S.V.K.P & Dr. K.S. RAJU ARTS & SCIENCE COLLEGE

(Autonomous)

Recognized by UGC as "College with Potential for Excellence (2016-21)"
Accredited by NAAC with "A" Grade
& ISO Certified Institution (with 3 ISO Certificates)
(Affiliated to ADIKAVI NANNAYA UNIVERSITY-Recognized by Govt. of Andhra Pradesh)
PENUGONDA – 534320. W.G.DIST.,

DEPARTMENT OF CHEMISTRY (U.G)

B.Sc., Chemistry

2024 – 25

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II- SEMESTER

COURSE 3 : GENERAL CHEMISTRY

Credits: 03

I. SYLLABUS

UNIT-1: ATOMIC STRUCTURE AND PERIODIC TABLE (9h)

Electronic configuration - Aufbau principle, Hund's rule and Pauli's exclusion principle. Periodic law and arrangement of elements in the periodic table, horizontal, vertical, and diagonal relationships in the periodic table. Definition and periodic trends of atomic radii, ionic radii, covalent radii, ionization potential, electron affinity, and electro negativity, Pauling scale, variable valency, inert-pair effect.

UNIT-2: IONIC BOND (9h)

Properties of ionic compounds, factors favouring the formation of ionic compounds, Lattice energy: definition, factors affecting lattice energy, Born-Haber cycle - enthalpy of formation of ionic

Compound and stability, Covalent character in ionic compounds - polarization and Fajan's rules, effects of polarization.

UNIT-3: COVALENT BOND (9h)

Valence Bond theory: Hybridization of atomic orbitals and geometry of molecules - $BeCl_2$, BF_3, CH_4, PCl_5, and SF_6

VSEPR model: Effect of bonding and nonbonding electrons on the structure of molecules - NH_3, H_2O,SF_4, $ICl_2^-$and XeF_4

Molecular orbital theory: LCAO method, construction of M.O. diagrams for homo nuclear and hetero nuclear diatomic molecules (N_2, O_2, CO and NO)

UNIT-4: METALLIC AND HYDROGEN BONDS (9h)

Metallic bond: Metallic properties, free electron theory, band theory of metals. Explanation of conductors, semiconductors and insulators.

Hydrogen bonding: Intra and Inter-molecular hydrogen bonding, influence on the physical properties of molecules, Vander waal's forces, dipole-dipole interactions.

UNIT-5: Acids and Bases (9h)

Theories of acids and bases: Arrhenius theory ,Bronsted -Lowry theory ,Lewis theory ,the solvent system ,Non aqueous solvents :classification – protic and aprotic solvents ,liquid ammonia as solvent-solutions of alkali and alkaline earth metals in ammonia .

Types of chemical reactions: oxidation-reduction, calculation of oxidation number.

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II- SEMESTER

COURSE 3 : QUALITATIVE ANALYSIS OF SIMPLE SALT

Credits: 01

I. SYLLABUS:

Analysis of simple salt containing **one anion and one cation** from the following:

Anions: Carbonate, sulphate, chloride, bromide, acetate, nitrate, borate, phosphate.

Cations: Lead, copper, iron, aluminium, zinc, nickel, manganese, calcium, strontium, barium, Ammonium.

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II – SEMESTER
COURSE 4: INORGANIC CHEMISTRY.

Credits: 03

I. SYLLABUS:

UNIT-1: CHEMISTRY OF p – BLOCK ELEMENTS – I (9h)

Group13: Preparation and structure of Diborane, Borazine and $(BN)_x$.

Group14: Preparation, classification and uses of silicones.

Group15: Preparation and structure of Phosphonitrilic Chloride $P_3N_3Cl_6$.

UNIT-2: CHEMISTRY OF p – BLOCK ELEMENTS – II (9h)

Group16: Classification of oxides, structures of oxides and oxoacids of sulphur.

Group17: Preparation and structures of Inter halogen compounds, Pseudo halogens.

UNIT-3: CHEMISTRY OF d-BLOCK ELEMENTS (9h)

Characteristics of d-block elements with special reference to electronic configuration, variable valency, colour, magnetic properties, catalytic properties and ability to form complexes. Stability of various oxidation states of 3d-series.

UNIT-4: CHEMISTRY OF f-BLOCK ELEMENTS (9h)

Chemistry of Lanthanides: Electronic configuration, oxidation states, colour, magnetic properties, Lanthanide contraction, consequences of lanthanide contraction.

Chemistry of Actinides: Electronic configuration, oxidation states, actinide contraction, Comparison of lanthanides and actinides.

UNIT-5: NUCLEAR CHEMISTRY (9h)

Definition, Isotopes, n/p ratio, binding energy, types of radioactivity, Soddy-Fajan's displacement law, Law of Radioactivity, Radioactive decay series, Nuclear Reactions-Fission and Fusion, Applications of radioactivity in agriculture and medicine.

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II- SEMESTER
COURSE: INORGANIC PREPARATIONS
Credits: 01

I. SYLLABUS:

1. Preparation of Potash alum.
2. Preparation of Ferrous oxalate
3. Preparation of Ferrous ammonium sulphate.
4. Preparation of Cuprous chloride.
5. Preparation of Chrome alum.

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III -SEMESTER

Course Code 5: FUNDAMENTALS IN ORGANIC CHEMISTRY

Credits: 03

Syllabus:

Unit 1. Structural theory in Organic Chemistry (9 h)

Types of bond fission and organic reagents (Electrophilic, Nucleophilic, and free radical reagents). Reaction intermediates – Carbocations, carbanions & free radicals. Bond polarization: Factors influencing the polarization of covalent bonds, inductive effect - Application of inductive effect (a) Basicity of amines (b) Acidity of carboxylic acids (c) Stability of carbonium ions. Resonance or Mesomeric effect, application to (a) acidity of phenol, and (b) acidity of carboxylic acids. Hyper conjugation and its application to stability of carbonium ions, Free radicals and alkenes.

Additional Inputs : Types of Organic reactions : Addition - electrophilic, nucleophilic and free radical. Substitution - electrophilic, nucleophilic and free radical. Elimination- Examples.

Unit II Saturated Hydrocarbons (Alkanes and Cycloalkanes) 9 h

General methods of preparation of alkanes- Wurtz and Wurtz Fittig reaction, Corey House synthesis, physical and chemical properties of alkanes, Conformational analysis of alkanes (Conformations, relative stability and energy diagrams of Ethane, Propane and butane).

General molecular formulae of cycloalkanes and relative stability, Baeyer strain theory, Cyclohexane conformations with energy diagram, Conformations of

monosubstituted cyclohexane.

Additional Inputs **:** Preparation of cycloalkanes by Freunds method, Wislicenus method, Sachse and Mohr predictions theory.

UNIT-III Unsaturated Hydrocarbons (Alkenes and Alkynes) 9 h

General methods of preparation, physical and chemical properties, Saytzeff and Hoffmann eliminations (with mechanism), Electrophilic Additions, (H_2, HX) mechanism (Markownikoff/ Antimarkownikoff addition) with suitable examples-syn and anti-addition;

addition of X_2, HX. Oxymercuration demercuration, ozonolysis, hydroxylation, Diels Alder reaction, 1,2- and1,4-addition reactions in conjugated dienes. Reactions of alkynes; acidity, electrophilic and nucleophilic additions, hydration to form carbonyl compounds, Alkylationof terminal alkynes.

Additional Inputs **:** Dienes - Types of dienes

UNIT-IV Benzene and its reactivity (9 h)

Structure of Benzene – Preparation - polymerisation of acetylene and decarboxylation- Properties -mechanism of electrophilic aromatic substitution of Friedel- Craft's alkylation andacylation. halogenation and nitration,

UNIT-V Orientation of aromatic substitution (9 h)

Concept of aromaticity, Huckel's rule - application to Benzenoid (Benzene, Naphthalene) and Non - Benzenoid compounds (cyclopropenylcation, cyclopentadienyl anion and tropylium cation) Orientation of aromatic substitution - ortho, para and meta directing groups. Ring activating and deactivating groups with examples (Electronic interpretation of various groups like NO_2 and Phenolic). Orientation of (i) Amino, methoxy and methyl groups (ii) Carboxy, nitro, nitrile, carbonyl and sulphonic acid groups (iii) Halogens.

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III -SEMESTER
Course Code 5: Organic Qualitative analysis

Credits: 01

Organic Qualitative analysis

Syllabus:

Analysis of an organic compound through systematic qualitative procedure for functional group identification including the determination of melting point and boiling point with suitable derivatives. Alcohols, Phenols, Aldehydes, Ketones, Carboxylic acids, Aromatic primary amines, amides and simple sugars.

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III -SEMESTER
Course Code 6: ORGANIC CHEMISTRY

(Halogen and Oxygen containing organic compounds)

Credits: 03

Syllabus:

Unit – I Halogen compounds (9 h)

Alkyl halides: Preparation of alkyl halides from i) alkanes, ii) alkenes and iii) alcohols. Properties - nucleophilic substitution reactions–$SN_1$and SN_2 and SN_i mechanisms with energy profile diagrams, stereo chemical aspects and effect of solvent. Williamson's synthesis.

Aryl halides: Preparation i) from phenols ii) Sandmeyer's reaction, nucleophilic aromatic substitution (Benzyne mechanism);relative reactivity of alkyl, allyl, vinyl and benzyl, aryl halides towards nucleophilic substitution reactions.

Unit II Alcohols and Phenols (9 h)

Alcohols: Preparation of 1^0,2^0,3^0alcohols from Grignard's reagent, Bouveault–Blanc Reduction; Chemical properties – substitution of –OH by using PCl_5, PCl_3, PBr_3, $SOCl_2$ and with HX / $ZnCl_2$, Oxidation of alcohols with PCC, PDC; Oxidation of diols by HIO_4 and $Pb(OAc)_4$, Pinacol Pinacolone arrangement with mechanism, relative reactivity of 1°, 2°, 3°alcohols.

Phenols : Preparation from diazonium salt and Cumene. Reactions and mechanism–Reimer– Tiemann**,**Kolbe–Schmitt Reactions, Fries and Claisen rearrangements.

Unit III Carbonyl Compounds (9 h)

Preparation from-Acid chlorides,1,3-dithiane and nitriles; Structure and reactivity of carbonyl group, Nucleophilic addition reactions with HCN, $NaHSO_3$ and alcohols. addition-

elimination reactions with hydroxylamine, hydrazine, phenyl hydrazine, 2,4DNP, semicarbazide. Oxidations and reductions (Clemmensen's, Wolf–Kishner's, withLiAlH4 & NaBH4).

Reaction & Mechanism- Aldol condensation, Cannizzaro reaction, Perkin reaction, Benzoin condensation, Claisen-Schmidt reaction, Haloform reaction

Unit-IV Carboxylic acid and Active methylene Compounds (9h)

Carboxylic Acids: Preparation from Grignard reagent and hydrolysis of nitriles, Reactions of monocarboxylic acids- Reactions involving -H, -OH and-COOHgroups, formation of salts, esters, acidchlorides, amides and anhydrides. Degradation of carboxylic acids by Huns- Diecker's reaction, decarboxylation by Schmidt reaction, Arndt-Eistert synthesis, halogenation by Hell- Volhard-Zelinsky reaction. Mechanisms of acidic and alkaline hydrolysis of esters, Reformatsky reactions, Curtius rearrangement.

Active methylene compounds: Ketoenol tautomerism, preparation of Aceto Acetic Ester(AAE) by Claisen condensation with mechanism,synthetic applications of AAE in the preparation of mono carboxylic acids, di carboxylic acids, α,β-unsaturated acids and heterocyclic compounds.

Unit V : Carbohydrates (9 h)

Classification and their biological importance, Monosaccharides: Structural elucidation of glucose and fructose, epimers and anomers, mutarotation, determination of ring size of glucose and fructose, Haworth projections and conformational structures; Interconversions of aldoses and ketoses; Killiani-Fischer synthesis and Ruff degradation; Disaccharides– Haworth structure of maltose, lactose and sucrose.

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III - SEMESTER
Course Code 6: Organic

preparationsCredits: 01

Organic preparation

Syllabus - Organic preparations (50M)

i. Acetylation of β-naphthol, vanillin and salicylic acid by:

a) Using conventional method.

b) Using green approach

ii. Preparation of Nerolin

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III - SEMESTER

Course Code 7: PHYSICAL CHEMISTRY - I

(Solutions & Electro

Chemistry)Credits: 03

Syllabus:

Unit I Solutions (9 h)

Classification - Miscible, Partially miscible and Immiscible - Raoult's Law - Azeotropes- HCl-H_2O system and ethanol-water system. Partially miscible liquids-phenol- water system. Critical solution temperature (CST), Effect of impurity on consulate temperature. Immiscible liquids and steam distillation. Nernst distribution law. Calculation of the partition coefficient. Applications of distribution law.

Unit II Colligative Properties
9 h)

Relative lowering of Vapour Pressure, Elevation in boing point depression in freezing point and Osmotic pressure. Determination of molecular mass of non-volatile solute by Ostwald- Walker method, Cottrell's method, Rast method and Barkeley-Hartley method.

Abnormal colligative properties. Van't Hoff factor.

Unit III – Photochemistry (9h)

Difference between thermal and photochemical processes, Laws of photochemistry- Grothus- Draper's law and Stark-Einstein's law of photochemical equivalence, Quantum

yield- Photochemical reaction mechanism- hydrogen- chlorine and hydrogen-

bromine reaction. Qualitative description of fluorescence, phosphorescence, Jablonski diagram, chemiluminescence - Photosensitized reactions- energy transfer processes (simple example), quenching, Photo stationary state.

Unit IV Electrochemistry-I (9 h)

Conductance, Specific conductance, equivalent conductance and molar conductance - effect of dilution. Cell constant. Strong and weak electrolytes, Kohlrausch's law and its applications,

Definition of transport number, determination of transport number by Hittorf's method. Debye-Huckel - Onsagar's equation for strong electrolytes (derivation excluded), Application of conductivity measurements- conductometric titrations.

Unit V Electrochemistry-II (9 h)

Electrochemical Cells- Single electrode potential, Types of electrodes with examples: Metal- metal ion, Gas electrode, Inert electrode, Redox electrode, Metal-metal insoluble salt- salt anion. Determination of EMF of a cell, Nernst equation, Applications of EMF measurements

-Potentiometric titrations. Fuelcells – Basic concepts, examples and applications.

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III - SEMESTER

Course Code 7: PHYSICAL CHEMISTRY -I

Credits: 01

CST, Conductometric and Potentiometric Titrimetry 50 M

1. Determination of CST for Phenol-water system.
2. Effect of electrolyte on CST.
3. Conductometric titration - Determination of concentration of HCl solution usingstandard NaOH solution.
4. Conductometric titration – Determination of concentration of CH_3COOHSolution using standard NaOH solution.
5. Potentiometric titration-Determination of concentration of HCl using standardNaOH solution.

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III –SEMESTER
COURSE CODE 8: INORGANIC AND PHYSICAL CHEMISTRY

Credits: 03

I. Syllabus;

Unit I Coordination Chemistry-I (9 h)

IUPAC nomenclature of Coordination compounds, structural and stereo isomerism in complexes with coordination numbers 4 and 6. Valence Bond Theory(VBT):Postulates- magnetic properties- Inner and outer orbital complexes. Limitations of VBT, CFT- Postulates

- Splitting in Octahedral, tetrahedral, tetragonal and square planar fields. Crystal field stabilization energy(CFSE), Crystal field effects for weak and strong fields. Factors affecting the magnitude of crystal field splitting energy, Spectro chemical series, Tetragonal distortion of octahedral geometry, Jahn-Teller distortion.

UNIT–II Coordination Chemistry II (9 h)

1. Inorganic molecular Reaction Mechanism: **(6 h)**

Introduction to inorganic reaction mechanisms. Concept of reaction pathways, transition state, intermediate and activated complex. Labile and inert complexes, ligand substitution reactions – SN_1 and SN_2,Substitution reactions in square planar complexes, Trans-effect, theories of trans effect and its applications

2. Stability of metal complexes: (3 h)

Thermodynamic stability and kinetic stability, factors affecting the stability of metal complexes, chelate effect, determination of composition of complex by Job's method and mole ratio method.

Unit III Organo metallic compounds (9 h)

Definition and classification of organo metallic Compounds on the basis of bond type, Metalcarbonyls:18electron rule, electron count of mononuclear, poly nuclear and substituted metal carbonyls of 3d series. General methods of preparation of mono and binuclear carbonyls of 3d series. π-acceptor behaviour of CO (MO diagram of CO to be discussed), synergic effect and use of IR data to explain extent of back bonding.

Unit IV Thermodynamics- I (9 h)

Concept of heat(q), work(w), internal energy(U), State function and Path function- statement of first law; enthalpy(H), relation between heat capacities, calculations of q, w, U and H for reversible, irreversible processes, Joule-Thomson effect- coefficient, Calculation of work for the expansion of perfect gas under isothermal and adiabatic conditions for reversible processes. Temperature dependence of enthalpy of formation- Kirchoff's equation.

Unit V Thermodynamics II (9 h)

Second law of thermodynamics Different Statements of the law, Carnot cycle and its efficiency, Carnot theorem, Concept of entropy, entropy as a state function, entropy changes in reversible and irreversible processes. Entropy changes in spontaneous and equilibrium processes. Third law of thermodynamics, Nernst heat theorem, Spontaneous and non- spontaneous processes, Helmholtz and Gibbs equation - Criteria for spontaneity.

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III- SEMESTER

COURSE CODE 8: QUALITATIVE INORGANIC ANALYSIS

Credits: 01

Qualitative inorganic analysis

(Minimum of Six mixtures should be analyzed)

Analysis of Mixture **50M**

Analysis of mixture salt containing two anions and two cations (From two different groups)from the following:

Anions: Carbonate, Sulphate, Chloride, Bromide, Acetate, Nitrate, Borate, Phosphate. **Cations:** Lead, Copper, Iron, Aluminium, Zinc, Nickel, Manganese, Calcium, Strontium, Barium, magnesium and Ammonium.

Minimum of Six mixtures should be analyzed.

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V- **SEMESTER**
Course: ENVIRONMENTAL CHEMISTRY
Credits: 03

SYLLABUS

UNIT-I ENVIRONMENTAL CHEMISTRY 9h

Definition – Concept of Environmental chemistry-Scope and importance of environment in now a days – Nomenclature of environmental chemistry – Segments of environment–Effects of human activities on environment – Natural resources– Renewable Resources–Solar and Biomass Energy and Nonrenewable resources – Thermal power and atomic energy – Reactions of atmospheric oxygen and Hydrological cycle.

UNIT-II AIR POLLUTION 9h

Definition – Sources of air pollution – Classification of air pollution – Ambient air quality standards- Climate change – Global warming – Pollution from combustion systems- Acid rain –Photochemical smog – Green house effect – Formation and depletion of ozone –Bhopal gas disaster –Instrumental techniques to monitor pollution – Controlling methods of air pollution.

UNIT-III WATER POLLUTION 9h

Unique physical and chemical properties of water – Water quality standards and parameters –Turbidity-Ph Dissolved oxygen –BOD, COD, Suspended solid total dissolved solids, alkalinity Hardness of water Methods to convert temporary hard water into soft water – Methods to convert permanent hard water into soft water – eutropication and its effects –Industrial waste water treatment.

UNIT-IV CHEMICAL TOXICOLOGY 9h

Toxic chemicals in the environment – effects of toxic chemicals – cyanide and its toxic effects – pesticides and its biochemical effects – toxicity of lead, mercury, arsenic and cadmium- Solid waste management.

UNIT-V ECOSYSTEM AND BIODIVERSITY 9h

Ecosystem : Concepts–structure–Functions and types of ecosystem– Abiotic and biotic components – Energy flow and Energy dynamics of ecosystem– Foodchains – Food web– Tropic levels– Biogeochemical cycles (carbon, nitrogen and phosphorus)

Bio diversity:

Definition – level and types of biodiversity – concept- significance – magnitude and distribution of biodiversity – trends-biogeographical classification of India – biodiversity at national, global and regional level.

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V - SEMESTER
Course 12 B: ENVIRONMENTAL CHEMISTRY

Credits: 01

Environmental Chemistry

Laboratory course Syllabus:

1. Identification of various equipment in the laboratory.
2. Determination of carbonate and bicarbonate in water samples by double titrationmethod.
3. Determination of Hardness of water

   using EDTA

   a) Permanent hardness
   b) Temporary hardness

4. Determination of Chlorides in water samples by Mohr's method.
5. Determination of pH, turbidity and total solids in water sample.
6. Determination of Ca^{+2} and Mg^{+2} in soil sample by flame photometry.
7. Determination of pH in soil samples using Ph metry.

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V – SEMESTER
Course 13 B: GREEN CHEMISTRY AND NANOTECHNOLOGY

Credits: 03

SYLLABUS

UNIT-I GREEN CHEMISTRY: I **9hrs**

Introduction-Definition of green Chemistry, Need for green chemistry, Goals of Green chemistry Basic principles of green chemistry. Green synthesis- Evaluation of the type of the reaction i) Rearrangements (100% atom economic),ii)Addition reaction(100% atom economic). Organic reactions by Sonication method: apparatus required and examples of sono chemical reactions (Heck, Hunds diecker and Wittig reactions).

UNIT- II GREEN CHEMISTRY : Part- II **9hrs**

A) Selection of solvent:

i) Aqueous phase reactions

ii) Reactions in ionic liquids, Heck reaction, Suzuki reactions,

epoxidation.iii)Solid supported synthesis

B) Supercritical CO_2:Preparation, properties and applications,(decaffeination, drycleaning)

UNIT-III MICROWAVE AND ULTRASOUND ASSISTED GREEN SYNTHESIS: **9hrs**

Apparatus required, examples of MAOS (synthesis of fused anthroquinones, Leukart reductive amination of ketones)-Advantages and disadvantages of MAOS. Aldol condensation –Cannizzaro reaction - Diels-Alder reactions- Strecker's synthesis

UNIT-IV GREEN CATALYSIS AND GREEN SYNTHESIS **9hrs**

Heterogeneous catalysis, use of zeolites, silica, alumina, supported catalysis-

Biocatalysis: Enzymes, microbes Phase transfer catalysis (micellar/surfactant)

1. Green synthesis of the following compounds : adipic acid, catechol, disodium imino diacetate (alternative Strecker's synthesis)

2. Microwave assisted reaction in water –Hoffmann elimination – methyl benzoate to benzoic acid – oxidation of toluene and alcohols–microwave assisted reactions in organic solvents. Diels-Alder reactions and decarboxylation reaction.

3. Ultrasound assisted reactions – sono chemical Simmons–Smith reaction(ultrasonic alternativeto iodine)

UNIT – V NANOTECHNOLOGY IN GREEN CHEMISTRY 9hrs

Basic concepts of Nanoscience and Nanotechnology – Bottom-up approach and Top down approaches with examples – Synthesis of Nano materials – Classification of Nanomaterials – Properties and Application of Nanomaterials. Chemical and Physical properties of Nanoparticles – Physical synthesis of nanoparticles – Inert gas condensation - aerosol method

Chemical Synthesis of nanoparticles – precipitation and co-precipitation method, sol-gel method.

S.V.K.P & Dr. K.S.RAJU ARTS & SCIENCE COLLEGE (Autonomous)
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Phone No: 08819-246126 Email Id:svkp_penugonda@rediffmail.com Website : svkpandksrajucollege.edu.in

V- SEMESTER

Course : Green Chemistry And Nanotechnology

Laboratory course Syllabus:

1. Identification of various equipment in the laboratory.
2. Acetylation of 1^0 amine by green method: Preparation of acetanilide
3. Rearrangement reaction in green conditions: Benzil - Benzilic acid rearrangement
4. Radical coupling reaction: Preparation of 1,1-bis -2-naphthol
5. Green oxidation reaction: Synthesis of adipic acid
6. Preparation and characterization of biodiesel from vegetable oil/ waste cooking oil
7. Preparation and characterization of Nanoparticles of gold using tea leaves.
8. Benzoin condensation using Thiamine Hydrochloride as a catalyst instead of cyanide.
9. Photoreduction of Benzophenone to Benzopinacol in the presence of sunlight.