemistry of bio-active molecules** | | | | | |
| | 1 | Proteins: primary structure of proteins, terminal group analysis, Edman degradation and DNP method. | 4 | Understand the primary structure of proteins by Edman degradation and DNP method. | Lecture with ppt. | Evaluation through class test and group discussion<br><br>Formative assessment II |
| | 2 | Secondary structure of protein principles leading to $\alpha$ –helix and $\beta$ sheet structure. Tertiary and quaternary structures. | 3 | Interpret the structures of proteins | Lecture and group discussion | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 3 | Structural elucidation of oxytocin - Tuppy's method (Synthesis not required) and insulin (Biosynthesis). | 2 | Elucidate the structure of Oxytocin and insulin | Lecture | |
| | 4 | Polynucleotides and polynucleotides, role and function of RNA's in protein synthesis, DNA replication, transcription and translation. Lipoproteins: LDL, HDL and their characteristics. | 4 | Explain the functions of RNA's in protein synthesis. | Lecture with videos | |
| | 5 | Antibiotics: Structural activity relationship of penicillins, cephalosphorin, streptomycin and chloramphenicol. | 2 | Compare the characteristics of LDL and HDL | Lecture | |
| **V** | **Natural Products** | | | | | |
| | 1 | Steroids: Structural elucidation of cholesterol (Synthesis not required), bile acids -Lithocholic acid. | 4 | Elucidate the structure of cholesterol and lithocholic acid | Lecture | Evaluation through class test, group discussion and quiz<br><br>Formative assessment I |
| | 2 | Sex-harmones: Synthesis of Progestrone, oestrone, oestriol, oesterodiol, testosterone and androsterone. | 3 | Understand the different types of sex harmones. | Lecture | |
| | 3 | Conversion of cholesterol into androsterone, Progestrone and testosterone. Conversion of oestrone into oestriol, oesterodiol | 4 | Convert cholesterol in to different sex harmones. | Lecture and group discussion | |

Course Instructor: Y. Christabel Shaji HOD: G. Leema Rose

**Semester: II**

## Name of the Course: Inorganic Chemistry II

## Subject Code: PG1722

**Teaching Plan**

| Unit | Module | Topics | Lecture Hours | Learning Outcome | Pedagogy | Assessment/ Evaluation |
|---|---|---|---|---|---|---|
| **I** | **Lanthanides and Actinides** | | | | | |
| | 1 | Lanthanides and actinides: Correlation of electronic structures, occurrence and properties of the elements. | 4 | Gain knowledge about lanthanides and actinides. | Lecture | Evaluation through class test<br><br>Formative assessment I |
| | 2 | Chemistry of separation of Np, Pu and Am from U fission products. | 3 | Know the separation of Np, Pu and Am from U | Lecture | |
| | 3 | Common and uncommon oxidation states. Lanthanide and actinide contractions | 4 | Differentiate Lanthanide and actinide contractions | Lecture | |
| | 4 | Spectral and magnetic properties of lanthanides and actinides, similarities between actinides and lanthanides. | 3 | Understand the similarities between actinides and lanthanides | Lecture | |
| | 5 | Preparation and properties of $UF_4$, $UO_2(NO_3)_2.9H_2O$, $ThO_2$, $Th(NO_3)_2$. | 2 | Know the preparation Uranium and Thorium compounds | Lecture | |
| **II** | **Inorganic Photochemistry** | | | | | |
| | 1 | Importance of photochemistry. Photochemistry of Co(III) complexes - photosubstitution reactions, photooxidation-reduction reactions (redox), photoanation reactions. | 4 | Explain the photochemistry of inorganic complexes. | Lecture | Evaluation through class test and group discussion<br><br>Formative assessment II |
| | 2 | Photochemistry of Cr(III) complexes : Photoaquation – octahedral complexes, mixed-ligand complexes, photoisomerization, | 4 | Recognise the different photochemical processes in complexes | Lecture | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 3 | Photoracemization, photoanation, photosubstitution in non-aqueous solvents, photoredox reactions | 4 | Know about various photochemical reactions in inorganic complexes | Lecture and group discussion | |
| | 4 | Photochemistry of Ruthenium polypyridyls: Preparation of $[Ru(bpy)_3]^{2+}$, important characteristics of $[Ru(bpy)_3]^{2+}$, properties of $[Ru(bpy)_3]^{2+}$ | 3 | Synthesise ruthenium polypyridyl complexes | Lecture and group discussion | |
| | 5 | Absorption spectroscopy, ground state properties, redox properties, emission spectroscopy, photosubstitution reaction, photo redox reaction and reductive quenching. | 3 | Explain the properties and reactions of ruthenium polypyridyl complexes | Lecture | |
| **III** | **Bio Inorganic Chemistry - I** | | | | | |
| | 1 | Metalloporphyrins, porphyrin ring in chlorophyll. Photosynthetic electron transport sequence. Biological electron transfer | 5 | Understand the structure of chlorophyll | Lecture | Evaluation through class test and group discussion<br><br>Formative assessment III |
| | 2 | Electron transfer agents - cytochromes, iron-sulphur proteins. Blue Copper proteins - Stellacyanin, Plastocyanin, Azurin | 3 | Explain electron transfer agents | Lecture and seminar | |
| | 3 | Non-blue copper proteins. Synthetic oxygen carriers. Vitamin $B_1$, $B_2$, $B_6$ and Vitamin $B_{12}$ coenzymes. | 2 | Predict the structure of proteins | Lecture and group discussion | |
| | 4 | Nitrogen fixation - invitro and invivo nitrogen fixation | 3 | Compare invitro and invivo nitrogen fixation | Lecture | |
| | 5 | Chelate therapy-therapeutic chelating agents and their uses-anticancer platinum complexes and their interaction with DNA. | 5 | Recognize the importance of metals in biological reactions and in chelate therapy | Lecture | |
| **IV** | **Application of spectroscopy to the study of inorganic compounds - I** | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 1 | IR and Raman Spectroscopy: Application of IR and Raman spectra in the study of coordination compounds | 4 | Apply IR and Raman spectra in coordination compounds. | Lecture | Evaluation through class test and group discussion<br><br>Formative assessment II |
| | 2 | Application to metal carbonyls and nitrosyls. Geometrical and linkage isomerism. | 3 | Apply IR and Raman spectra to metal carbonyls and nitrosyls | Lecture and group discussion | |
| | 3 | Detection of inter and intramolecular hydrogen bonding. Stretching mode analysis of metal carbonyls. | 2 | Detect intermolecular and intramolecular hydrogen bonding | Lecture | |
| | 4 | Photoelectron Spectroscopy: Basic principles, Koopmans's theorem.UPS, XPEs of $N_2$, $O_2$ and $NH_3$-chemical shifts in XPES | 4 | Understand the principles of Photoelectron spectroscopy | Lecture | |
| | 5 | Application of ESCA to inorganic systems-Auger electron spectroscopy. | 2 | List out the applications of ESCA and charge transfer spectrum | Lecture | |
| **V** | **Applications of spectroscopy to the study of inorganic compounds - II** | | | | | |
| | 1 | Electronic spectra: Term, states and microstates, term symbols, selection rules, Hund's rule, | 4 | Gain knowledge about Electronic spectra | Lecture | Evaluation through class test, group discussion and quiz<br><br>Formative assessment I |
| | 2 | LS coupling, J - J coupling schemes, Racah parameters B and C. Orgel and Tanabe-Sugano diagrams, | 5 | Understand the LS J - J coupling. | | |
| | 3 | Evaluation of 10 Dq and $\beta$ for octahedral $Ni^{2+}$ system, tetrahedral $Co^{2+}$ complexes. | 4 | Evaluate 10 Dq and $\beta$ for octahedral $Ni^{2+}$ system, tetrahedral $Co^{2+}$ complexes. | Lecture | |
| | 4 | Charge transfer spectra - Applications of charge transfer spectra. | 3 | List out the applications of charge transfer spectrum | Lecture | |
| | 5 | Electronic spectra of lanthanide and actinide complexes | 2 | Know electronic spectra of lanthanide and actinide complexes | Lecture | |

Course Instructor: S. Lizy Roselet HOD: G. Leema Rose

**Semester: II** **Core VI**

**Name of the Course: Physical Chemistry II**

**Subject Code: PG1723**

**Teaching Plan**

| Unit | Module | Topics | Lecture Hours | Learning Outcome | Pedagogy | Assessment/ Evaluation |
|---|---|---|---|---|---|---|
| **I** | **Electrochemistry – I** | | | | | |
| | 1 | Debye Huckel limiting law, determination of activity coefficient by electrical method. | 4 | Gain knowledge about electrochemistry. | Lecture | Evaluation through class test<br><br>Formative assessment I |
| | 2 | Debye-Huckel limiting law at appreciable concentration of electrolytes, Huckel equation, Debye Huckel-Bronsted equation | 3 | Derive Debye Huckel - Bronsted equation | Lecture | |
| | 3 | Qualitative and quantitative verification. Electrode - electrolyte interface, electrolytic interface. | 4 | Explain the principles and applications of Huckel - Bronstedequation | Lecture and Seminar | |
| | 4 | Adsorption at electrified interface - alloy deposition, electrical double layer. | 3 | Gain knowledge about the significances of electron exchange | Lecture | |
| | 5 | Electro capillary phenomenon - Lippmann equation. | 2 | Derive Lippmann equation | Lecture | |
| **II** | **Electrochemistry – II** | | | | | |
| | 1 | Electrode potential, mechanism of electrode reaction polarization and over potential -theory and applications of over potential | 4 | Deduce various relations of electrode potential. | Lecture | Evaluation through class test and group discussion<br><br>Formative assessment II |
| | 2 | Butler-Volmer equation, electron transfer reaction. Significance of electron exchange current density and symmetry factor. | 4 | Derive Butler-Volmer equation | Lecture | |
| | 3 | Transfer coefficient and its significance. Mechanism of hydrogen and oxygen evolution reactions. | 4 | Know about the Transfer coefficients | Lecture and group discussion | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 4 | Corrosion- corrosion of common metals, atmospheric and immersed types of corrosion, acid, colloidal, oxide-film, electrochemical and differential aeration theories. | 3 | Employ the methods of preventing corrosion | Lecture and group discussion | |
| | 5 | Passivation of metals - Pourbaix diagram, Evan's diagram. Fuel cells, acid and alkaline storage batteries. Electrode deposition - principle and applications. | 2 | Employ the methods of the Construction of fuel cells | | |
| **III** | **Photochemistry** | | | | | |
| | 1 | Introduction to photochemistry - laws of photochemistry, quantum yield calculation. Physical properties of electronically excited molecules. | 5 | Deduce photochemical relations. | Lecture | Evaluation through class test and group discussion<br><br>Formative assessment III |
| | 2 | Excited state dipolemoment, acidity constant and redoxpotential. Photophysical processes in electronically excited molecules. | 3 | Understand excited state dipolemoment, acidity constant and redoxpotential. | Lecture and seminar | |
| | 3 | Jablonski diagram, intersystem crossing, internal conversion, fluorescence, phosphorescence and other deactivation processes. | 2 | Explain Jablonski diagram | Lecture and group discussion | |
| | 4 | Delayed fluorescence. Stern-Volmer equation and its application. Photosensitation and chemiluminescence. Chemical lasers. | 3 | Derive Stern-Volmer equation | Lecture and seminar | |
| | 5 | Photoexplosion and dissociation laser - experimental techniques. Chemical actinometry and flash photolysis. | 5 | Understand laser methods | Lecture | |
| **IV** | **Catalysis** | | | | | |
| | 1 | Homogenous Catalysis: General catalytic mechanism - equilibrium treatment and steady state treatment, general acid - base catalysis | 4 | Infer the catalytic mechanism of equilibrium. | Lecture | Evaluation through class test and group discussion |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 2 | Determination of catalytic co-efficient. Discussion of protolytic and prototropic mechanisms of acid catalysis. | 3 | Compare protolytic and prototropic mechanisms | Lecture and group discussion | Formative assessment II |
| | 3 | Bronsted relationships as linear free energy relationships. Acidity functions and correlation of mechanisms. | 2 | CorrelateBronstedand linear free energy relationships | Lecture | |
| | 4 | Heterogeneous Catalysis: Physisorption and chemisorption - Langmuir adsorption isotherm, mechanism of surface reactions | 4 | Differentiate homogeneous and heterogeneous catalysis | Lecture | |
| | 5 | Langmuir - Hinshelwood and EleyRideal mechanism. Absolute rate of surface reactions. | 2 | Identify Langmuir - Hinshelwood and EleyRideal mechanism | Lecture | |
| **V** | **Quantum mechanics – II** | | | | | |
| | 1 | Approximation methods - Variation Theorem - Application of variation principle to Helium atom. | 4 | Apply variation principle to Helium atom. | Lecture | Evaluation through class test, group discussion and quiz<br><br>Formative assessment I |
| | 2 | Perturbation theory - application of perturbation theory to Helium atom. Pauli's exclusion principle | | Explain perturbation theory | | |
| | 3 | Slater determinant, Secular determinant and secular equation. Chemical bonding in diatomic molecules | 4 | Determine determinant and secular equation. | Lecture | |
| | 4 | Born Oppenheimer approximation. M.O. theory. LCAO approximation. | 3 | List out the types of approximation. | Lecture with videos | |
| | 5 | Application to hydrogen molecule ion $H_2^+$- Hydrogen molecule $H_2$, Valence bond theory - application to $H_2$ molecule. | 2 | Apply quantum mechanics to various molecules | Lecture | |

Course Instructor: A.K. Shermila HOD: G. Leema Rose

**Semester: II** **Elective II**

**Name of the Course: Research Methodology**

**Subject Code: PG1724**

**Teaching Plan**

| Unit | Module | Topics | Lecture Hours | Learning Outcome | Pedagogy | Assessment/ Evaluation |
|---|---|---|---|---|---|---|
| **I** | **Literature Searching and Preparation of Project Report** | | | | | |
| | 1 | Primary, secondary and tertiary sources of information | 2 | Identify the sources of information | Lecture and group discussion | Evaluation through class test<br><br>Formative assessment I |
| | 2 | Libraries<br>Databases<br>Abstracts and Journals<br>Books and Newspapers<br>Government documents | 5 | Utilize the e-resources and documents | Lecture and Seminar | |
| | 3 | Conference proceedings<br>Dissertations<br>Thesis<br>Inflib net | 4 | Know how to write articles and thesis | Lecture and Seminar | |
| | 4 | Presentation of seminar by OHP and powerpoint | 2 | Create and design presentations | Lecture with PPT | |
| | 5 | Project report writing<br>International conventions | 2 | Present project report | Lecture and Seminar | |
| **II** | **Statistical Analysis** | | | | | |
| | 1 | Classification of errors<br>Expression of errors<br>Calculation of errors<br>Calculation of errors - related problems | 4 | Analyse the errors arising during estimations | Lecture and seminar | Evaluation through class test and group discussion<br><br>Formative assessment II |
| | 2 | Precision and accuracy<br>Precision and accuracy - related problems | 2 | Differentiate and determine precision and accuracy | Seminar and group discussion | |
| | 3 | Confidence limits<br>Confidence limits - related problems | 2 | Determine confidence limits | Lecture | |
| | 4 | F-test, t-test and chi square test.<br>F-test, t-test and chi square test related problems | 4 | Calculate F-test, t-test and chi square test | Lecture and seminar | |
| | 5 | Annova<br>Regression analysis<br>correlation analysis | 3 | Correlate regression and correlation analysis | Lecture and seminar | |

| | | | | | | |
|---|---|---|---|---|---|---|
| **III** | **Instrumental Analysis** | | | | | |
| | 1 | Basic concepts of spectroscopy.<br>UV spectroscopy - Application in structural elucidation | 2 | Understand the concept and applications of UV spectroscopy | Lecture with videos | Evaluation through class test and group discussion<br><br>Formative assessment III |
| | 2 | IR spectroscopy - Application in structural elucidation<br>NMR spectroscopy - Application in structural elucidation<br>Mass spectroscopy - Application in structural elucidation | 3 | Elucidate the structure of compounds | Lecture with ppt and videos | |
| | 3 | ESR spectroscopy - Principle and its basic concepts<br>ESR spectroscopy - Applications | 2 | Interpret the structure of compounds | Lecture and group discussion | |
| | 4 | XRD - Principle and experimental technique<br>XRD - Applications | 2 | Determine the particle size of compounds | Lecture and seminar | |
| | 5 | SEM - Principle and experimental technique<br>SEM - Applications<br>STM - Principle and experimental technique<br>STM - Applications | 4 | Predict the surface morphology of compounds | Lecture with videos | |
| | 6 | AFM - Principle and experimental technique<br>AFM - Applications | 2 | Determine the surface morphology using AFM | Lecture with videos | |
| **IV** | **Computer in Research** | | | | | Evaluation through class test and quiz<br><br>Formative assessment I |
| | 1 | Introduction - Use of computer in research<br>Basic features common to Word, Excel, Access and Power point | 4 | Explain the basic features of MS office | Lecture with demo | |
| | 2 | Toolbars and dialog box | 2 | List out and identify the tools in toolbars | Lecture with demo | |
| | 3 | Internet - introduction and history,<br>Types of internet | 2 | Explain the types of internet connections | Seminar | |
| | 4 | HTML and<br>Web design | 2 | Design website using HTML | Lecture with demo | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 5 | Hypelinks and HTTP<br>URLs and Internet protocol<br>Domain server<br>static and dynamic ID<br>Internet security | 5 | Describe various internet protocols | Seminar | |
| V | **Cheminformatics** | | | | | |
| | 1 | Cheminformatics - Introduction and history and applications | 2 | Understand the history of cheminformatics | Lecture | Evaluation through class test and quiz<br><br>Formative assessment II |
| | 2 | Line notation - Inchi and WLN<br>Line notation - SMILES<br>Connection table and line notation versus connection table<br>SMARTS | 3 | Convert the chemical structure into a line notation and connection tables | Lecture with ppt | |
| | 3 | Nomenclature: IUPAC names, trade names and common names | 2 | Identify the nomenclature of compounds | Seminar | |
| | 4 | Molecular similarity -ways to measure similarity<br>2D topology<br>3D configuration | 2 | Determine molecular similarity | Lecture | |
| | 5 | Clustering<br>Physical properties and cheminformatics toolkits | 2 | Describe cheminformatics toolkits | Seminar | |
| | 6 | Chemical registration system<br>Chemistry softwares | 2 | Apply chemistry softwares for drawing | Lecture with ppt and demo | |
| | 7 | Cheminformatics - Applications<br>Drug delivery | 2 | Explain the applications of cheminformatics | Lecture and seminar | |

Course Instructor: S. Santhiya HOD: G. Leema Rose

**Semester: IV** **Core IX**

**Name of the Course: Organic Chemistry IV**

**Subject Code: PG1741**

**Teaching Plan**

| Unit | Module | Topics | Lecture Hours | Learning Outcome | Pedagogy | Assessment/ Evaluation |
|---|---|---|---|---|---|---|
| **I** | **Retrosynthetic Analysis** | | | | | |
| | 1 | Planning – relay, linear and convergent approach, protecting groups and activating groups. Target molecule containing one functional group requiring a single disconnection. | 4 | Understand the concept of reterosynthesis | Lecture | Evaluation through class test<br><br>Formative assessment I |
| | 2 | Synthons and synthetic equivalents. Latent polarity. Target molecules with two functional groups - 1,3-, 1,5- and 1,4-dicarbonyl compounds. | 5 | Analyse the reterosynthetic approach of target molecules with two functional groups | Lecture | |
| | 3 | Functional group interconversions. Umploung synthesis. | 3 | Generalize functional group interconversions and Umploungsynthesis | Lecture | |
| | 4 | Retrosynthetic analysis of bisabolene, cis-Jasmone and longifolene. | 3 | Explain the retrosynthesis of bisabolene, cis-Jasmone and longifolene | Lecture | |
| **II** | **Alkaloids** | | | | | |
| | 1 | Alkaloids, Extraction, general properties and classification. | 4 | Discuss the chemistry of alkaloids | Lecture | Evaluation through class test and group discussion<br><br>Formative assessment II |
| | 2 | Alkaloids -general methods for determining structure. | 3 | Know about the general methods for determining the structure of alkaloids | Lecture | |
| | 3 | Structural elucidation of morphine, atropine and cocaine. | 5 | Elucidate the structure of morphine, atropine and cocaine | Lecture and group discussion | |
| | 4 | Structural elucidation of quinine and papaverine. | 3 | Elucidate the structure of quinine and papaverine | Lecture and group discussion | |
| **III** | **Molecular rearrangements** | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 1 | Classification - electrophilic, nucleophilicand free radical rearrangements. Mechanisms of Di- π- methane rearrangement. | 2 | Classify the types of rearrangements and understand the mechanism of Di- π-methane rearrangement | Lecture | Evaluation through class test<br><br>Formative assessment III |
| | 2 | Mechanisms of Tiffenev-Demyanov, Dienone- Phenol and von-Richter rearrangements. | 3 | Explain the mechanism of Tiffenev-Demyanov, Dienone- Phenol and von-Richter rearrangements | Lecture | |
| | 3 | Mechanisms of Favorskii, Fries, Baeyer-Villager rearrangements. | 4 | Explain the mechanism of Favorskii, Fries and Baeyer-Villager rearrangements | Lecture | |
| | 4 | Mechanisms of Stevens, Neber and Sommelet-Hauser rearrangements. | 3 | Explain the mechanism of Stevens, Neber and Sommelet-Hauser rearrangements | Lecture | |
| | 5 | Mechanisms of Baker-Venkatraman,Wagner Meerwin and Ullmann rearrangements. | 3 | Explain the mechanism of Baker-Venkatraman,Wagner Meerwinand Ullmann rearrangements | Lecture | |
| **IV** | **Organic Photochemistry** | | | | | |
| | 1 | General introduction. Thermal versus photochemical reactions. Jablonski diagram. | 3 | Differentiate thermal and photochemical reactions | Lecture | Evaluation through class test and group discussion<br><br>Formative assessment II |
| | 2 | Photochemical reactions of ketones– photosensitization, Norrish type - I and Norrish type - II reactions and mechanisms. | 3 | Know the photochemical reactions of ketones | Lecture and group discussion | |
| | 3 | Paterno–Buchi reaction, photooxidation and photoreduction of ketones,. | 3 | Identify photooxidation and photoreduction of ketones | Lecture | |
| | 4 | Photochemistry of arenes. Photodimerisation and photoisomerisation. | 3 | Understand the mechanism of photochemical reactions in ketonesandarenes | Lecture | |
| | 5 | Reactions involving free radicals – Barton, Huns-diecker, Pschorr and Gomberg-Bauchman reactions. | 3 | Know the mechanism of photochemical reactions in free radicals | Lecture | |
| **V** | **Pericyclic Reactions** | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 1 | Characteristics and classifications of pericyclic reactions - electrocyclic, cycloaddition and sigmatropic reactions. | 4 | Identify the reactions involving in pericyclic reaction | Lecture | Evaluation through class test, group discussion and quiz<br><br>Formative assessment I |
| | 2 | Woodward Hofmann rule. 2+2, 2+4 – reactions, Retro-Diels Alder reaction and Diels Alder reaction. | 4 | Understand the mechanism of photochemical reactions | Lecture | |
| | 3 | Cope rearrangements and Claisen rearrangements. Conservation of orbital symmetry. Prediction of reaction conditions using FMO. | 4 | Know about FMO diagram | Lecture and group discussion | |
| | 4 | Correlation diagrams and Zimmerman (Mobius-Huckel analysis) approaches. | 3 | Correlate pericyclic reactions | Lecture | |

Course Instructor: Y. Christabel Shaji HOD: G. Leema Rose

**Semester: IV** **Core X**

## Name of the Course: Inorganic Chemistry III

## Sub Code: PG1742

### Teaching Plan

| Unit | Module | Topics | Lecture Hours | Learning Outcome | Pedagogy | Assessment/ Evaluation |
|---|---|---|---|---|---|---|
| **I** | **Application of spectroscopy to the study of Inorganic compounds – III** | | | | | |
| | 1 | NMR Spectroscopy: Principle, $^{31}P$, $^{19}F$, $^{15}N$, applications in structural problems. Monitoring the course of reaction. | 4 | Know the principle and applications of NMR spectroscopy in structural determination | Lecture | Evaluation through class test<br><br>Formative assessment I |
| | 2 | NMR of fluxional molecules. NMR of paramagnetic molecules - contact shift and shift reagents. | 3 | Analyse the NMR spectrum of various molecules | Lecture | |
| | 3 | NQR Spectroscopy: Principle, comparison with NMR, electric field gradient, quadrupolar splitting of energy levels in symmetric and asymmetric fields, quadrupolar coupling in atoms and molecules, asymmetry parameter. | 5 | Compare and understand NQR and NMR spectroscopy | Lecture | |
| | 4 | Application - hydrogen bonding, phase transition, substituent effect and structural information. | 3 | Know the applications of NQR spectroscopy | Lecture and Seminar | |
| **II** | **Applications of spectroscopy to the study of inorganic compounds – IV** | | | | | |
| | 1 | ESR spectroscopy - Introduction and Principle. Presentation of the spectrum and hyperfine splitting. Factors affecting the magnitude of g values | 3 | Understand the concept of ESR spectroscopy | Lecture | Evaluation through class test and group discussion<br><br>Formative assessment II |
| | 2 | Zero-field splitting and Kramer's degeneracy. Anisotropy in the hyperfine coupling constant | 3 | Know about zero-field splitting, Kramer's degeneracy and anisotropy | Lecture | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 3 | Covalency of M-L bonding by ESR.Jahn- Teller distortion in Cu (II) complexes from ESR studies. | 3 | Determine the ESR spectrum of Cu complexes | Lecture and group discussion | |
| | 4 | Mossbauer Spectroscopy: Principle, Doppler Effect, recoil energy, minimizing recoil energy, Doppler broadening. | 3 | Understand the principle and concept of Mossbauer spectroscopy | Lecture and group discussion | |
| | 5 | Isomer shift in Fe and Sn compounds. Electro negativity and chemical shift. Quadrupole interaction - quadrupole splitting in the MB spectra of Fe complexes. | 3 | Differentiate the MB spectrum of $Fe^{2+}$ and $Fe^{3+}$ complexes | Lecture | |
| **III** | **Non- aqueous solvents** | | | | | |
| | 1 | Non- aqueous solvents- Introduction<br>General properties and classification of solvents | 2 | Classify solvents | Lecture | Evaluation through class test and group discussion<br><br>Formative assessment III |
| | 2 | Self-ionization and leveling effect. Reactions in non-aqueous solvents. Solute-solvent interaction. | 2 | Understand the reactions in non-aqueous solvents and solute-solvent interaction | Lecture and seminar | |
| | 3 | Solution of metals in liquid ammonia. Reaction in liquid HF, liquid halogens, interhalogens and liquid $H_2SO_4$. | 3 | Identify the reactions in non-aqueous solvents | Lecture and group discussion | |
| | 4 | Molten salts as non-aqueous solvents. Titration in non-aqueous solvents. | 3 | Know about molten salts and titrations in non-aqueous solvents | Lecture and seminar | |
| | 5 | HSAB theory and solvent system definitions. | 2 | Define HSAB theory and solvent systems | Lecture | |
| | 6 | Acid base concepts - Arrhenius, Lux flood, Usanovich, Lowry-Bronsted and Lewis concept. | 3 | Infer acids and bases using various concepts | Lecture | |
| **IV** | **Electrical and magnetic properties of solids** | | | | | |
| | 1 | Conductivity of pure metals and Electrical conductivity | 2 | Explain the conductivity of metals | Lecture | Evaluation through class test and |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 2 | Photoconductivity, photoconductive device. Solar cell and solar energy conversion. | 3 | Describe solar cells and solar energy conversion | Lecture and group discussion | group discussion<br><br>Formative assessment II |
| | 3 | Dielectric properties - permittivity, dielectric constant, electric susceptibility, electronic polarization, ionic polarization, orientation, dielectric loss and dielectric break down, ferro electricity. | 4 | Define the electrical proprieties of metals | Lecture | |
| | 4 | Applications of magnetic properties of solids - dia, para, ferro, antiferro and ferrimagnetism. | 3 | Describe the magnetic properties of metals | Lecture | |
| | 5 | Effect of temperature on magnetism - Curie and Weiss law. Calculation of magnetic moments. | 3 | State Curie and Weiss law and determine the magnetic moment of metals | Lecture | |
| **V** | **Bio Inorganic Chemistry - II** | | | | | |
| | 1 | Photosynthesis, photosystem I and II and photosynthetic reaction centre. | 3 | Generalize photosystem I, II and photosynthetic reaction | Lecture | Evaluation through class test, group discussion and quiz<br><br>Formative assessment I |
| | 2 | Metalloenzymes - enzymes in di-oxygen management. | 2 | Describemetalloenzymes | Lecture | |
| | 3 | Super oxide dismutase, superoxide toxicity, structure of Cu, Zn-SOD, enzymatic activity and mechanism. | 3 | Know about superoxide dismutase | Lecture and group discussio n | |
| | 4 | Peroxidases, catalases, oxidases and mono oxygeneases. | 2 | Explain peroxidases, catalases, oxidases and mono oxygeneases | Lecture | |
| | 5 | Zinc enzymes - the structural role of zinc and zinc constellations of carbonic anhydrase, carboxy peptidase and alcohol dehydrogenase. | 3 | Understand the role of zinc inzinc enzymes | Lecture | |
| | 6 | Metal complexes as probes of nucleic acids. Gold compounds and anti-arthritic agents. | 2 | Express the role of metal complexes and its applications | Lecture and group discussio n | |

Course Instructor: A.K. Shermila HOD: G. Leema Rose

**Semester: IV** **Core XI**

**Name of the Course: Physical Chemistry IV**

**Sub Code: PG1743**

**Teaching Plan**

| Unit | Module | Topics | Lecture Hours | Learning Outcome | Pedagogy | Assessment/ Evaluation |
|---|---|---|---|---|---|---|
| **I** | **Advanced topics in electrochemistry** | | | | | |
| | 1 | Photo-electrochemistry - Introduction, band bending at the semiconductor/solution interface. | 3 | Understand photo-electro chemistry | Lecture | Evaluation through class test<br><br>Formative assessment I |
| | 2 | Photo-excitation of electrons by absorption of light, surface effects in photo-electrochemistry. | 2 | Explain photo-excitation of electrons | Lecture and Seminar | |
| | 3 | Photo-electro catalysis, photo-electrochemical splitting of water, photo-electrochemical reduction of $CO_2$. | 3 | Generalize photo-electrochemical reactions | Lecture and Seminar | |
| | 4 | Bio-electrochemistry – bio-electrodes, membrane potentials. Electrochemical communication in biological organisms | 3 | Know about bio-electrochemistry | Lecture with PPT | |
| | 5 | Enzymes as electrodes, electron transfer in p450 enzymes | 2 | Understand the role of enzymes as electrodes | Lecture | |
| | 6 | Electrochemical sensors, electrochemical biosensors, gas sensors and sensor arrays. | 3 | Describe various sensors | Lecture with ppt | |
| **II** | **Nanomaterials for catalysis** | | | | | |
| | 1 | Nanocatalyst: fundamentals, homogeneous vs heterogeneous catalysis | 3 | Differentiate homogeneous and heterogeneous nano-catalysis | Lecture and seminar | Evaluation through class test and group discussion<br><br>Formative assessment II |
| | 2 | Effect of surface area, shape, morphology, particle size and composition on catalysis. | 3 | Know the effect of surface area, shape, morphology, particle size and composition on catalysis | Lecture with ppt | |
| | 3 | Nano-materials for photo-catalysis - dye degradation, water splitting, organic transformations. | 4 | Apply nano-materials for photo-catalysis | Lecture and group discussion | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 4 | Plasmon assisted photo-catalysis and band gap tuning | 3 | Understand the concept of plasmon assisted photo-catalysis and band gap tuning | Lecture and group discussion | |
| | 5 | Nanomaterials for $CO_2$ capture and conversion. | 2 | Explain nanomaterials for $CO_2$ capture and conversion | Lecture | |
| **III** | **Molecular Spectroscopy - II** | | | | | |
| | 1 | Electronic Spectroscopy: Principle, laws of light absorption, Born-Oppenheimer approximation | 3 | Know the principle of electronic spectroscopy and Born-Oppenheimer approximation | Lecture | Evaluation through class test and group discussion<br><br>Formative assessment III |
| | 2 | Franck-Condon principle, Wave-mechanical formulation, dissociation energy and dissociation products. | 3 | Understand Franck-Condon principle, dissociation energy and dissociation products | Lecture and seminar | |
| | 3 | Pre-dissociation, fluorescence and phosphorescence - principle and theory. | 2 | Generalize the principle and theory of fluorescence and phosphorescence | Lecture and group discussion | |
| | 4 | Nuclear magnetic resonance spectroscopy: Principle, Nuclear spin and nuclear moment, chemical shift and its measurements. | 2 | Explain the principle and concept of NMR spectroscopy | Lecture and seminar | |
| | 5 | Factors influencing chemical shift, shielding and deshielding effects, spin-spin interactions, | 2 | Discuss the factors affecting chemical shift and sipn-spin interactions | Lecture | |
| | 6 | NMR of simple AMX type molecules, coupling constant, FTNMR, NMR of $^{19}F$, $^{31}P$ and $^{13}C$ . | 5 | Interpret the concept of FTNMR, $^{19}F$, $^{31}P$ and $^{13}C$ NMR spectroscopy | Lecture | |
| **IV** | **Molecular Spectroscopy - III** | | | | | |
| | 1 | ESR: Theory, hyperfine interactions in ESR. Double resonance (ENDOR, ELDOR), Mc Connell's relation. | 4 | Understand the theory of ESR spectroscopy, double resonance and Mc Connell's relation | Lecture | Evaluation through class test and group discussion<br><br>Formative assessment II |
| | 2 | Verification of the relation for cyclic polyene radical and calculation of electron density. Experimental techniques. | 3 | Explain the ESR spectroscopy of cyclic polyene radical and calculation of electron density | Lecture and group discussion | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 3 | Laser Raman spectroscopy: Einstein treatment of absorption and emission phenomena. Einstein's coefficients. | 2 | Know about Laser Raman spectroscopy | Lecture | |
| | 4 | Probability of induced emission and its applications to lasers. Conditions for laser action. | 4 | Describe the applications of laser Raman spectroscopy | Lecture | |
| | 5 | Properties and types of lasers. Advantages of lasers in Raman spectroscopy. Experimental Techniques. | 2 | Discuss the properties and advantages of lasers in Raman spectroscopy | Lecture | |
| V | **Solid State Chemistry** | | | | | |
| | 1 | Ionic radii - determination. Gold Schmit'srule. | 2 | Determine the ionic radii of solids | Lecture | Evaluation through class test, group discussion and quiz<br><br>Formative assessment I |
| | 2 | Closed packing in solids. Structure of metallic crystals. | 3 | Explain the structure of metallic crystals | | |
| | 3 | Perovskite, CsCl, Zinc blende, Wurtzite, Rutile, fluorite and antifluorite. Covalent crystals. Diamond and graphite. | 5 | Discuss the structure of covalent crystals, diamond and graphite | Lecture | |
| | 4 | Mechanical properties of solids. | 2 | Understand the mechanical properties of solids | Lecture with videos | |

Course Instructor: S. LizyRoselet HOD: G. Leema Rose

**Semester: IV** **Elective IV**

**Name of the Course: Energy for the Future**

**Subject Code: PG1744**

## Teaching Plan

| Unit | Module | Topics | Lecture Hours | Learning Outcome | Pedagogy | Assessment/ Evaluation |
|---|---|---|---|---|---|---|
| **I** | **Introduction to Energy Sources** | | | | | |
| | 1 | Introduction, conventional energy sources like coal, oil, gas, agricultural and organic wastes, water power, thermal power and nuclear power. | 4 | Know the sources of conventional energy | Lecture with videos | Evaluation through class test and seminar<br><br>Formative assessment I |
| | 2 | Non-conventional energy sources like solar energy and wind energy. | 3 | Explain non-conventional energy sources | Lecture and Seminar | |
| | 3 | Energy from bio-mass and bio-gas, ocean thermal energy, tidal energy. | 4 | Understand various sources of energy | Lecture and Seminar | |
| | 4 | Geothermal energy and hydrogen energy. Advantages of renewable energy. | 4 | Generalize the advantages of renewable energy | Lecture and seminar | |
| **II** | **Solar Energy** | | | | | |
| | 1 | Solar radiation and its measurement - Introduction, solar constant, solar radiation at the earth's surface, solar radiation geometry and solar radiation data. | 4 | Explain solar radiations and its measurement | Lecture and seminar | Evaluation through class test and seminar<br><br>Formative assessment II |
| | 2 | Solar energy collectors - Introduction, physical principles of the conversion of solar radiation into heat, flat plate and concentration collectors. | 4 | Understand the principle of solar energy conversion and collectors | Seminar | |
| | 3 | Advantages and disadvantages of concentration collectors over flat collectors. | 3 | Know the advantages and disadvantages of different collectors | Lecture | |
| | 4 | Energy balance equation and collector efficiency. | 4 | Determine energy balance and collector efficiency | Lecture and seminar | |
| **III** | **Wind Energy** | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 1 | Introduction, basic principles of wind energy conversion, power of the wing, forces on the blades. | 2 | Understand the basis of wind energy | Lecture with videos | Evaluation through class test and seminar<br><br>Formative assessment III |
| | 2 | Wind energy conversion, wind data and estimation, site selection. | 3 | Illustrate wind energy conversion | Lecture with ppt and videos | |
| | 3 | Types of wind machines - Horizontal axis and vertical axis machines. | 3 | Classify the types of wind machine | Lecture and seminar | |
| | 4 | Analysis of aerodynamic forces acting on the blade, performance of wind machines. | 3 | Analyse the forces acting on the blade | Lecture and seminar | |
| | 5 | Generating systems - Introduction, schemes of electric generation, generator control, load control, energy storage. Application of wind energy. | 4 | Explain generating system and applications of wind energy | Lecture with videos | |
| **IV** | **Bio-energy** | | | | | |
| | 1 | Introduction, biomass conversion techniques - wet processes and dry processes. | 3 | Explain biomass and its conversion | Lecture and seminar | Evaluation through class test and quiz<br><br>Formative assessment I |
| | 2 | Biogas generation. Classification of biogas plants - floating drum plant and fixed dome type plant. Biogas from plant waste. | 4 | List out the classification of biogas plants | Lecture and seminar | |
| | 3 | Materials used for biogas generation, selection of site for a biogas plant, digester design. Problems related with biogas plants. | 4 | Generalize biogas generation and identify the problems related to biogas plant | Seminar | |
| | 4 | Fuel properties of biogas and utilization of biogas. | 4 | Understand the properties of biogas | Lecture and seminar | |
| **V** | **Chemical energy sources** | | | | | |
| | 1 | Fuel cells - Introduction, conversion efficiency of fuel cells, types of electrodes, work output. | 2 | Understand the basis of fuel cells | Lecture and seminar | Evaluation through class test and quiz<br><br>Formative assessment II |
| | 2 | EMF of fuel cells. Applications of fuel cells. | 3 | Determine the EMF of fuel cells and explain the applications of it | Lecture and seminar | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 3 | Hydrogen energy: Hydrogen production – electrolysis, thermo-chemical, fossil fuel and solar energy methods. | 4 | Explain hydrogen production by various methods | Seminar | |
| | 4 | Hydrogen storage and hydrogen transportation. | 2 | Know about hydrogen storage and hydrogen transportation | Lecture and seminar | |
| | 5 | Utilization of hygrogen gas. Hydrogen as an alternative fuel for motor vehicles. Safety and management. | 4 | Describe the utilization and safety measures of hydrogen gas | Seminar | |

Course Instructor: S. Santhiya HOD: G. Leema Rose