H.H. THE RAJAH'S COLLEGE (AUTONOMOUS)

PUDUKKOTTAI-622 001

PG & RESEARCH DEPARTMENT OF CHEMISTRY

M.Sc., CHEMISTRY

COURSE STRUCTURE UNDER

CREDIT BASED COURSE SYSTEM

FOR THE STUDENTS ADMITTED FROM THE ACADEMIC YEAR

2015 – 2016 ONWARDS

M.Sc., CHEMISTRY - SYLLABUS

H.H. THE RAJAH'S COLLEGE (AUTONOMOUS B$^+$)
PUDUKKOTTAI
M.Sc., CHEMISTRY COURSE STRUCTURE UNDER CBCS
(For the candidates to be admitted from the academic year 2015 – 2016 onwards)

Semester	Subject code	Subject title	Ins. Hours / Week	Credit	Exam Hrs	Marks		Total
						Int.	Ext.	
I	JSPCHA1	Organic Chemistry-I	6	5	3	25	75	100
	JSPCHB1	Inorganic Chemistry-I	6	5	3	25	75	100
	JSPCHF2P	Inorganic Practical-I	6	-	-	-	-	-
	JSPCHE2P	Organic Practical-II	6	-	-	-	-	-
	JSPCHEC1	Photochemistry and Pericyclic Reaction(Elective -I)	6	5	3	25	75	100
II	JSPCHC2	Physical Chemistry-I	5	5	3	25	75	100
	JSPCHD2	Inorganic chemistry-II	5	5	3	25	75	100
	JSPCHEC2	Basic Research - Green chemistry and Nano science (Elective -II)	4	5	3	25	75	100
	JSPCHED1	Electrochemical devices and corrosion (Extra disciplinary course-I)	4	5	3	25	75	100
	JSPCHF2P	Inorganic Practical-I	6	5	6	40	60	100
	JSPCHE2P	Organic Practical-II	6	5	6	40	60	100
III	JSPCHG3	Organic Chemistry-II	6	5	3	25	75	100
	JSPCHH3	Physical Chemistry-II	6	5	3	25	75	100
	JSPCHI3	Inorganic Chemistry-III	6	5	3	25	75	100
	JSPCHEC3	Physical methods in chemistry (Elective -III)	6	5	3	25	75	100
	JSPCHM4P	Physical chemistry practical-III	6	-	-	-	-	-
IV	JSPCHJ4	Organic chemistry-III	5	5	3	25	75	100
	JSPCHK4	Physical chemistry-III	5	5	3	25	75	100
	JSPCHL4	Industrial chemistry	4	5	3	25	75	100
	JSPCHM4P	Physical chemistry practical-III	6	5	6	40	60	100
	JSPCHN4	Project work	10	5	-	25	75	100

SEMESTER – I

SUBJECT CODE: JSPCHA1

ORGANIC CHEMISTRY-I

UNIT – I

Nomenclature and reaction intermediates

Naming of linear and branched alkanes, alkenes, polyenes and alkynes without and with functional groups by IUPAC nomenclature. Aromatic and hetero aromatic systems – nomenclature of heterocycles having not more than two hetero atoms such as oxygen, nitrogen and sulphur. Nomenclature of alicyclic, bicyclic and tricyclic compounds.

Electronic effects – inductive effect – resonance effect – hyperconjugation (Baker – Nathan effect) – hydrogen bonding (intramolecular and intermolecular).Free radicals, carbenes, nitrenes, carbanions, carbo cations and arynes – generation, stability, structure and reactivity non classical carbocations.

UNIT – II

Stereo chemistry – I : Optical Isomerism

Principles of symmetry – concepts of chirality – elements of symmetry and chirality – Newmann, Sawhorse and Fischer notations – Representations and interconversions. Type of molecules – R – S nomenclature of acylic and cyclic chiral compounds stereochemistry of allenes, spiranes, biphenyl (atropisomerism) stereochemistry of ansa compounds, cyclophanes and trans cyclo alkenes – definition of terms like prochirality enantiotropic and diastereotropic group – asymmetric synthesis – Cram's rule.

UNIT – III

Stereochemistry II – Geometrical Isomerism

Cis and trans nomenclature of three, four, five and six membered substituted cyclic systems, configuration of cyclohexane, mono and disubstituted cyclohexanes and decalins. E and Z nomenclature – determination of configuration of the geometrical isomers.

Dynamic stereo chemistry

Quantitative correlation between conformation and reactivity. Winstein – Eliel equation – Curtin – Hammett principle, conformation, reactivity and mechanism of cyclic systems – saponification of an ester, esterification of an alcohol, chromic acid oxidation of cyclohexanols, neighbouring group participation, determination of 2-amino cyclohexanol – stereo specific and stereo selective reactions.

UNIT – IV

Reaction mechanisms

Thermodynamic and kinetic aspects of organic reactions, energy profile diagrams – intermediate versus transition states, isotopic effects – kinetic and non kinetic methods of determining reaction mechanism, product analysis and its importance. Cross over experiments – isotopic labeling studies – stereo chemical studies – substituent effects.

Correlation analysis : linear free energy relationship – Hammett equation – significance of sigma and rho-applications. Taft, Swain-Scott, Grunwald – Winstein equations and their applications, classification of solvents.

UNIT – V

Aromaticity

Elements of aromaticity – Huckel's and Craig's rules – effect of aromaticity on bond lengths – ring currents – non benzenoid aromatic compounds – aromatic character in three, five, seven and eight membered rings. Anti aromaticity systems with 2, 4, 8 and 10 electron systems, annulenes and sydnones – alternant and non-alternant hydrocarbons.

Heterocyclic Compounds

Nomenclature and familiarity with hetercyclic systems containing up to three hetero atoms. Synthesis and reactions of azoles – pyrazole, imidazole, oxazole and thiazole. Synthesis and reactions of diazine, pyrazine, pyrimidine, synthesis and reactions of purines : uric acid, adenine, guanine.

References

1. Advanced Organic Chemistry, Part A & B, F.A.Carey and Sundberg, III Edn. Plenum Press, 1990.
2. Organic Chemistry, S.H.Pine, J.B. Hendrickson, D.J.Cram and G.S.Hammond, IV Edn. McGraw-Hill Company 1980.
3. Mechanism and Theory in Organic Chemistry – T.H. Lowry and K.S. Richardson, Harper and Row, NY 1976.
4. Organic Reactions and Mechanisms, P.S.Kalsi, II Edn. New Age International Publishers, 2000.
5. Fundamentals of Organic Reaction Mechanisms- J.M.Harris and C.C. Wamser, John Wiley & Sons, Inc. 1976.
6. R Panico, W H Powell, L Jean and C Ridcher, Agenda of nomenclature of organic compounds, 1993.
7. R S Cahn and O L Dermer, Introduction to chemical nomenclature, 5th Edition, Butterworth, 1979.
8. Jerry March, Advanced Organic Chemistry, 4th Edition, Wesley, 1999.
9. D.Nasipuri, Stereochemistry or organic compounds.
10. I L Finar, Organic Chemistry, Vol.I and II.
11. P S Kalsi, Stereochemistry conformation and mechanism.
12. P J Carratt, Aromaticity, McGraw Hill, 1971.

SUBJECT CODE:JSPCHB1

II – INORGANIC CHEMISTRY – I

UNIT – I

Co-ordination Chemistry

Nomenclature of mono and polynuclear complexes. Crystal field theory – shapes of d orbitals. d-orbital Splitting pattern in trigonal, square planar, trigonal bipyramidal, square pyramidal, cubic symmetries. Splitting of d orbitals in octahedral symmetry (d^1-d^{10})– CFSE – strong field and weak field splitting – calculations CFSE for dn system splitting in tetrahedral symmetry – only weak field splitting – reasons. Tetragonal symmetry – differences between tetrahedral and tetragonal symmetry. Jahn – Teller distortion –. Factors affecting the magnitude of splitting (10 Dq) oxidation state of the metal ion, nature of the metal ion, number and geometry of the ligands, nature of the ligands. Jorgensen relation, Magnetic properties of complexes.

M.O theory – octahedral, tetrahedral and square planar complexes, Pi bonding and sigma bonding.M O theory – ligands having filled and empty pi bonds – effect of 10 Dq.

UNIT – II

Stability of co ordination compounds

Thermodynamic and kinetics stability—stepwise stability constant (K values) – Factors influencing stability coordination compounds – charge, size, basicity, chelation and steric effect. Detection complex formation by physical methods – determination of stability constants – spectrophotometric method (Job's method).

UNIT – III

Kinetics and mechanism of coordination complexes

Labile and inert complexes ligand displacement reactions – hydrolysis, equation in octahedral and square planar complexes – Trans effect. Electron transfer reactions – Complementary and non-complementary types – inner sphere and outer sphere process –

isomerisation and racemisation. Reactions of coordinated ligands. Template effect and syntheses of macrocyclic ligands.

UNIT – IV

Chemistry of Metal carbonyls

Metal carbonyls, structure and bonding, vibrational spectra of metal carbonyls for bonding and structural elucidation, important reactions of metal carbonyls, preparation, bonding, structure and important reactions of transition metal nitrosyl, dinitrogen and dioxygen complexes, tertiary phosphine as ligand. Catalysis by organometallic compounds – Hydrogenation and hydroformylation of olefins – oxidations olefins to aldehydes and ketones – polymerization of alkenes cyclo – oligomerisation of acetylene – Fischer – Tropsch synthesis.

UNIT – V

Polymeric inorganic compounds and polyacids

Homo atomic inorganic polymers – borazines, silicones and related compounds. Phosphonitrilic polymers – tetrasulphur tetranitride compounds. Polycations – iso poly and heteropoly acids of transition metals. Silicates, borates and condensed polymers.

References

1. Keith F Purchell and John C Koltz, Inorganic Chemistry, Saunders Golden Sunburst Series
2. James E Huheey, Inorganic Chemistry principles of structure and reactivity, 4^{th} Edition, Aldeson – Wesley, New
3. H.J. Emeleus and A.G.Sharpe , Modern aspects of inorganic chemistry.
4. F A Cotton and Wilkinson, Advance Inorganic Chemistry, V Edition, John Wiley and Sons
5. A B P Lever, Inorganic Electronic Spectroscopy, Elsevier

SUBJECT CODE:JSPCHF2P

III – INORGANIC CHEMISTRY PRACTICAL-I

1. **Semi micro qualitative anlaysis of a mixture containing two common and two Rare cations.**
2. **Colorimetric estimation of Copper, Ferric, Nickel, Chromium and Manganese using photoelectric colorimeter.**
3. **Titrimetry and Gravimetry**

(i) Cu(V), Ni(G); (ii)Cu(V), Zn(G); (iii)Fe(V), Zn(G); (iv)Fe(V), Ni(G); (v)Zn(G), Cu(V)

4. **Preparation of the following complexes**

1. Tetramminecopper(II) sulphate
2. Potassiumtrioxalatochromate(III)
3. Hexathiourealead(II) nitrate
4. Potassium trioxalaoaluminate(III)
5. Tristhioureacopper(II) sulphate
6. Tristhioureacopper(II) chloride

SUBJECT CODE:JSPCHE2P

IV – ORGANIC CHEMISTRY PRACTICAL-II

1. Qualitative analysis of organic mixture

Pilot separation, bulk separation, Analysis, Derivative, determination of m.p/b.p of the derivative.

2. Preparation of oraganic compounds (single stage)

1. methyl-m-nitrobenzene from methylbenzoate (nitration)
2. Glucose pentaacetate from glucose (Acetylation)
3. Resacetophenone from resorcinol (Acetylation)
4. o-Chlorobenzoic acid from anthranilic acid (Chlorination & Diazotisation)
5. Phenyl azo-2-naphthol from aniline (diazotization)

3. Quantitative analysis of organic compounds

Estimation of phenol, aniline, ketone, glucose, saponification value and iodine value of oil.

4. Preparation of organic compounds (double stage)

1. p-Bromoacetanilide from aniline (Acetylation + Bromination)
2. Acetyl salicylic acid from methyl salicylate (Hydrolysis + Acetylation)
3. 1, 3, 5 – tribromobenzene from aniline (Bromination + Diazotisation + Hydrolysis)
4. p-Nitroaniline from acetanilide (Nitration + Hydrolysis)
5. Benzilic acid from benzoin (Rearrangement)
6. Benzanilide from benzophenone
7. p-Aminobenzoic acid from para nitrotoluene (Oxidation + Reduction)
8. p-Bromo aniline from acetanilide (Bromination + Hydrolysis)
9. m-Nitroaniline from nitrobenzene (Nitration + Reduction)

SUBJECT CODE:JSPCHEC1

PHOTOCHEMISTRY AND PERICYCLIC REACTION (Elective I)

UNIT – I

Photophysical processes

Photo physical processes in electronically excited molecules – Radiation less transitions – Jablonski diagram -- Internal conversion and intersystem crossing. Fluorescence emission – Fluorescence and structure. Triplet states and phosphorescene emission – Photo physical kinetics unimolecular processes – Stern-Volmer equation.

UNIT – II

Photochemical reactions

Photo reduction and related reactions Norrish type I and type II reactions Photo oxidation and Photo oxygenation Nature and importance of singlet oxygen quenching on Fluorescence by oxygen. Cyclo addition reactions Photo dimerisation, oxetane formation – Woodward – Hoffman rules, Chemiluminescence.

UNIT – III

Organic photochemistry

Photochemistry of alkenes and carbonyl compounds; Photooxygenation; Photochemistry of aromatic compounds; Photochemical isomerisation, addition and substitution; Photo-Fries rearrangement of ethers and anilides; Barton reaction, Hoffmann-Loefller-Freytag reaction, di-π-methane rearrangement; Singlet molecular oxygen reactions; Photo-cleavages.

UNIT – IV

Photochemical techniques

Experimental techniques in photo chemistry –Chemical actinometry –Ferrioxalate, uranyl oxalate, photochromic , Reinecke's salt actinometeres – Lasers and their applications.

UNIT-V

Pericyclic Reaction

Concerted reaction-Stereochemistry-Orbital symmetry and concerted symmetry-Correlation Diagrans-Frontier Molecular Orbital approach-Woodward and Hoffman rules-Electrocyclic Reaction – Cycloaddition reaction – Sigmotropic Rearrangements – selection rules and examples with simple molecules -1,3 and 1,5 hydrogen shifts.

References

1. K K Rohatgi Mukherjee, Fundamentals of photo chemistry. Wiley Eastern Ltd. 1988.
2. N J Turro, Molecular photochemistry, New York, W A Benjamin, 1966.
3. S. Arunachalam, Inorganic photochemistry, Kala Publications.

SEMESTER – II

SUBJECT CODE:JSPCHC2

PHYSICAL CHEMISTRY – I

UNIT – I

Chemical Kinetics-I

Kinetics of opposing, consecutive and parallel reactions. Theories of reaction rates – simple collision theory – absolute reaction rate theory – application of ARRT to simple unimolecular and bimolecular processes – potential energy surfaces – kinetic isotopic effect.

Theory of unimolecular reactions – Lindemann's theory – Hinshelwood theory – treatment of KRR and KRRM theory – Slaters treatment – principle of microscopic reversibility – steady state approximation.

UNIT – II

Chemical Kinetics-II

Chain reactions – characteristics of chain reactions – branched and stationary chain reactions - Thermal and photochemical reactions between hydrogen and halogens. Comparison of hydrogen halogen reactions — explosion reaction and discussion of explosion limits – gas phase auto oxidations – hydrogen and oxygen reaction.

Factors influencing reaction rates in solution – application of ARRT to solution kinetics – effect of solvents – double sphere and single sphere model – effect of ionic strength – influence of pressure on rates in solution – significance of volume of activation – substituent effect – LFER – Hammet and Taft equations.

Study of Fast reactions: Flow methods, pulse methods, relaxation methods, Shock-tube method & nuclear magnetic resonance method.

UNIT – III

Classical Thermodynamics

Laws of thermodynamics, Free energy, Chemical potential and entropies. Partial molar properties; partial molar free energy, partial molar volume and partial molar heat content and their significance. Determinations of these quantities--concept of fugacity and determination of fugacity.

Non-ideal systems : excess functions for non-ideal solutions. activity, activity coefficient, Debye-Huckel theory for activity coefficient of electrolytic solutions, determination of activity and activity coefficients, Ionic strength.

Application of phase rule to three component system.

UNIT – IV

Statistical Themodynamics I

Permutation and combinations, combinatory rule, probability theorems, gaseous velocity, microstates and macrostates. Distinguishable and indistinguishable particle. Maxwell – Boltzmann Statistics, phase space, thermodynamic probability, statistical equilibrium, derivation of M-B statistics relation between entropy and probability, statistical meaning of third law of thermodynamic, partition functions, translational, rotational and vibrational partitions functions of diatomic molecules and polyatomic molecules. Electronic partition functioin.

UNIT – V

Statistical Themodynamics II

Derivation of thermodynamics quantities E, S, A, H, G, P and C_p, C_v using partition functions--Sackur--Tertode equation. Heat capacity of solids, molecular hydrogen-- ortho – para ratio of hydrogen gas. Vibrational contribution to heat capacity. Einstein theory and Debye theory of solid. Quantum statistics. Bose Einstein Statistics, Fermi – Dirac statistics, behaviour of helium at low temperature, phase transitions.

References

1. P.W. Atkins, Physical chemistry, ELBS.
2. Chemical Kinetics – K.J. Laidler Third Edition, Tata McGraw Hill.
3. Chemical Kinetics – Principles and Selected topics – I Amdur and C.G Hammer – McGraw Hill – 1996.
4. Glasstone, S. Thermodynamics for Chemists New Delhi Affiliated East West Affiliated private Ltd (1964). Rakshid, Thermodynamics.
5. Rice, Statistical Thermodynamics.
6. Lee, Sears, Turcotte, Satistical thermodynamics New York Addison Wasley Co., (1963).
7. Chemical Kinetics – K.J. Laidler Third Edition, Tata McGraw Hill.
8. Chemical Kinetics – Principles and Selected topics – I Amdur and C.G Hammer – McGraw Hill – 1996.

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SUBJECT CODE:JSPCHD2

INORGANIC CHEMISTRY – II

UNIT – I

Acids and Bases

Bronsted and Lewis acids and bases, pH, pKa, acid-base concept in non-aqueous media, buffer solution, Protonic acids – Proton Affinities – Differentiating and leveling solvents – acidic Behavior of the Binary hydrides – strength of oxyacids – Hydrolysis – Amphoteric oxides – Non protonic Concepts of Acid – Base reactions – Lux concept – Solvent Ion theory of Acids and Bases – Liquid Ammonia, Acetic acid, Bromine trifluoride, Dinitrogen, Soft-Acid-Base strength and Hardness and softness – Symbioses – Theoretical bases of Hardness and Softness – electro negativity and Hardness and softness.

UNIT – II

Crystal structure

Ionic Bond, Crystal Structure and Advanced Covalent Bonding : Radius ratio rules – calculation of some limiting Radius ratio Values for C.N.3 (Planner triangle), C.N.4 (Tetrahedral) C.N.6 (Octahedral).

Classification of Ionic Structure

AX, AX_2, AX_3 types. AX type (ZnS, NaCl, $CaCl_2$) Structures only. AX_2 type, fluorite, rutile, betacrystobalite (structure only). layer Structure – CdI_2, Nickel arsenide Structures – Lattice energy, Born Lande equation derivation – important points arising from Born Lande equation – Schohttky defect and Frenkel defect — Metal excess defect – F centres and interstitial ions – extra interstitial negative ions – Band theory of solids – insulators, semiconductors and super conductors. Walsh Diagram.

UNIT – III

Nuclear Chemistry

Radioactive decay – theories of decay processes – laws of radioactivity – detection and measurements of radiations – nuclear structure – composition of nuclei - properties of nuclei – nuclear radii – nuclear spin, nuclear forces - its characteristics – Meson Field theory – nuclear stability – nuclear models – liquids drop, shell and collective models.

UNIT – IV

Artificial Radioactivity

Nuclear reaction – transmutation – stripping and pick up, fission products and fission yields, fusion, spallation and fragmentation reactions scattering reactions – nuclear cross section – Q – value-nuclear reactors (functioning) – charged particle accelerators – neutron sources – gamma ray and X-ray sources. Radioactive techniques – tracer technique neutron activation and isotopic dilution analysis, counting techniques such as G.M. ionization and proportional counter. Applications of nuclear science in agriculture and biology. Radiation risks and medical benefits – natural and manmade isotopes.

UNIT – V

Chemistry of rare earths and noble gases

Occurrence of lanthanides and actinides – mineral wealth of rare earths in India and the world -- extraction of Th, U. Chemistry of lanthanides and actinides – spectral and magnetic properties, lanthanide contraction. Noble gases : Isolation, chemistry and structure of rare gas compounds (Xenon Compounds).

References

1. W.Kain and B.Schwederski, Bioinorganic Chemistry, Inorganic Elements in the Chemistry of Life, John wiley & sons, New York.
2. James E.Huheey, Ellen A.Keiter and Rechard L.Keiter, Inorganic Chemistry : Principles of structure and Reactivity, 4th edn, Wesley, New York.
3. Shriver and Atkins, Inorganic Chemistry, III edn, Oxford, 1999.
4. Badie E. Duglas, 'Concepts and models in Inorganic Chemistry', Indian Edition, 1970, Oxford and IBH publishing Co., New Delhi.

5. J.D.Lee, A New concise Inorganic Chemistry, 4th Edition, ELBS, 1995.
6. G.Friedlander, J.W.Kennedy and J.M.Miller, Nuclear and Radiochemistry.
7. Keith F.Purchell and John. C.Kotz, Inorganic Chemistry, Saunders Golden Sunburst Series, W.B.Saunders Company, Philadelphia.
8. Cotton and Wilkinsin, Advanced Inorganic Chemistry, 5th Edition, John Wiley & Sons, New York.

SUBJECT CODE:JSPCHEC2

BASIC RESEARCH - GREEN CHEMISTRY AND NANO SCIENCE

UNIT I

Literature Search

Primary and secondary sources of Literature – Journals,Patents,current contents – Chemical Abstract – Subject index, Substance index, Author index, formula index and other indices – Use of these indices with examples – Science citation index – Monographs and treatise – Literature search using computer – browsing and downloading of paper, articles (through chem. Webs), Chemistry programmes – Chemdraw - Chemsketch

UNIT II

Basics of Green Chemistry

The need for green chemistry -- eco-efficiency--environmental protection laws, challenges --pollution control and pollution prevention – green methods, green products, recycling of waste-- Twelve principles of green chemistry-- inception of green chemistry--awards for green chemistry ---international organizations promoting green chemistry.

UNIT III

Designing Green Synthesis

Green Synthesis-- Designing , choice of starting materials, choice of reagents, choice of catalysts – bio catalysts, polymer supported catalysts, choice of solvents-- Synthesis involving basic principles of green chemistry – examples – synthesis of adipic acid, methyl methacrylate, paracetamol-- Organic synthesis under microwaves – benefits, limitations, microwave assisted reactions in water and organic solvent - Ultrasound assisted reactions – esterification, reduction, coupling reactions--Strecker synthesis and reformatsky reaction.

UNIT IV

Characterization and synthesis of nano particles

Introduction-importance and characterisation of nanomaterials- SEM, TEM, AFM synthesis of metal nanomaterials: Physical methods (LaserAblation, Evaporation, sputerring and solvated metal dispersion) chemical methods (Thermolysis, sonochemical approach, reduction of metal ions by hydrogen and methanol) - Biosynthesis.

UNIT V

Nano material and its applications

New carbon structures-Carbon clusters- Fullerenes-dicovery of C_{60} – Doping in C_{60} – Superconductivity in C_{60} – Carbon Nanotubes- Types, Method of synthesis, Structure, Characterization and Application – Nanowires and Nano Shells. Nanocrystal shape--Sequestration of gases--destructive adsorption of environmental toxins--optical propertiesnanoparticles in polymers, inks, fluids, dyes and catalysis--Nanocrystals as colorants, ultraviolet absorbers, electronics -- biomedical applications- nano pipettes, nano arrays, molecular diodes.

References

1. http:/www.inflibnet.ac.in
2. http:/www.springerlink.com
3. http:/www.rsc.org
4. http:/www.pubs.acs.org
5. J.March, "Advanced Organic Chemistry; Reactions,Mechanisms and Structure" 6th Ed., Wiley – Interscience, 2007
6. .Kenneth . Klabunde, Nanoscale Materials in Chemistry, John Wiley & Sons,
7. Nanotechnology: basic science and emerging technologies – Mick Wilson Kamali Kannangara, Geoff Smith, Michelle Simmons, Burkhard Raguseas Overseas Press (2005).
8. Paul T. Anastas Green Chemistry
9. Sanghi A Shrivastav Green Chemistry
10. M.Kidwai & Ahlavalia V.K. Green Chemistry
11. V. Kumar, An Introduction to Green Chemistry, Vishal Publishing CO. Jalandhar, 2007 .

SUBJECT CODE:JSPCHED1

ELECTROCHEMICAL DEVICES AND CORROSION

UNIT – I

Energy Conversion

Electrochemical energy conversion – thermodynamic reversibility – characteristic and performance criteria – battery terminology Gibb's equation – EMF – phenomena of polarization, battery terminology – energy density – power density – basic principles and criteria for selection of anodes and cathodes – different types of primary cells and secondary cells – applications of primary and secondary cells – types of electrolytes – aqueous, non-aqueous, molten salt and solid electrolytes.

UNIT – II

Energy storage devices

Basic electrochemical reactions and performance characteristics of the following primary systems (1) Laclancy dry cell (2) Metal air cells such as Zinc/air. Iron/air and Aluminium/air. (3) Button cells – Zn – MnO_2. Mercuric oxide cells and Lithium cells. (4) Solid electrolyte cells (5) Activated battery – water activated battery such as Mg/AgCl and Mg/CuCl systems, Lead-Acid, Ni-Cd, Ni-Fe, Ni-Metal hydride and lithium – ion batteries – basic electrochemical reactions – charge/discharge characteristics – electrode design and separators – raw material characterizations – components and assembly of cells.

UNIT – III

Fuel cells

Introduction – types of fuel cells, advantages – thermodynamics and efficiencies – electro catalysis of hydrogen oxidation and oxygen reduction – porous electrodes. Types, current –

voltage relationship – limiting current density, mercury porosimetry. Various fuel cell systems – alkaline, phosphoric acid, molten carbonate, solid oxide and solid polymer fuel cell systems.

UNIT – IV

Principles of corrosion

Significances of corrosion studies – EMF and Galvanic series – Classification of corrosion – theories of corrosion – corrosion kinetics – Pourbaix diagram for Fe – H_2O system – passivity – theories of passivity, criteria for selecting metals exhibiting passivity – oxidation of metals – high temperature corrosion. Forms of corrosion – definition, factors and control methods of various forms of corrosion such as pitting, inter granular, dezincification, stress corrosion, crevice corrosion and corrosion fatigue, fretting corrosion, film form corrosion and erosion corrosion.

UNIT – V

Environmental aspects of corrosion

Atmospheric corrosion – classification, factors influencing atmospheric corrosion – temporary atmospheric corrosion preventive methods. Corrosion in immersed condition – effect of dissolved gases, salts, pH, temperature on the rate of flow of corrosion. Underground corrosion – corrosion process in soil, factors influencing soil corrosion. Biological and marine corrosion – definition, mechanism and control methods.

References

1. S N Banerjee, An introduction to corrosion and corrosion inhibition, Oxonian Press Ltd., New Delhi.
2. L L Shrier, Corrosion Vol I & II Goege Nouns Ltd., Southampton Street, London.
3. M G Fonlana & N D Greene, Corrosion Science and Engineering. McGraw Hill Book Co., New York.
4. D.Pletcher and F C Walsh, Industrial Electrochemistry, Vol II, Blakrid Academic Professional, London, 1993.
5. D Jones, Principles and prevention of corrosion Macmillan Publications New York, 1992.
6. J J Meketta, Cathodic Protection Theory and practice, Marcel Dekker Publication, New York, 1993.

SEMESTER – III

SUBJECT CODE:JSPCHG3

ORGANIC CHEMISTRY – II

UNIT – I

Alkaloids and Steroids

General methods of determining structure. Classification of alkaloids – structural elucidation of (-) quinine, morphine, conine, atropine, reserpine, ephedrine. Biosynthesis of alkaloids.

Steroids – Occurrence, nomenclature, basic skeleton, diel's hydrocarbon and stereochemistry. Isolation, structure determination and synthesis of cholesterol, bile acids, androsterone, testosterone, estrone, progesterone, aldosterone, bio synthesis of steroids.

UNIT – II

Terpenes and flavonoids

Terpenes – Introduction structural elucidation of sentoxin, phytol, abietic acid and β carotene. Anthocyanins and flavones – Occurrence, nomenclature and general method of structure determination, isolation and synthesis of apigenin, luteolin, quercetin, myrcetin, aureusin, cyaniding – 7 – obinoside, cyaniding, Histidine. Biosynthesis of flavonoids : Acetate pathway and shikimic and pathway.

UNIT – III

Carbohydrates

Determination of the configuration of the saccharides, ring structure of mono saccharides Glycoxides, Hudson's rule. Methods for determining the size of the sugar rings – Conformational analysis. Structure determination of starch, cellulose, peptides and proteins : synthesis of peptides – primary, secondary, tertiary and quaternary structure of proteins protection protection of N-terminal and C-terminal groups of proteins – biosynthesis of proteins.

UNIT – IV

Nucleic acids

Chemistry of nucleic acids – Structure of DNA, properties, biological implications of DNA Replication of DNA, structure of RNA – types of RNA and their functions. Antibiotics – introduction – structural elucidation of penicillin, streptomycin, cephlosphorin c, terramycin.

UNIT-V

Retrosynthesis

Synthons-types of synthons, synthetic equivalent, One group disconnection- alcohol, ketone, alkenes, carboxylic acids and amines, Two group disconnection- Convergent Synthesis – Functional group inter conversion – Functional group Addition.

References

1. Organic chemistry volume II I.L. Finar., ELBS.
2. O.P. Agarwal, Chemistry of organic natural products Vol I and Vol II 1997. Goel publications.
3. Chatwal Anand, Natural Products, Vol I and Vol II.
4. Gurdeep Chatwal, Natural products chemistry.
5. Advanced Organic chemistry , Bahul and Arun Bahul.
6. Organic chemistry VII edition, Morrison and Boyd.(Retro synthesis)
7. Strateges and tactics in organic synthesis, M. Harmata.
8. Organic synthesis – Disconnection approach, Stuart Warren.

SUBJECT CODE:JSPCHH3

PHYSICAL CHEMISTRY – II

UNIT – I

Fundamentals of Group Theory

Molecular symmetry elements and symmetry operations, point groups- low symmetry, higher symmetry and special symmetry point groups – Group-definition and properties of a group, group multiplication table for C_2V and C_3V point groups-- matrix representation of symmetry operations and transformation matrices —– representation of a group-reducible and irreducible representations – Great orthogonality theorem – characters – construction of a character tables– C_2V, C_3V, C_2h.

UNIT – II

Quantum Mechanics

Classical mechanics – General principles and basic assumptions conservation laws – Lagrangian and Hamiltonian equations of motion inadequancy of classical mechanics

Wave particle dualism – uncertainty principles – postulates of quantum mechanics – operator algebra – operator. Linear and Hermitian-- eigen function and eigen values. Angular momentum operator--commutation relations.

Applications of wave mechanics to simple systems – particle in a box – one and three dimensional – quantum numbers. Zero point energy – orthogonality and Normalisation.

UNIT – III

Application of Group Theory to Spectroscopy

Symmetry of Normal modes of vibrations, application of Group theory to normal modes of vibrations and to normal mode analysis – symmetry properties of integrals – application for spectral selection rules of vibration spectra – IR and Raman active fundamentals symmetry of

molecular orbitals and symmetry selection rule for electronic transitions in simple molecules like water, ammonia and ethylene.

UNIT IV

Applications of Quantum chemistry

Rigid rotator – Harmonic Oscillator – rotational and vibrational quantum mumber and selection rules– Bohr's correspondence principle – Hydrogen atom --shapes and nodal properties of orbital.

Approximation methods – many electron atoms – wave function – one electron orbitals – Pauli's principle and Slater determinants – variration method – application to hydrogen and helium atoms – perturbation method for nondegenerate systems – application of perturbation theory to helium atom. Hertree – Fork self consistent field method. L – S and J – J coupling.

Born – Openheimer approximation : Hydrogen molecule ion. LCAO method. MO and VB treatments of the hydrogen molecule. Hybrization and molecular orbitals of H_2O, NH_3 and CH_4. Huckel pi-electron method for butadiene and benzene.

UNIT –V

Fundamentals of molecular spectroscopy

Rotational spectrum : Diatomic molecules. Energy levels of a rigid rotor selection rules. Poly atomic molecules - Isotope effect. Vibrational spectrum : Infrared spectrum : vibrating diatomic molecules, diatomic vibrating rotator-. Raman spectrum : Rayleigh and Raman scattering stokes and antistokes lines, concept of polarizarity, pure rotational Raman spectra- vibrational Raman spectra Electronic spectrum : Electronic spectra of diatomic molecules – Born-Oppen heimer approximation – Franck -Condon principle – Dissociation energy – Rotational fine structure—Fortrat diagram

References

1. R.K. Prasad, Quantum Chemistry, third Reprint new age International limited.
2. P.W. Atkins, Physical chemistry, ELBS.
3. Chemical Applications of group theory, F.A. Cotton.
4. Quantum Chemistry, Ira N. Levine Prentice Hall.
5. Introduction to Quantum Chemistry, A.K. Chandra Tata Megraw Hill.
6. C.N. Banwell, Fundamentals of molecular spectroscopy
7. Quantum Chemistry, Ira N. Levine Prentice Hall.
8. Introduction to Quantum Chemistry, A.K. Chandra Tata Megraw Hill.

SUBJECT CODE:JSPCHI3

INORGANIC CHEMISTRY – III

UNIT – I

Metal ions in biological systems

Macrocyclic ligands – synthesis – crown ethers, cryptands and spirans - Essential and trace metals – Na^+/K^+pump – Role of metal ions in biological processes. Bioenergetics and ATP cycle – DNA Polymerization, Glucose storage, metal complexes in transmission of energy. Chlorophylls, photo system I, photo system II in the cleavage of water, model systems.

UNIT – II

Transport and storage of oxygen

Heme proteins and oxygen uptake, structure and function of haemoglobin, myoglobin, hemocyanins, and hemerythrin, model synthetic complexes of iron, cobalt and copper.

UNIT – III

Electron transfer in biological systems

Structure and function of metalloprotiens in electron transport processes – cytochromes and iron-sulphur proteins, synthetic models.

UNIT – IV

Nitrogenase systems

Biological Nitrogen fixation, molybdenum nitrogenase, spectroscopic and other evidence, other nitrogenase model systems.

UNIT – V

Medicinal Bioinorganic Chemistry

Metal ion toxicity-Sources –general mechanism of metal ion toxicity – chemical speciation of metals in environment – Toxic effects of metals: Cadmium, Mercury, Aluminium, Iron and Copper. Detoxification – Basic requirements of chelating drug - Detoxification by metal chelates(representative chelating drugs) Chemotherapy – Cis platin in chemotherapy – Drug action and mechanism – Gold containing drugs as Anti-Rheumatic agents – Lithium in Psychopharmacological drugs.

References

1. Principles of Bioinorganic chemistry, S.J.Lippard and J.M.Berg. University Science Book.
2. Bioorganic chemistry, I.Bertini, H.B.Gray, S.J.Lippard and J.S.Valentine, University Science Books.
3. Inorganic Biochemistry Vol.I & Vol.II L. Ed. G. Eichhorn, Elsevier.
4. Hussain Reddy, Bioinorganic chemistry.

SUBJECT CODE:JSPCHEC3

PHYSICAL METHODS IN CHEMISTRY

UNIT I

Electronic Spectra of Transition metal complexes

Spectroscopic ground states, spectral terms, R-S coupling and J-J couplings- term symbol – selection rules—microstates—Pigeon hole diagram for p^2 and d^2 configuration. Orgel and Tanabe – sugano diagrams for transition metal completes (d^1-d^9 states) electronic spectra of transition metal complexes—calculation of Dq values -- Racah parameters and Beta parameters, Nephelexatic effect, charge transfer spectra.

UNIT – II

IR and Raman Spectroscopy

Isotopic substitution—combined use of IR and Raman in the structural elucidation of simple molecules—N_2O, ClF_3, NO_3^-, ClO_3^-, ClO_4^-. – Effect of coordination on ligand vibration—urea, cyanide, nitrate, sulphate, DMSO. Vibrational spectra of metal carbonyls.

UNIT – III

NMR spectroscopy

Nuclear spin, Nuclear resonance, saturation, Shielding of magnetic nuclei --chemical shift and its measurement, factors influencing chemical shift --deshielding, spin-spin interaction. factors influencing coupling constant, spin decoupling. ^{13}C NMR, ^{31}P NMR, P-NMR, FT-NMR. Spectrum of paramagnetic molecules – Isotropic shift—lanthanide shift reagents – fluxional behaviour of molecules.

UNIT – IV

ESR and Mossbauer spectroscopy

ESR- Zeeman effect, hyperfline splittings (isotropic systems) – coupling constants – Zero field splitting and Kramers degeneracy – esr of transition metal complexes. McConnell equation--g-value.

Mossbauer spectroscopy—Dopler effect and isomer shift, quadrupole interactions (NQR) – MB spectrum of Iron and tin compounds.

UNIT –V

Magnetic properties, Diffraction Methods, and PES

Magnetic properties—Types of magnetism, quenching of orbital angular momentum (A,E and T term).determination of magnetic susceptibility by Guoy method. Magnetic properties of lanthanides and actinides.

Space groups- Difference between crystal symmetry and molecular symmetry- X ray diffraction – Neutron diffraction and electron diffraction – elementary treatment.

Photo electron spectroscopy (PES) – principle and applications.

References

1. Modern spectroscopy, J.M.Hollas, John Wiley.
2. Physical methods in chemistry, R.S.Drago, Saunders College
3. Introduction to Molecular Spectroscopy, G.M.Barrow, Mc.Graw Hill.
4. Introduction to Magnetic Resonance, A.Carrington and A.D.Maclachalan.
5. Group theory and Application to Chemistry, K.V.Raman, New Delhi, Tata. Mc Graw Hill.

SUBJECT CODE:JSPCHM4P

PHYSICAL CHEMISTRY PRACTICAL (Non Electrical)

1. Determination of molecular weight of given unknown substance by Rast Method (Determination of K_f value of given solvent)
2. Determination of molecular weight by transition temperature method. (Determination of K_f value of given substance)
3. CST of phenol – water system – Effect of impurities on CST.
4. Determination of eutectic temperature and eutectic composition of a primary mixture of compound A & B (phase diagram of compound formation)
5. i. Determination of partition or distribution coefficient of iodine between CCl_4 and water.
   ii. Determination of equilibrium constant of the reaction between Kl and I_2 and to find out the concentration of the given KI solution.
6. Comparison of strength of acid by kinetics of hydrolysis of ester.
7. Determination of energy of activation (E_a) and Arrhenius factor (A) for the acid catalysed hydrolysis of ester.
8. Effect of ionic strength on kinetics of reaction – primary salt effect (Determination of concentration of the given KNO_3 solution)
9. Determination of concentration of the given oxalic acid by studying the adsorption of oxalic acid on charcoal (Adsorption Isotherm)
10. Determination of solubility and heat of solution of the given oxalic acid.

PHYSICAL CHEMISTRY PRACTICAL (Electrical)

Conductometric titrations

1. Determination of strength of strong and weak acid present in the given mixture of acids using 0.1N NaOH and crystalline NH_4Cl.
2. Determination of strength of NaOH and NaOAc present in the given mixture using 0.1N HCl and crystalline NaOAc.
3. Determination of strength of HCl and NH_4Cl in the given mixture using 0.1N NaOH and crystalling NH_4Cl.
4. Determination of strength of Cl^- and I^- present in the given mixture of halides using 0.1N $AgNO_3$ and crystalline Kcl (conductometric precipitation titration)
5. Determination of ionization constant of a weak acid (determination of cell constant of a conductivity cell)
6. Determination of strength of K_2SO_4 (conductometric precipitation titration) determination of solubility and solubility product of $BaCl_2$.

Potentiometric Titrations

1. Determination of strength of strong and weak acid potentiometrically using 0.1N NaOH and a standard solution of HCl.
2. Determination of strength of given ferrous sulphate solution potentiometrically using ferrous sulphate (standard solution) and 0.1N $K_2Cr_2O_7$ (link solution)
3. Determination of strength of given KI solution using KI (standard solution) and $KMnO_4$ (link solution) (potentiometric redox titration)
4. Determination of strength of Cl^- and I^- ions present in the given solutions using 0.04N $AgNO_3$ solution and 0.02 N KCl (standard solution).

SEMESTER – IV

SUBJECT CODE:JSPCHJ4

ORGANIC CHEMISTRY – III

UNIT – I

Aliphatic Nucleophilic Substitution

SN_1, SN_2 and SN_i mechanisms, Effects of substrate structure, leaving group, attracting nuclophile and Solvent – Neighbouring group participation – substitution at allylic carbons and reactivity – ambident nucleophiles.

Aliphatic Electrophilic Substitution

SE_1, SE_2 and SE_i mechanism – effect of substrate structure leaving group, attacking nucleophile and solvent – Stark – Enamine reaction – decarboxylation of aliphatic acdis – halogenation of aldehyde and ketone.

Aromatic Electrophilic Substitution

Aromatic ion mechanism – orientation and reactivity nitration – halogenation – Friedel – crafts reaction – Gattarmann, Kolbe – Schmidt, Reimer – Tiemann, Houben – Hoesch reactions.

UNIT – II

Elimination Reactions

E_1, E_2, E_1CB and E_i – Mechanism – Stereochemistry of Eliminations – Hoffman and Saytzeff rules, competition between elimination and substitution reactions – Chugaev reaction dehydration of alcohols, dehydrohalogenation – Hoffman degradation. Cope elimation – Bredt's rule.

Addition Reactions

Addition to carbon – carbon multiple bonds – electrophilic addition, Nucleophile and free radical addition, orientation and reactivity – Birch reduction, hydroxylatioin, hydroboration,

epoxydation, Diels – Alder reaction, Michael addition ozonolysis, carbenes and their addition to double bonds.

Addition to carbonyl groups

Mannich, Crossed Cannizzaro, Stobbe, Benzoin condensation, formation of ketenes. Oppenauer Oxidation, MPV reduction, Darizen's glycidic ester condensation. Wittig reaction.

UNIT – III

Molecular rearrangements

Mechanism of the following rearrangements – Wagner meerwein, Dienone – Phenol, Wolf, Lossen,, Schmit, Bayer – Villeger, Stevents, Wittig, Favorski, Cope and Claisen rearrangements.

Reduction

Catalytic hydrogenation and dehydroxynation selection in reduction. Clemmensen reduction, Wolf – Kishner reduction, reduction with $LiALH_4$, $NaBH_4$, Tri tertiary butoxy aluminium hydride, sodium cyanoborahydride trialkyl tin hydride, hydrazines.

Oxidation

Oxidation with chromyl chloride, periodic acid, Selenium dioxide, lead tetra acetate. Osmium tetroxide and H_2O_2.

UNIT – IV

UV – visible spectroscopy

Beers – Lambert law, various electronic transititon, effect of solvent on electronic transitions, UV bands for carbonyl compounds, unsaturated carbonyl compounds, dienes and conjugated systems.Wood ward- Fiesher rules.UV spectra of aromatic and heterocyclic compounds. Steric effect in biphenyls.

Infrared spectroscopy

Characteristics vibrational frequencies of alkanes, alkenes, alkynes, aromatic compounds, alcohols, ethers, phenols and amines. Detailed study of vibrational frequencies of carbonyl compounds (ketones, aldehydes, esters, amides, acids, anhydrides, lactums, lactones and conjugated carbonyl compounds). Effect of hydrogen bonding and solvent effect on vibrational frequencies, overtones, combination bonds and Fermi resonance.

UNIT – V

Nuclear magnetic resonance spectroscopy

General introduction and definition, chemical shift, spin – spin interaction. Shielding mechanism of measurement, chemical shift values and correlation for protons bonded to carbon (aliphatic, olefinic aldehydic and aromatic) and other in nuclei (alcohols, phenols, enols, carboxylic acids amines, amides and mercapto) chemical exchange, effect of deuteration, complex spin – spin interaction between two, three, four and five nuclei (first order spectra) virtual coupling, stereo chemistry, hindered rotation, karplus curve variation of coupling constant with dihydral angle-simplification of complex spectra – nuclear magnetic double resonance, contact – shift reagents, solvent effects, Fourier transform technique, nuclear overhauser effect.

Mass spectrometry

Introduction, ion production – EI, CI, FD and FAB, factors affecting fragmentation, Ion analysis, ion abundance. Mass spectral fragmentation of organic compounds. Common functional groups, molecular ion peak, meta stable peak, Mclafferty rearrangement. Nitrogen rule. High resolution mass spectrometry. Examples of mass spectral fragmentation of organic compounds with respect to their structure determination.

References

1. Advanced organic chemistry – F.A. Carey and R.J. Saundberg, Plenum
2. A guide book to mechanism in organic chemistry – Peter sykes, Longman
3. Structure and mechanism in organic chemistry – C.K. Ingold, Cornell university press.
4. Principles of organic synthesis – R.O.C.Norman and J.M.Coxcon, blackie academic and professional.
5. Reaction mechanism in organic chemistry – S.M. Mukherji and S.P.Singh Macmillan.

6. Spectrometric identification of organic compounds – R.M.Silverstein, G.C.Bassler and T.C.Morrill, John wiley.
7. Application of spectroscopy of organic compounds – J.R. Dyer, Prentice Hall
8. Raj K Bansa, Organic reaction mechanisms 3rd edition.
9. Jerry March, Advanced organic chemistry, Reaction Mechanism and structure, 4th Edition.

SUBJECT CODE:JSPCHK4

PHYSICAL CHEMISTRY – III

UNIT – I

Ionic activity

Debye Huckel theory – radius of ionic atmosphere calculation of radium of ionic atmosphere – Debye Huckel Onsager equation modifications – asymmetry and electrophoretic effects – evidences for ionic atmosphere – Debye Falcanhagen and Wein effects – Debye Huckel limiting law – statement – activity and activity coefficient with concentration – Derivation of Debye Huckel limiting law – verification and modification – finite ion size model – Huckel – Bronsted equation – calculation of activity coefficients – determination of ion size parameter solubility product and solubility of sparingly soluble salts – effect of common ion solubility – neutral salt effect – determination of solubility and solubility products.

UNIT – II

Electrodynamics

EMF and thermodynamic quantities – Nernst equation – Gibb's Helmholtz relation and EMF – reversible electrodes types electrode potentials – single electrode potentials electrochemical series – chemical cells concentration cells – with and without transport – liquid junction potentials – applications of EMF measurements - activity coefficients and solubility determination.

UNIT – III

Electrokinetic phenomena

Electro osmosis – electrophoresis – streaming potential and sedimentation potential kinetics of electrode processes. Theories of electrical double layer – electrical double layer at electrode – electrolyte interface – Helmholtz double layer model– Gouy Chapman diffused double layer theory -- Stern's model of double layer-.Equilibrium and activation polarizations –

theory of electrochemical overpotential. Butler Volmer and and Tafel equations – derivations and verifications of these equations.

UNIT – IV

Electrocapillary phenomena

Electrocapillary curves – ECM. Lippmann equation and Lippman potential –Capillary electrometer – contact angle method. Hydrogen over voltage – mechanism of hydrogen overpotential. Technique of polarography – Dropping mercury electrode and supporting electrolyte – Residual, migration currents and diffusion current – Polarogram Halfware potential. Ilkovic equation — Application of polarography Zn and Cd mixture. Cyclic voltammetry-principle and applications.

UNIT – V

Computer in chemistry

C programming – structure of a C program – Data types, variables, constants, keywords, operators, expressions. Control structure – if, if-else, nested if-else, while, while-do, for, nested for, go to, continue, break, switch case statements. Arrays – user defined functions (recursion, call by value and call by reference) – string functions – preprocessors – storage class – structure, union. Pointer expressions, arithmetic passing pointers through arrays and functions – file handling, introduction to loops. C programming – simple applications to chemistry.

References

1. Bockris J O M and Reddy A K N, Modern electrochemistry Volumes I & II. New York, Plenum Press, 1970.
2. Glasstone S An introduction to electrochemistry, New Delhi, East – West Press Pvt. Ltd., 1956
3. Noel M and Vasu K I, Cyclic Voltametry and the frontiers of electrochemistry, Oxford & IBH, 1990
4. E.Balagurusamy, Programming in C, Tata McGraw Hill, New Delhi.

SUBJECT CODE:JSPCHL4

INDUSTRIAL CHEMISTRY

UNIT – I

Sugar : Cane sugar manufacture, recovery of sugar from molasses, sugar estimation, sugar industries in India.

Paints & Vanishes : Primary constituents of paints, Dispersion medium (solvent), binder, pigments, oil based paints, latex paints (alkyd resins), formulation or paints and varnishes. Requirements of a good paint.

Cleaning Agents : Preparation of toilet and washing soaps, synthetic detergents – alkyl aryl Sulphonates, fatty alcohol sulphates, ethanolamines, nonionic detergents, Builders, additives, corrosion inhibitors.

UNIT – II

Cement : Manufacture – Wet Process and Dry process. Types, Analysis of major constituents, setting of cement, reinforced concrete. Cement industries in India.

Ceramics : Important clays and feldspar, glazing and verification.

Glass : Types, Composition, manufacture of Optical glass, colored glasses, lead glass and neutron absorbing glass.

Fertilizers : Fertilizer industries in India, Manufacture of ammonia, ammonium salts, urea, superphosphate, triple superphosphate and nitrate salts.

UNIT – III

Coal : Origin and economic importance of coal, type's analysis and composition, coal gasification. Carbonization, coal-tar and coal-tar based chemicals manufacture, coal mines in India.

Petroleum : Origin, refining, cracking, reforming knocking and octane number, LPG, synthetic gas, synthetic petrol.

Fuel Gases : Large scale production, storage, hazards and uses of coal gas, water gas, producer gas and oil gas.

UNIT – IV

Electrochemical industries : Production of materials like chlorine caustic soda sodium chlorate, per chlorates potassium permanganate hydrogen peroxide. Hydroxyl amine Electrolytic refining of aluminium, Electro synthesis of aniline, p-aminophenol, Electro-Oxidation and electro-reduction processes with examples.

Batteries – primary and secondary cells, solar cells- applications.

Agrochemical industries : Important categories of insecticides, fungicides, herbicides, rodenticide, Mode of action and synthesis of common pesticides like Gammexane, DDT, alathrin, Parathion, Malathion, Baygon, DDVP, Warfarin, Tabun, Paraguat, decamethrin.

UNIT – V

Chemical Explosives : Origin of explosive, preparation and chemistry of lead azide, nitroglycerine, nitrocellulose, TNT, Dynamite, cordite, picric acid, gunpowder, introduction to rocket propellants.

Leather Industry : Curing, Preservation and tanning of hides and skins, process of dehairing and dyeing. Treatment of tannery effluents.

Water in Industry : Pollution of water by fertilizers, detergents, pesticides, and industrial wastes, BOD, COD thermal pollution, water Treatment – Ion exchange electro dialysis, reverse osmosis, Softening of hard water.

References

1. B.N.Chakrabarty, Industrial chemistry, Oxford & IBH Publishing Co., New Delhi, 1981
2. B.K.Sharma, Industrial chemistry, Geol Publishing House, Meerut.
3. P.P.Singh, T.M.Joseph, R.G.Dhavale, College Industrial Chemistry, Himalaya Publishing House, Bombay, 4th edn., 1983.