AC 29-5-15

Item No. 4.13

UNIVERSITY OF MUMBAI

Syllabus for the S.Y.B.Sc.
Program: B.Sc.
Course: CHEMISTRY

(Credit Based Semester and Grading System with effect from the academic year 2015–2016)

S.Y.B.Sc.
CHEMISTRY
Credit Based Semester and Grading System
SEMESTER III

Course Code	Unit	Topic	Credits	L/Week
USCH301	**I**	1.1 Chemical Thermodynamics-II 1.2 Photochemistry 1.3 Chemical Kinetics-II	2	3
	II	2.1 Electrochemistry-I 2.2 Titrimetric Analysis -II		
	III	3.1Titrimetric Analysis–III 3.2 Separation Techniques		
USCH302	**I**	1.1 Chemical Bonding 1.2 Inorganic Polymers	2	3
	II	2.1 Chemistry of transition metals 2.2 Chemistry of organic compounds- I 2.2.1 Aromatic hydrocarbons 2.2.2 Haloarenes and Phenols 2.2.3 Aromatic Nitro compounds		
	III	3.1 IUPAC nomenclature 3.2 Aromaticity 3.3Organic reaction mechanism –I		
USCH303	**I**	1.1 Sources Of Organic Compounds 1.2. Unit processes in organic chemistry 1.3 Unit operation	2	3
	II	2.1 Physico-chemical principles 2.2 Manufacture of basic chemicals 2.3 Introduction to Environmental Chemistry		
	III	3 Chemistry Of Water		
USCHP3	**Practical Course**		2	9

SEMESTER –IV

Course Code	Unit	Topic	Credits	L/Week
USCH401	**I**	1.1 Electrochemistry-II 1.2 Nuclear Chemistry-II 1.3 Liquid State	2	3
	II	2.1 Phase Equilibria 22 Spectroscopy –I		
	III	3.1 Statistical treatment of Analytical data 3.2 Titrimetric Analysis-IV		
USCH402	**I**	1.1 Coordination Chemistry 1.2 Bioinorganic Chemistry	2	3
	II	2.1 Organometallic Chemistry. 2.2 Chemistry of organic compounds-II 2.2.1 Aldehydes and Ketones 2.2.2 Acids and derivatives		
	III	3.1 Organic Reaction Mechanism-II 3.2 Stereochemistry 3.3 Amino compounds and Diazonium salts .		
USCH403	**I**	1.1Oils , Fats & Soaps 1.2 Corrosion and protection of metals	2	3
	II	2.1 Metallurgy of Cu, Ag and Al 2.2Toxicology		
	III	3 Sources , Effects & treatment of water pollution		
USCHP4	**Practical Course**		2	9

COURSE CODE	CREDITS	
USCH301	2 (45 Lectures)	
Topic		**L/Week**
1.1 CHEMICAL THERMODYNAMICS-II (7L) 1.1.1 Free Energy Functions: Helmholtz Free Energy, Gibb's Free Energy, Variation of Gibb's free energy with Pressure and Temperature, Gibbs-Helmholtz equation. (Numericals expected).(2L) 1.1.2 Thermodynamics of Open System: Partial Molal Properties, Chemical Potential and its variation with Pressure and Temperature, Gibb's Duhem equation. (2L) 1.1.3 Concept of Fugacity and Activity (1L) 1.1.4 Chemical Equilibrium and Equilibrium Constant: Equilibrium constant, Kp and Kc and their inter-relation, van't Hoff reaction isotherm, van't Hoff reaction isochore. (Numericals expected). (2L). **1.2 PHOTOCHEMISTRY (4L)** 1.2.1 Introduction. Difference between Thermal and Photochemical reactions. Laws of Photochemistry. Grothus-Draper Law, Stark-Einstein law. Einstein of energy. (Numericals expected). (1L) 1.2.2 Quantum efficiency, determination using actinometer. (Numericals expected).(1L) 1.2.3 Photochemical reactions and Primary and secondary processes. Reactions with High (formation of HCl)and Low quantum efficiency (formation of HBr). Reasons For High and low quantum efficiency. (2L) 1.2.4 Photochemical Phenomenon. Fluorescence, Phosphorescence, Chemiluminiscence, Ozone depletion. (1L) **1.3 CHEMICAL KINETICS-II (4L)** 1.3.1 Types of Complex Chemical reactions. 1.3.1.1 Reversible or opposing, consecutive and parallel reactions. (No derivations, only examples expected) 1.3.1.2 Thermal chain reactions. H_2 and Br_2 reaction .(Steps involved only, no kinetic expressions needed) 1.3.2. Effect of temperature on rate of reaction, Arrhenius equation, Concept of energy of activation (Ea). (Numerical Problems on Arrhenius equation expected).		**3**
2.1 ELECTROCHEMISTRY-I (8 L) 2.1.1 Variation of molar conductance with dilution. 2.1.2 Mobility of ions – Kohlrausch's law, Application of Kohlrausch's law– determination of i. degree of dissociation ii. Solubility of sparingly soluble salt. 2.1.3 Arrhenius theory of electrolytic		

dissociation and its limitations 2.1.4 Debye Huckel's theory of strong electrolyte – electrophoretic and relaxation effect. **2.2 TITRIMETRIC ANALYSIS–II (7 L)** **Theoretical aspects of titration curves:** Construction of titration curves and choice of indicators in the titration of 1)Weak acid Vs Strong base 2) Strong acid Vs weak base 3) Weak acid Vs Weak base 4) Polybasic acid Vs Strong base, End point evaluation – Choice and suitability of indicators in each case.(Numerical problems expected)	
3.1 TITRIMETRIC ANALYSIS-III (5L) **Complexometric Titration:** General introduction, EDTA titrations –Advantages and limitations of EDTA as a chelating agent, absolute and conditional formation constants of metal EDTA complexes, Construction of titration curves, Types of EDTA titrations ,Methods of increasing the selectivity of EDTA as a titrant, Metallochromic indicators-Theory and applications. (Numerical problems expected) **3.2 SEPARATION TECHNIQUES (10 L)** **3.2.1Types of Separation Techniques**-Precipitation, filtration, distillation, Chromatography, solvent extraction. **3.2.2 Solvent Extraction:** Partition coefficient and Distribution ratio, Extraction efficiency, Separation factor, Role of complexing agents in solvent extraction, chelation, ion pair formation, Solvation, Types of solvent extraction-Batch and Continuous process(Numerical problems expected)	

COURSE CODE	CREDITS	
USCH302	2 (45 Lectures)	
Topic		L/Week
1.1CHEMICAL BONDING: (11L) **1.1.1** Valence Bond Theory: Potential Energy (PE) Diagram, Postulates of VBT, need for hybridization, Energetics of hybridization, orbitals involved in hybridization(sp,sp^2,sp^3.sp^3d,sp^3d^2,dsp^2,sd and sd^3) (3L) **1.1.2** Molecular Orbital Theory: Concept of orbital overlaps, Types of orbital overlaps(s-s,s-p,p-p), Applications of MOT to homonuclear diatomic molecules, and heteronuclear diatomic molecules. (3L) **1.1.3** Ionic Bond: Formation of ionic bond, Types of ionic crystals with examples, Radius ratio rule, Calculation of limiting radius ratio for coordination number 3 and 4, Lattice energy, Born-Lande equation, Kapustinski equation, Born-Haber cycle and its application, Solvation energy, Solubility criteria of ionic compounds. (Numerical problems expected) (5L) **1.2INORGANIC POLYMERS (4L)** Introduction, Classification Preparation, Properties and applications of silicones and borazine.		**3**
2.1COMPARATIVE CHEMISTRY OF TRANSITION METALS (7L) Electronic configuration of transition elements, metallic character, variable oxidation states, ability to form complexes, size of atom and ions, melting point and boiling point, density, ionization enthalpy, colour, magnetic property, catalytic property , difference between first row and the other two rows – M-M bonding in cluster compounds, stability of oxidation state, complexes, size, magnetism. **2.2 CHEMISTRY OF ORGANIC COMPOUNDS - I (8L)** **2.2.1 Alkyl arenes** - Preparation by Friedel-Crafts alkylation using olefins, alcohols and alkyl halides. Reactions: Side chain oxidation, Ring vs side chain halogenation (2L). **2.2.2 Haloarenes and phenols** Preparation of haloarenes: Direct halogenation of benzene and monosubstituted benzenes with molecular halogens (limitations). From aromatic amines via diazonium salts. Reactions of haloarenes: Lack of reactivity to S_N1 and S_N2 reactions. Aromatic S_N on haloarenes; hydrolysis and amination. Effect of nitro substituents on the reaction. Aromatic S_E on haloarenes: halogenation and nitration. Ullman reaction, Grignard reagent formation. Preparation of phenols: From i) halobenzenes, ii) aromatic sulfonic		

acids (benzene and naphthalene sulfonic acids), iii) cumene and 2-butyl benzene by hydroperoxide method. Properties and reactions of phenols: H-bonding in ortho substituted phenols, acidity of phenols, effect of substituents on acidity, salt formation, O-alkylation (Williamson synthesis), O-acylation. Applications of haloarenes and phenols (4L). **2.2.3 Aromatic nitro compounds** Structure, nomenclature including common names. Nitration of benzene. Reduction of nitrobenzene under different pH conditions, electrolytic reduction. Applications of aromatic nitro compounds (1L).	
3.1 IUPAC NOMENCLATURE (3L) Nomenclature of polysubstituted benzenes, trisubstituted naphthalenes and disubstituted anthracenes. **3.2 Aromaticity (4L)** Structures of benzene, naphthalene, linear and angular acenes. General characteristics of aromatic compounds. Criteria for aromaticity including Huckel's rule. Aromaticity of benzenoid compounds and carbocyclic ions. Antiaromatic, homoaromatic and non aromatic systems. **3.3 ORGANIC REACTION MECHANISM- I (8L)** **3.3.1 Aromatic electrophilic substitution** General mechanism of aromatic electrophilic substitution with energy profile diagram. Mechanism of nitration, sulfonation, halogenation and Friedel Crafts reaction. Electrophilic substitution reaction on monosubstituted benzenes: Drawing resonance structures of monosubstituted benzenes. Activated and deactivated rings. Effect of substituents (hydroxyl, amino, methyl, halo, acyl and nitro) on the rate of reaction and directing influence of the substituent based on (i) electron density distribution and (ii) stability of intermediate. **3.3.2 Aromatic nucleophilic substitution** Elimination-addition mechanism of aromatic nucleophilic substitution on halobenzenes. ipso and cine substitution. Addition-elimination mechanism of aromatic nucleophilic substitution on nitrohalobenzenes with energy profile diagram.	

COURSE CODE	CREDITS	
USCH303	2 (45 Lectures)	
Topics		**L/Week**
1. 1. SOURCES OF ORGANIC COMPOUNDS 1.1.1. Sources (a) Non-renewable : Coal, Petroleum (crude oil) and Natural gas (b) Renewable: Biomass 1.1.2. Coal: Structure and types of coal, Destructive distillation of coal, Coal tar refining, coal liquefaction (coal to liquid) coal gasification Synthesis gas (syn gas),Hydropyrolysis. 1.1.3. Petroleum: Characteristics, composition and origin of petroleum, Refining of petroleum, Catalytic cracking and reforming, hydrocracking, thermal cracking, steam cracking. 1.1.4. Natural gas: Composition ,Conversion of methane higher alkanes, synthetic diesel (gas to liquid), methanol, aromatic compounds, Natural gas hydrates : occurrence, structure. 1.1.5. Synthesis gas (Syn gas : production of syngas fromcoal, natural gas, biomass, Composition, Synthetic uses of syn gas. Separation of hydrogen, Production of methanol, alkanes, hydroformylation of olefins, synthesis of aromatic hydrocarbons, Fischer Tropsch synthesis. Synthetic diesel(biomass to liquid) 1.1.6. Biomass: Transforming biomass into chemicals(pyrolysis) and synthesis gas 1.1.7. Biofuels: Methanol, Ethanol, biodiesel, synthetic diesel. **(7L)** **1.2. UNIT PROCESSES IN ORGANIC CHEMISTRY** 1.2.1. Nitration : Mechanism, Industrial preparation of Nitrobenzene, m-dinitrobenzene 1.2.2. Sulphonation : Mechanism, Industrial preparation of DDB and DDBS (detergent)**(4L)** **1.3 UNIT OPERATION -**Distillation 1.3.1. Introduction 1.3.2. Fractional distillation 1.3.3. Azeotropic distillation 1.3.4. Vaccum distillation 1.3.5. Extractive distillation **(4L)**		**3**
2.1 PHYSICO CHEMICAL PRINCIPLES: 2.1.1.Criterion for spontaneity of chemical reaction 2.1.2. Chemical equilibrium, 2.1.3.Le Chatelier principle 2.1.4.Law of mass action 2.1.5.Catalysis.**(3L)**		

2.2. MANUFACTURE OF BASIC CHEMICALS 2.2.1.Ammonia : Physico- chemical principles involved, Manufacture of Ammonia by modified Haber-Bosch process 2.2.2.Sulphuric acid : Physico-chemical principals involved, Manufacture of sulphuric acid by contact process**(4L)** **2.3 INTRODUCTION TO ENVIRONMENTAL CHEMISTRY** 2.3.1. Concept and scope of environmental chemistry. Components of environment; Biotic and Abiotic. **(1L)** 2.3.2. Composition of various segments of environment –Atmosphere, Hydrosphere, Lithosphere, Biosphere. (with respect to composition and interrelationship) **(2L)** 2.3.3.Natural chemical processes: Carbon Cycle, Nitrogen Cycle, Oxygen Cycle **(3L)** 2.3.4. Untoward chemical events causing hazards to the Environment: London smog, Mithi River (Mumbai), Chernobyl accident. 2.3.5. Concept of 4 'R's : Reduce- Recover- Reuse- Recycle, **(2L)**	
3.1 CHEMISTRY OF WATER 3.1.1. Water as a natural resource, physical properties of water , chemical properties of water - auto -ionization and types of reactions in water. **(6L)** 3.1.2. Sources of water, Chemical composition of various water sources: Ground water, Surface water (River and lake water), Rainwater and Sea water. **(5L)** 3.1.3. Important parameters measuring the quality of water- Salinity, Chlorinity, alkalinity, pH, pE, DO, Hardness, TS, TSS, TDS, Electrical conductivity, Silica content and transparency (brief introduction). Standards for Industrial water and Potable water. **(4L)**	

COURSE CODE	CREDITS
USCHP3	2

PRACTICALCOURSE BASED ON USCHP301

1. To study reaction between potassium persulphate and potassium iodide kinetically and hence to determine order of reaction.
2. To verify Ostwalds dilution law conductometrically.
3. To determine solubility of sparingly soluble salts (any two) conductometrically.
4. To determine dissociation constant of weak acid by incomplete titration method using pH meter.
5. Determination of Calcium and Magnesium contents of a Dolomite ore sample.
6. Assay of commercial sample of Aspirin using Phenol red as indicator.
7. Determination of Partition coefficient of I_2 between organic solvent and H_2O.
8. Determination of the amount of Strong acid in the given solution by titration with strong base using Conductometer.

PRACTICAL COURSE BASED ON USCHP302

Inorganic Chemistry

Identification of an Inorganic Compound, involving qualitative and Quantitative Analysis. (Salts such as copper sulfatepentahydrate,Nickel chloride hexahydrate, Cupric chloride dehydrate may be given for identification. Students are expected to qualitatively identify one ion and quantitatively determine the other using standard volumetric methods.) (Minimum 4 salts).

Organic estimations

a. Acetone
b. Amide
c. Benzoic acid

Organic preparations:

a. Acetylation of primary amine (preparation of acetanilide)
b. Base catalysed aldol condensation(synthesis of dibenzalpropanone)

PRACTICAL COURSE BASED ON USCHP303

1. Preparation of tribromo derivative of Phenol/Aniline
2. Preparation of Aspirin
3. oxidation of cyclohexanone (Cyclohexanone to adipic acid) (distillation)
4. Fractional distillation – Simple liquids
5. Determination of Saponification value of an oil or fat.
6. Determination of Total Hardness of given water sample.
7. Determination of Physical parameters- pH, colour, electrical conductivity of waste water. (To be performed by using hand held portable pH-meter, conductometer.)
8. Determination of TSS, TS & TDS.

COURSE CODE	CREDITS	
USCH 401	2 (45 Lectures)	
TOPICS		L/Week
1.1 ELECTROCHEMISTRY-II (6 L) 1.1.1Migration of ions, velocity of ions and change in concentration around electrodes(unattackable). 1.1.2 Transport number definition and determination by Moving Boundary Method. 1.1.3 Factors affecting transport number of ions. 1.1.4 Relation between transport number and ionic conductance. **1.2 NUCLEAR CHEMISTRY-II (4L)** **Nuclear Stability** 1.2.1 Factors affecting stability of nucleus: Mass defect of Nucleus, binding energy, binding energy per nucleon, binding energy curve, N/P ratio, Odd-Even number rule, Magic numbers. (3L) (problems on mass defect, binding energy ,binding energy per nucleon is expected) 1.2.2 Basic units of radioactivity and dosimetry– exposure units, absorbed dose and equivalent dose.(Numericals expected.) External dose due to natural sources (2L) **1.3 LIQUID STATE (5 L)** 1.3.1 **Surface tension** : Introduction, methods of determination of surface tension -drop number method (in details)Parachor value and applications of surface tension(Numerical expected). 1.3.2**Viscosity**: Introduction, coefficient of viscosity, relative viscosity, Method of determination by Ostwald viscometer (Numerical expected). 1.3.3 **Liquid Crystals** :- Introduction, Classification & structure of Thermotropic phases, (Nematic, Smectic & Cholesteric phases). Applications of Liquid Crystals.		**3**
2.1 PHASE EQUILIBRIA(5L) 2.1.1 Liquid-liquid Mixtures: 2.1.1.1 Completely Miscible Liquids: Raoult's Law and Ideal and Non-ideal Solutions (Positive and Negative Deviations) (Numericals Expected) 2.1.1.2 Partially Miscible Liquids: Partially Miscible Liquids with Upper Critical Solution Temperature (Example: Phenol-Water System), Partially Miscible Liquids with Lower Critical Solution Temperature (Example: Triethylamine-Water System), Partially Miscible Liquids with Upper and Lower Critical Solution Temperature (Example: Nicotine-Water System **2.2 MOLECULAR SPECTROSCOPY-II (10 L)** **2.2..1 Terms –**Energy of light ,Intensity of light, Polychromatic and		

Monochromatic light, Wavelength of maximum absorption **2.2.2 Theory-** Statement and Derivation of Lambert's law and Beer's law, Statement of Beer Lamber's law –Combined expression, Absorbance ,Transmittance, Percentage transmittance, Molar extinction coefficient, Validity of Beer-Lamberts law, Deviations from Beer-Lamberts law. Quatitative Analysis by Calibration curve method. (Numerical problems expected) **2.2.3 Instrumentation** –Single beam and Double beam photoelectric colorimeter (details of components expected) –Principle Construction and Working **2.2.4 Photometric titrations** –Principle, instrumentation, Types of photometric titration curves with examples including estimation of Cu(II) and Bi(III) –Advantages and limitations	
3.1 STATISTICAL TREATMENT OF ANALYTICAL DATA (12L) **3.1.1 Errors in Chemical analysis**: Types of errors-Determinate and Indeterminate errors-Constant and Proportionate errors, Absolute and Relative error-Minimization of errors **3.1.2 Measures of central tendency and dispersion :** Measures of central tendency-Mean, Median, Mode. Measures of dispersion- Deviation, Average deviation, Relative average deviation ,Range , Standard deviation, Variance, Correlation coefficient and Relative standard deviation (Numerical problems expected) **3.1.3Performance Characteristics of an Analytical method:** Accuracy, Precision, Sensitivity, Specificity, Selectivity, Robustness, Ruggedness, Linearity range, Limit of quantification, Limit of Detection, Signal to Noise ratio. **3.2 TITRIMETRIC ANALYSIS-IV (3L)** **Precipitation titrations** Argentimetric titrations, Construction of titration curves, Volhard"s method, Mohr's method, Adsorption indicators- theory and applications.	

COURSE CODE	CREDITS	
USCH 402	**2 (45 Lectures)**	
TOPICS		**L/Week**
1.1 COORDINATION CHEMISTRY: (10L) **1.1.1Descriptive Coordination Chemistry** 1.1.1.2 Basic terms and nomenclature of coordination compounds. 1.1.1.2 Difference between double salts and complex salts 1.1.1.3Types of ligands. 1.1.1.4 Evidence for the formation of coordination compounds. 1.1.1.5 Types of isomerisms. 1.1.1.6 Applications of coordination compounds. **1.1.2Theories of Coordination Chemistry:** 1.1.2.1Werner's Theory. 1.1.2.2 Effective Atomic Number (EAN) Rule. **1.1.3Nature of the Metal-Ligand Bond:** Valence Bond Approach. **(5L)** **1.2 BIOINORGANIC CHEMISTRY:(5L)** Introduction,essential and non-essential elements in biological systems,Role of metal ions such as Na(I), K(I), Fe(II)/(III) and Cu(II) in biological systems; Introduction to biological roles of metalloenzymes w.r.t. myoglobin, hemoglobin,Structure and function; dioxygen binding,transfer and utilization.		**3**
2.1 ORGANOMETALLIC CHEMISTRY (7L) Introduction, definition, classification based on hapticity and nature of metal- carbon bond, importance and few applications of organometallic compounds like catalysts (e.g. Ziegler-Natta, Wilkinson), reagents in organic synthesis, etc.; Eighteen electron rule and its applications, exceptions; Metal carbonyls: bonding, general methods of preparation and properties. **2.2. CHEMISTRY OF ORGANIC COMPOUNDS- II (8L)** **2.2.1 Aldehydes and Ketones** Introduction, nomenclature of aliphatic and aromatic aldehydes and ketones. Methods of preparation: Oxidation of primary and secondary alcohols using PCC, reduction of esters using DIBAL-H, Rosenmund reduction, hydration of alkynes, action of Grignard reagent on esters, Gatterman – Koch formylation and Friedel Craft acylation of arenes. Reactions of aldehydes and ketones with $NaHSO_3$, HCN, RMgX, Phenyl hydrazine, 2,4-Dinitrophenyl hydrazine, $LiAlH_4$ and $NaBH_4$. Aldol and crossed aldol condensation, Haloform reaction, Benzoin condensation. (4L) **2.2.2 Acids and Acid derivatives**		

Introduction, nomenclature of mono and di carboxylic acids. Preparation of mono and dicarboxylic acids: hydrolysis of nitriles, reaction of Grignard reagent and dry ice, oxidation of alkylbenzenes (toluene and xylenes), Kolbe- Schmidt synthesis of salicylic acid. Acidity of carboxylic acids. Reactions of carboxylic acids: Reduction with $LiAlH_4$, decarboxylation Formation of acid derivatives (acid chlorides, amides, acid anhydrides, esters) (4L)	
3.1 ORGANIC REACTION MECHANISM– II (6L) 3.1.1 Tautomerism: Keto-enol tautomerism in aldehydes and ketones. Acid and base catalysed enolisation. Stabilisation and enol content of β- diketones. 3.1.2 Reactions of carbonyl compounds with nucleophiles: reaction with alcohol, ammonia and amines. 3.1.3 Enols, enolates and addition of carbon nucleophiles to carbonyl group: Claisen-Schmidt, Knovenagel, Claisen ester condensation reactions. 3.1.4 Reactions of aldehydes with no α –hydrogen:Cannizaro reaction. **3.2 STEREOCHEMISTRY (4L)** 3.2.1 Assigning stereodescriptors: Cahn- Ingold-Prelog(CIP) rules for assigning configurational descriptors (R and S) to a chiral centre, assigning configuration to molecules having maximum two chiral centres, assigning E and Z stereodescriptors to olefines. 3.2.2 Diastereomers of disubstituted cycloalkanes (3 and 4 membered rings) 3.2.3 Resolution of enantiomers: Chemical method of resolution. 3.2.4 Conformational analysis: Ethane, n butane (around C_1-C_2 and C_2-C_3 bonds). **3.3 AMINO COMPOUNDS AND DIAZONIUM SALTS. (5L)** **3.3.1 Aliphatic and aromatic amines:** Classification and nomenclature Preparation of amines from alkyl halides, aryl halides, nitrohaloarenes, nitriles, aliphatic and aromatic nitro compounds (including chemoselective reduction of dinitrobenzenes), aldehydes and ketones (reductive alkylation), amides(Hofmann degradation) Basicity of amines: Comparative basicity of 1^o, 2^o and 3^o aliphatic amines in gas phase and in aqueous medium. Basicity of aryl amines and effects of substituents on basicity, Salt formation Reactions of amines: N-alkylation, N-acylation, reaction with nitrous acid, halogenation of aromatic amines. **3.3.2 Synthetic applications of diazonium salts**: Replacement of diazonium group by -H, -OH, -I, -F, -Ar (Gomberg reaction), -Cl, -Br, -CN (Sandmeyer reaction),	

Azo coupling reactions with phenols, naphthols and aromatic amines. Preparation of Orange II. Reduction (formation of phenyl hydrazine.)	

COURSE CODE	CREDITS	
USCH 403	**2 (45 Lectures)**	
Topics		**L/Week**
1.1. OILS , FATS & SOAPS 1.1.1. Oils Composition of some common oils &fats (peanut oil, sesame oil, cotton seed oil, castor oil, butter fat, animal fat, etc.) 1.1.2.Classification of oils. 1.1.3.properties of oils & fats 1.1.4.Extraction of oil from oil seeds- Hydraulic pressing, Solvent extraction process, 1.1.5.Extraction of animal fats 1.1.6.Hydrogenation of oil 1.1.7.Manufacture of soap, Settled or grained soap, Laundry and bath soap, glycerol recovery. **(8L)** **1.2 CORROSION AND PROTECTION OF METALS.** 1.2.1.Introduction (to include economics & importance of corrosion.) 1.2.2. Types of corrosion 1.2.3. Electrochemical theory of corrosion. 1.2.4. Methods of protection i. Coating, ii. Electroplating, iii. Cathodic protection, iv. Anodizing, v. Sacrificial coating **(7L)**		3
2.1 METALLURGY OF Cu, Ag AND Al 2.1.1. Principles of Metallurgy 2.1.2.Extraction and purification of i. Copper by pyro-metallurgy &electrolysis ii. Silver by hydrometallurgy iii. Aluminum by electrometallurgy **(7L)** **2.2 TOXICOLOGY:** 2.2.1. Concept and important terms. **(1L)** 2.2.2. Effects of Toxic substances General aspects of mechanism of metal ion toxicity i)Biochemical effects ii) Observable physiological effects iii) Reversible and Irreversible effect, iv) Effect on immune system **(3L)** 2.2.3Toxicity of various chemicals: i) Heavy metals-As, Hg, Pb,Cd. ii) Non metals – SOx, NOx, CO. iii) Organic – Hydrocarbons. **(3L)** 2.2.4.Case studies : i) Minamata episode ii) Bhopal gas tragedy **(1L)**		

3.1 SOURCES , EFFECTS & TREATMENT OF WATER POLLUTION 3.1.1. Sources of water pollution : Domestic, Industrial, agricultural, commercial. Types of water pollutants -Biological, chemical, physical agents, Radioactive materials. **(5L)** 3.1.2 Effects of water pollution: i) Eutrophcation ii) Effects of Soaps and detergents. iii) Effects of oil spills & marine pollution iv) Thermal pollution **(5L)** 3.1.3. Treatment of water pollution. Pre- primary , Primary , Secondary & Tertiary Treatment **(3L)** 3.1.4 Case study of water pollution (film/ppt.)**(2L)**	

COURSE CODE	CREDITS
USCHP4	2

PRACTICALCOURSE BASED ON USCHP401

1. Determine the Surface Tension of methyl acetate, ethyl acetate and chloroform and hence calculate atomic parachors of C, H,Cl.
2. Determine the Viscosity of a given liquid by Ostwald's Viscometer.
3. To Determine the Critical Solution Temperature (CST) of Phenol - Water System.
4. To determine standard emf and the standard free energy change of Danial cell.
5. Determination of the amount of Dissolved oxygen in water sample by Wrinkler's method.
6. Determination of Vitamin C content in a given tablet by pH meter.
7. Determination of Fe (II) and Fe(III) in a given mixture titrimetrically.
8. Determination of λ_{max} and molar absorptivity (ε) of Manganese in $KMnO_4$photometrically.

PRACTICAL COURSE BASED ON USCHP402

Inorganic Preparations

a. A metal chelate; (Nickel dimethyl glyoximate, using microscale method)
b. A Complex Cation; (tris-ethylenediamine Nickel(II) thiosulfate)
c. A complex Anion; (Potassium trioxolato ferrate)
d. Inorganic Salt. (Ca or Mg oxalate,using PFHS technique)

IDENTIFICATION OF AN ORGANIC COMPOUND

The identification should be done through preliminary tests, element detection, group tests and physical constant determination.

Analysis should be done by micro scale technique, about 500mg of any compound with not more than two functional/neutral groups be given belonging to following categories,

Acids, phenols, aldehydes or ketones, alcohols, esters, amines (primary, secondary & tertiary), amides, ethers, hydrocarbons, halo or nitro hydrocarbons.

PRACTICAL COURSE BASED ON USCHP403

1. Estimation of Ibuprofen
2. Preparation of Schiff's base
3. Determination of Alkalinity of water sample
4. Preparation: Tris (Thiourea) Copper I Sulphate Cu $3[Cs(NH_2)_2]_2.2H_2O$
5. Preparation: Hexamine Ni(II) chloride, $[Ni(NH_3)_6].Cl_2$
6. Separation of Cu, Ni & Fe using Paper chromatography.
7. Determination of COD (microscale)
8. Determination of salinity of the given water sample

SUGGESTED REFERENCES: USCH301 & USCH 401

1. Physical Chemistry by N B Singh, D S Das & R J Singh.
2. Physical Chemistry by S Pahari Vol I.
3. Principles of Physical Chemistry, S H Maron and C F Prutton (4th edition)
4. Advanced Physical Chemistry, D N Bajpai, S Chand Publications, New Delhi, 2012.
5. Fundamentals of Physical Chemistry by S H Maron and J B Lando (Macmillan Ltd. N.Y.) 1966
6. Principles of Physical Chemistry by B R Puri and L R Sharma (S Chand & Co) 33rded 1992
7. Physical Chemistry by Gilbert W Castellan (Narosa Publ house) 3rded 1985
8. Physical Chemistry by P W Atkins (Oxford Univ Press) 2008
9. Textbook of Physical Chemistry Vol II & III by K L Kapoor (Macmillan India Ltd) 2006
10. Physical Chemistry by R A Alberty& R J Silby (Wiley Eastern N.Y.) 2nded 1997
11. Fundamentals of Radiochemistry by D D Sood, A V R Reddy and N Ramamoorthy (IANCAS Ed) 2000
12. Essentials of Nuclear Chemistry by H J Arnikar (New Age International) 4thed 1995
13. Nuclear and Radiochemistry, 3rd Edition by G. Friedlander, J. W. Kennedy, E. S. Macias, J. M. Miller (Wiley) 3rded 1981
14. Basic concepts of Analytical Chemistry byS.M.Khopkar , Publisher : New Age International 1998
15. Analytical Chemistry by Gary D. Christian , Publisher: Wiley –India edition
16. Modern Analytical Chemistry by David Harvey, Publisher :The McGraw-Hill Companies, Inc
17. Fundamentals of Analytical Chemistry by Douglas A. Skoog, Donald M. West, F. James Holler, Stanley R. Crouch, Publisher: Brooks Cole
18. Instrumental Methods of Analysis by H. H. Willard, L.L.Merritt ,J.A Dean , Publisher :East –West
19. Instrumental Methods of Chemical Analysis by G. W. Ewing, Publisher : The McGraw-Hill Companies, Inc

Practicals

1. **A Text book of Quantitative Inorganic analysis A.I VogelPublisher** :Longman

2. Chemical Analysis in the laboratory –A Basic guide by Irene Muller-Harvey ,Richard M. Baker ,Royal Society of Chemistry
3. Quatitative Analysis, R.A Day &A.L Underwood, Prentice Hall Publication Co.

SUGGESTED REFERENCES:USCH302 & USCH402

For (Units-I and II)

1. D. Banerjea, *Coordination chemistry,* Tata McGraw Hill, New Delhi, (1993).
2. D. F. Shriver and P. W. Atkins, *Inorganic chemistry,* 3rd Ed., Oxford University Press, (1999).
3. K. F. Purcell and J. C. Kotz, *Inorganic chemistry,* Saunders, Hongkong, (1977).
4. N. N. Greenwood and E. Earnshaw, *Chemistry of elements,* Pergamon Press, Singapore, (1989).
5. W. L. Jolly, *Modern inorganic chemistry,* 2nd Ed. McGraw Hill Book Co., (1991).
6. B. E. Douglas and H. McDaniel, *Concepts and models in inorganic chemistry*, 3rd Ed., John Wiley & Sons, Inc., New York, (1994).
7. G. N. Mukherjee and A. Das, *Elements of bioinorganic chemistry,* Dhuri and Sons, Calcutta, (1988).
8. R. W. Hay, *Bioinorganic chemistry,* Ellis Harwood, England, (1984).
9. R. C. Mehrotra and A. Singh, *Organometallic chemistry: A unified approach*, Wiley Eastern, New Delhi, (1991).

For (Units- II and III)

1. Francis A Carey and Robert M Giuliano, McGraw Hill, 8th Edition, (2012).
2. Organic Chemistry, R.T. Morrison, R.N. Boyd and S.K. Bhatacharjee, 7th Edition, Pearson Education (2011).
3. Organic Chemistry, T.W.G. Solomon and C.B. Fryhle, 9th Edition, John Wiley & Sons, (2008)
4. A guide to mechanism in Organic Chemistry, 6th Edition, Peter Sykes, Pearson Education
5. Fundamentals of Organic Chemistry , G. Marc Loudon, 4th Edition Oxford
6. Organic Chemistry, L.G. Wade Jr and M.S. Singh, 6th Edition,2008
7. Organic Chemistry, Paula Y. Bruice, Pearson Education, 2008
8. Organic Chemistry, J.G. Smith, 2nd Edition Special Indian Edition, Tata

McGraw Hill
9. Organic Chemistry, S.H. Pine, McGraw Hill Kogakusha Ltd.
10. Stereochemistry, P.S. Kalsi, New Age International Ltd. 4th Edition,2006.
11. Nomenclature of Organic Compounds, S.C. Pal, Narosa Publications, 2006
12. Organic Chemistry, Volume 1, I.L.Finar Pearson Education, 6th Edition
13. Advanced Organic Chemistry, Reactions, Mechanism and Structure. Jerry March, Wiley Student Edition.

SUGGESTED REFERENCES: USCH 303 & USCH 403

1. Shreeves 'Chemical process industries' 5th Edition, G.T. Oustin, McGraw Hill
2. Industrial Chemistry-B.K. Sharma, Goyal publishing house, Mirut
3. Riegel`s hand book of Industrial chemistry, 9th Edition, Jems A. Kent
4. Environmental Chemistry – A. K. De, 5th Edition (New age international publishers)
5. Environmental Chemistry – A. K. Bhagi and C. R. Chatwal (Himalaya Publishing House)
6. Environmental Chemistry – J. W. Moore and E. A. Moore (Academic Press, New York)
7. Industrial Chemistry -E Stoch, Vol-I, Ellis Horwood Ltd. UK.
8. Renewable sources of Energy and the environment -E Hinnawi and A K Biswas
9. An Introduction to Industrial Organic Chemistry-Wiseman and Peter, ""
10. Coal and Combustion: Dr. Kale
11. Unit operations and processes – P. H. Groggins
12. : Nanotechnology Applications to Telecommunication Networking-Daniel Minoli
13. Unit operations I and II – P.P. Kale – Pune VidyarthigruhPrakashan
14. Introduction to Petroleum Chemicals: H Steiner Pargamon Press
15. Catalysis- Heterogeneous and homogenous- Delmol and Janner
16. Unit operations in Chemical engineering by W.L. McCabe and Smith
17. Handbook of Chemical engineering by J. H. Perry
18. Industrial instrumentation by D. R. Eckman
19. Principles of Chemical Processes- R.M. Felder, R. W. Rousseau: Elementory, Wiley Publisher, New Delhi.

20. Riegel's Handbook of Industrial Chemistry- J.A. Kent, CBS Publishers, New Delhi.
21. Introduction to Medicinal Chemistry-G.L. Patrick, Oxford University Press, UK
22. Medicinal and Pharmaceutical Chemistry-Harikishan, V.K. Kapoor, Vallabh Prakashan, Pitampura, New Delhi.
23. New Trends in Green Chemistry- V.K. Ahluwalia & M.R. Kidwai, Anamalaya Publishers (2005).
24. Green Chemistry- Theory and Practical, P.T. Anastes& J.K. Warmer: Oxford, University Press (1998).
25. Introduction to Green Chemistry-A.S. Matlack, Marcel Dekkar (2001).
26. M.C. Cann& M.E. Connely: Real- World cases in Green Chemistry, American Chemical Society, Washington (2002).
27. M.A. Ryan &M.Tinnesand, Introduction to Green Chemistry, American Chemical Society, Washington (2002).
28. Advanced Practical Chemistry A Pragati Edition
29. Environmental Chemistry. A.K. De Seventh Ed.
30. Environmental Chemistry And Green Chemistry by Asim Das
31. Environmental Chemistry by V. K. Ahluwalia
32. Textbook of Environmental Chemistry by BalramPani
33. Advance Inorganic Chemistry II (Including Environmental Chemistry by Gurudeep Raj, Goyl Publication)
34. Waste Water Treatment: M. N. Rao and A. K. Datta.
35. H. Meshram, IICT, Hyderabad, Private Communication