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Semester I

CORE - I

11UCH1401

Inorganic, Organic and Physical Chemistry

(75 Hours) (5 hrs / week)

UNIT-I

1.1. **Quantum Numbers**: Principal, Azimuthal, Magnetic and spin quantum numbers and their significance - principles governing the occupancy of electrons in various quantum levels - Pauli’s exclusion principle, Hund’s rule, Aufbau Principle, (n+1) rule, stability of half and fully filled orbitals – inert pair effect.

1.2. **Periodic properties**: Variation of atomic volume, atomic and ionic radii, Ionization energy, electron affinity and electronegativity along the periods and down the groups - factors affecting periodic properties, Pauling’s and Mulliken’s scale of electronegativity.

UNIT-II


UNIT – III

3.1 **Nomenclature of organic compounds** – IUPAC naming of simple aliphatic compounds containing different functional groups – naming of aromatic compounds and alicyclic compounds.

3.2 **Bond**: Types of bonds – homolytic and heterolytic fission of bonds- orbital overlap – sigma and pi bonds – hybridization and geometry of molecules methane, ethane, ethylene, acetylene and benzene.

UNIT – IV

4.1 **Reactive intermediates**: Generation, structure, reactivity and stability of carbocation, carbanion, free radical and carbenes.

4.2 **Electron displacement effects**: Inductive, electromeric, mesomeric, resonance, hyperconjugation and steric effects.
Unit – V

Gaseous State:


5.2 Expansivity and compressibility, Mean free path, Collision diameter, Collision number, Collision frequency, Viscosity of gases and Mean free path, Heat capacity of gases, Determination of heat capacity ratio.

5.3 Real gases and ideal gases, Deviation of real gases from the ideal gas laws, Vander Waals equation, critical phenomenon, Calculation of critical constants.

REFERENCES:

Hybridization and shapes of covalent molecules:
1.1. Hybridization and hybrid orbitals - salient features of phenomenon of hybridization - VSEPR theory - geometry of molecules containing only bond pairs of electrons (BeCl₂, BF₃, CH₄, PCl₅, SF₆, IF₇)
1.2. Lattice energy - Born-Haber cycle - applications.
1.3. Hydrogen bonding - Its nature, types, effect on properties - Intermolecular forces - London forces.
1.4. Principles of qualitative analysis : Solubility product – common ion effect - complexation reactions including spot tests.

UNIT-II
(18)
2.2. Interhalogen compounds - general methods of preparation – structure - properties - uses of ICl, IBr, ICl₃, ClF₃, IF₅, IF₇.
2.3. Pseudohalogens - preparation -properties - uses of cyanogens and thiocyanogen.

UNIT-III
(18)

UNIT – IV
(18)
4.1 Alkanes – Preparation by Wurtz reaction – mechanism of free radical substitution in alkanes.
4.2 Cycloalkanes – preparation using Wurtz reaction, Dieckmanns ring closure and reduction of aromatic hydrocarbons, substitution and ring opening reactions – Bayer strain theory.
4.3 Petroleum: Thermal and catalytic process of cracking, Synthetic petrol– Fischer-Tropsch’s Process - Bergius process – flash point, fire point, smoke point, cloud point, pour point – knocking - octane number and cetane number, anti -knocking reagents – Power alcohol.
UNIT –V

5.1 **Alkenes** – Preparation by Wittig reaction - properties of alkenes – electrophilic and free radical addition – Addition reactions with Hydrogen, Halogens, Hydrogen halides (Markownikoff’s Rule), (peroxide effect) – hydroboration, ozonolysis, hydroxylation with KMnO₄ – allylic substitution by NBS.

5.2 **Dienes**: Types of dienes – conjugated – Non conjugated and cumulated dienes – relative stabilities of dienes and chemical reactivity – 1,2 and 1,4- additions – kinetic and thermodynamic controlled reactions - Diels-Alder reaction.

5.3 **Alkynes** – preparation – properties and uses – Acidity of alkynes - formation of metal acetylides (Li, Na and Cu) – Addition of water with HgSO₄ – Halogens – Hydrogen halides – oxidation by KMnO₄ – Ozonolysis and Hydroboration.

REFERENCES:

Semester III

CORE - IV
Organic and Physical Chemistry (90 Hours)(6 hrs / week)

UNIT –I (18)

1.1 **Alcohols:**

1.2 **Ethers:**

1.3 **Alkyl halides:**
   Preparation – properties – Vicinal and gem dihalides - Grignard reagent – preparation and synthetic applications. Aliphatic Nucleophilic substitution reaction - mechanism of $\text{SN}_1$, $\text{SN}_2$, $\text{SN}_i$ reactions – Elimination reactions - mechanisms of E1, E2 reactions – Saytzeff’s and Hofmann rules.

UNIT –II (18)

**Carbonyl Compounds:**


2.2 Mechanism of Aldol, Perkin, Knoevenagal and Benzoin condensation, Claisen, Reformatsky, Wittig and Cannizaro reactions.


UNIT – III (18)

3.1 **Aromaticity:**
   Aromaticity – Definition – Huckel’s rule - aromaticity of benzenoid compounds.

3.2 **Aromatic Electrophilic substitution reactions:**

UNIT – IV (18)

**Liquid State:**

4.1 Properties of liquids, vapour pressure, measurement of vapour pressure, heat of vapourization, Trouton’s rule, surface tension, measurement of surface tension, surface tension and vapour pressure, variation of surface tension with temperature.

4.2 Viscosity - determination of viscosity, variation of viscosity with temperature and pressure, liquid crystals – definition, classification, theory of liquid crystals, molecular viscosity – parachor, atomic parachor, structural parachor and application of parachor in deciding structures.

UNIT – IV (18)

Solid state:

5.1 Solid state – crystalline and amorphous solids, isotropic and anisotropic solids. Crystal systems (Cubic system only) space lattice and unit cell. Seven crystal systems - crystal structure of NaCl, CsCl. Packing in crystals – hcp, ccp, bcc. Bravais lattice – law of rational indices, Weiss indices and Miller indices.

5.2 X-ray diffraction - Derivation of Bragg’s equation – Determination of crystal structure – Laue’s powder method.

5.3 Adsorption on solids – Chemisorptions and physisorptions, potential energy diagrams – Freundlich, Langmuir, and BET adsorption isotherms (No Derivation).

REFERENCES:

SEMESTER-IV  
Core-V 
Inorganic and Physical Chemistry  (60 Hours) (4 hrs / week)

UNIT-I  
(12)

1.1. **Boron family** - Comparative study of boron family elements - compounds of boron - diborane structure discussion – borax - boron nitride - boron carbide and borazole.

1.2. **Carbon family** - Comparative study of carbon family elements and their compounds (hydrides, halides and oxides).

1.3. **Chemistry of cyanogens** - Hydrocyanic acid - cyanic acid - thiocyanic acid - ammonium thiocyanate and carbon disulphide - structure of diamond and graphite.

UNIT-II  
(12)

2.1. **Nitrogen family** - Comparative study of nitrogen family elements and their compounds (oxides, halides, hydrides and oxyacids) - Chemistry of hydrazine, hydrazoic acid, hydroxyl amine and sodium bismuthate - Non aqueous solvents - classification - liquid ammonia as a solvent - Preparation - properties and uses of PH₃, P₂O₅ and H₃PO₄.


UNIT – III  
(12)

3.1 **Electrical Properties of Matter**:  
Polar and non – polar molecules, dipole moment, polarization of molecules in an electric field - Electronic polarization, atomic polarization, orientation polarization. Clausius Mosotti equation , Debye equation (no derivation). Methods to determine dipole moment – Temperature method and dilute solution method- applications of dipole moment.

3.2 **Macromolecules**:  
Definition – monomer – Number and weight average molecular weight of macromolecules – determination of molecular weight by osmometry, ultra- centrifuge.

Unit – IV  
(12)

4.1 **Acids and bases** – Arrhenius , Bronsted lowry , Lewis acid base – Theories of acid and base. Ionic Equilibria -Buffer solution – Definition, buffer capacity, mechanism of buffer action, pH scale ,pOH, Kw, pKa and calculation of pH of buffer mixtures by Henderson’s equations.

4.2 **Hydrolysis of salts** – Definition, salts of strong acids-strong base - salt of weak acids-strong bases, salt of weak base - strong acid, salt of weak acid - weak base, hydrolysis constant(Kₜₕ), relation between Kₜₕ, Kₒ and Kₜ₇, degree of hydrolysis - salt of weak acid-strong base, salt of weak base - strong acid, salt of weak acid - weak base.
Unit – V


REFERENCES:
UNIT-I

1.1 **Alkali and alkaline earth metals**: Comparative study of alkali and alkaline earth metal compounds – (oxides, halides, hydroxides, carbonates and sulphates), diagonal relationship between lithium and magnesium. Preparation, properties and uses of lithium aluminium hydride.

1.2 **Transition metals and their compounds**: group study of Titanium, Vanadium, Manganese and Iron groups. Preparation, properties and uses of TiO$_2$, V$_2$O$_5$, MnO$_2$ - commercial forms of Iron.

UNIT-II

2.1 **Zero group elements** - position in the periodic table, isolation of noble gases from air and uses - Compounds of xenon - XeF$_2$, XeF$_4$, XeF$_6$, XeO$_3$ and XeOF$_4$ – preparation, properties, structure and uses.

2.2 **Silicates** - classification – structures with typical examples, composition. Properties and uses of beryl, asbestos, talc and mica.

2.3 **Clathrates** – examples- structures – Interstitial compounds and Non-stoichiometric compounds.

UNIT-III


3.2 **Non-aqueous solvents**: liq.NH$_3$, liq.SO$_2$, liq.HF, N$_2$O$_4$ and CH$_3$COOH.

UNIT-IV

**Nuclear Chemistry**:

4.1. Introduction: Composition of nucleus and nuclear forces.

4.2. Nuclear stability: n/p ratio, mass defect, binding energy, packing fraction and magic number, nuclear shell and liquid drop models.

4.3. Isotopes – Separation - Isotopic constitution of elements and Whole Number Rule. Isobars, isotones and isomers.

4.4. Radioactivity: Definition of $\alpha$, $\beta$ and $\gamma$ rays – properties - detection and measurements- Wilson cloud chamber and G.M. Counter.

UNIT- V

**Nuclear chemistry**:

5.1. Disintegration - Modes of decay – group displacement law, rate of disintegration - half life and average life - radioactive series.


5.3. Nuclear reaction energy (Q value) - Calculation of Q-value – nuclear reactor (Breeder reactor) – nuclear power stations in India.

5.4. The particle accelerators- Cyclotron, Betatron.
5.5. Application of radioisotopes and disposal of radioactive waste.

REFERENCES:
Stereochemistry – I
1.2 R & S Notations – Cahn – Ingold – Prelog rules – Erythro and threo representations. Fischer, Sawhorse and Newmann projection formulae of compounds containing two asymmetric carbon atoms.

UNIT – II
(Stereo Chemistry - II)
2.1 Optical activity of compounds containing no asymmetric carbons – Biphenyls, allenes and spiranes.
2.2 Geometrical Isomerism:- Cis-trans, Syn – Anti and E – Z notations – Geometrical isomerisms of maleic and Fumaric acids and unsymmetrical ketoximes – Methods of determination of the configuration of geometrical isomers.
2.3 Conformation Analysis -Definition – conformation and configuration – conformation of ethane and n-butane molecules and their stability. Conformations of cyclohexane – energy profile diagrams. Conformation analysis of mono and disubstituted cyclohexanes and methyl cyclohexanes and 1,2, 1,3 and 1,4-dimethylcyclohexanes.

UNIT – III
(Heterocyclic compounds)
3.1 Preparation, properties and uses of furan, pyrrole, thiophene and pyridine. Comparative basic characters of pyrrole, pyridine and piperidine with alkyl amines. Synthesis and reactions of Quinoline, Isoquinoline and Indole with special reference to Skraup, and Fischer indole synthesis – Fischer Napieralski synthesis.

UNIT – IV
(Monocarboxylic acids and Dicarboxylic acids:
4.2 Dicarboxylic acids – preparation and properties of oxalic, malonic, succinic, glutaric and adipic acids.
4.3 Esters - Preparation – properties and synthetic applications of malonic, acetoacetic esters - keto-enol tautomerism of acetoacetic esters.
Unit – V

5.1 **Terpenoids:** Isoprene rule, special isoprene rules, gem – dialkyl rule - Classification, structural elucidation of citral, geraniol, α–terpineol.

5.2 **Alkaloids:** Classification – General methods of isolation, Hofmann exhaustive methylation, structural elucidation of conine, nicotine and piperine.

5.3 **Vitamins:** Biological importance and structural elucidation of pyridoxine and ascorbic acid.

**References:**

UNIT – I

First Law of Thermodynamics and Thermo Chemistry
1.1. Terms used in thermodynamics – Conservation of energy, internal energy, work and heat, state function, path function, exact and inexact differentials, zeroth law of thermodynamics, first law of thermodynamics- definition, heat capacity – Cp and Cv. Joule-Thomson effect – definition, Joule Thomson co-efficient and inversion temperature. Calculation of $\Delta U$, $\Delta H$, $q$ and $w$ for ideal gases, calculation of $\Delta U$, $\Delta H$, $q$ and $w$ for real gases - Reversible and irreversible isothermal expansion, reversible and irreversible adiabatic expansion.

1.2. Thermo chemistry: Change of internal energy and enthalpy in a chemical reaction, Enthalpy of reaction at constant volume and at constant pressure, Enthalpy of combustion, formation, neutralization, dissociation, solution, hydration, dilution, precipitation. Enthalpies of compounds and formation of ions, Kirchhoff equation, Hess’s law and its application.

UNIT – II

Second and third Law of Thermodynamics
2.1. Need for the law, spontaneous process, Carnot’s cycle, efficiency of Carnot’s engine, Carnot’s theorem, thermodynamic scale of temperature, entropy - Concept of entropy, entropy as a state function, entropy change in isothermal expansion of ideal gas, entropy change in reversible and irreversible processes.

2.2. Entropy change accompanying change of phase – Solid to liquid, liquid to vapour crystalline changes, isothermal, isochoric and isobaric processes, entropy of mixture of ideal gases, entropy of mixing, Physical significance of entropy. Other state functions – Free energy, work functions, variation of G with T and P, Maxwell’s relations, Gibb’s–Helmholtz equation.

UNIT – III

Third Law of Thermodynamics and Phase Rule
3.1. Third law of thermodynamics - Nernst heat theorem, Third law of thermodynamics, Determination of absolute entropies, Absolute entropies of elements and compounds, Application of Third law.

3.2. Phase Rule - Definition of the terms – Phase, components, degrees of freedom, derivation of Gibbs’s phase rule, one component system – H$_2$O, CO$_2$, and Sulphur systems, two components system – Simple eutectic system - Pb-Ag, freezing mixture, compound formation with congruent melting points - FeCl$_3$-H$_2$O system, compound formation with incongruent melting points - Na$_2$SO$_4$-H$_2$O system.
UNIT – IV

Solutions of Non-Electrolytes


4.2. Vapour pressure of non-ideal solution - deviations from Raoult’s law, vapour pressure composition and boiling point - composition curves, azeotropic mixtures (HCl–H₂O and ethanol–water system).

4.3. Solubility of partially miscible liquids pairs – system with upper CST - Phenol–Water, aniline–hexane, system with lower CST – Triethylamine-water and system with upper and lower CSTs - Nicotine-water, effects of impurities on CST, completely immiscible liquid pairs –Nernst distribution law and its application to solvent extraction.

UNIT – V

Properties of Dilute Solutions

5.1. Colligative properties – Definition, lowering of vapour pressure, relative lowering of vapour pressure, determination of molecular weight from lowering of vapour pressure, measurement of lowering of vapour pressure, osmosis and osmotic pressure – definitions, expression for calculating osmotic pressure, determination of molecular weight from osmotic pressure, relation between osmotic pressure and lowering of vapour pressure, experimental determination of osmotic pressure.

5.2. Elevation of boiling point – Definition, derivation of ebullioscopic constant, determination of molecular weight from elevation of boiling point, elevation of boiling point determination, depression of freezing point – definition, derivation of cryoscopic constant, determination of molecular weight from depression of freezing point, experimental determination, abnormal colligative property – Association, dissociation and Van’t Hoff factor, degree of dissociation.

REFERENCES
SEMESTER – VI  
CORE–XI  
11UCH6411

PHYSICAL CHEMISTRY-II

(90 Hours) (6 hrs / week)

UNIT – I  
(18)

Atomic Structure, Quantum Theory and Spectroscopy
1.1. De-Broglie theory of matter, experimental proof, Heisenberg’s uncertainty principle, derivation of Schrodinger wave Equation, significance of $\Psi$ and $\Psi^2$.
1.2. Electromagnetic radiations – Definition, regions of electro magnetic radiations, quantization of energies in molecules - Translational, rotational, vibration, and electronic energies, molecular spectra - origin of molecular spectra - Interaction of electromagnetic radiations with molecules.
1.3 UV visible spectroscopy – Theory of electronic spectroscopy, Frank – Condon Principle, types of electronic transitions – Dissociation and Predissociation spectra – Application to geometrical isomerism. (maleic and fumaric acids, cis & trans stilbenes)

UNIT – II  
(18)

Absorption Molecular Spectroscopy
2.1. Microwave spectroscopy - Molecular rotation, theory of microwave spectroscopy, selection rule, effect of isotopic substitution and calculation of moment of inertia and bond length of diatomic molecules.
2.2. Infrared spectroscopy - Molecular vibration – Modes of vibration of diatomic, tri-atomic linear(CO$_2$) and non linear (H$_2$O) molecules - Stretching and bending vibrations, selection rules, expression for vibration frequency, calculation of force constant - fingerprint region.
2.3. Raman spectroscopy – Raman effect, Rayleigh and Raman scattering – Stokes and anti-stokes lines - Modes of vibrations and change in polarisability of H$_2$O and CO$_2$, mutual exclusion principle, comparison between Raman and IR spectroscopy.

UNIT – III  
(18)

Resonance and mass Spectra
3.1. NMR spectroscopy - Magnetic and non–magnetic nuclei, Principle of nuclear magnetic resonance- shielding mechanism, chemical shift, factors affecting chemical shifts (electronegativity and anisotropic effect) number of signals – Proton counting - Spin-spin coupling, coupling constant, NMR spectrum of ethyl alcohol.
3.2. ESR spectroscopy - theory of ESR spectra, hyperfine splitting, ESR spectra of methyl, benzene anion and naphthalene anion radicals.
3.3. Mass spectroscopy- Basic principle, molecular ion peak, base peak, isotopic and meta stable peaks, nitrogen rule and mass spectra of toluene and branched alkanes.
UNIT – IV (18)

**Electrolytic Conductance and Transference**

4.1. Ionic mobility – Definition, experimental determination, experimental proof for migration of ions, transport number – Definition, Hittorf’s rule, experimental determination - Hittorf’s method, moving boundary method, effect of concentration on transport number.


4.3. Activity of ions in solutions – Mean ionic activity and activity coefficient, ionic strength, Deybe-Huckel limiting law of activity coefficient. (No Derivation)

UNIT – V (18)

**Electromotive Force of Galvanic Cells**

5.1. Galvanic cell – Definition, chemical cell, concentration cell, reversible cell and irreversible cell, types of reversible electrodes – Metal-metal ion electrodes, amalgam electrodes, gas electrodes, metal-insoluble metal salt electrode and oxidation - reduction electrode, single electrode potential.

5.2. E.M.F. of galvanic cell and cell reaction – Cell e.m.f., sign conventions of cell e.m.f. and cell reaction, Nernst equation for cell e.m.f., reference electrode – primary and secondary reference electrode, standard electrode potential and its determination, electro chemical series, standard cell,

5.3. Thermodynamics of galvanic cells – Relation between E.M.F. and $\Delta G$, $\Delta H$, $\Delta S$ and equilibrium constant(K), concentration cells – Electrode concentration cells – Amalgam and gas concentration cells, electrolyte concentration cells - Concentration cells without transference and its e.m.f., concentration cells with transference and its e.m.f., liquid junction potential.

References:


Semester VI MAJOR BASED ELECTIVE - II 11UCH6502

ORGANIC CHEMISTRY – II

(75 Hours) (5 hrs / week)

UNIT - I


1.2 Reactions of phenols – Esterfication, Nitration, Sulphonation, Halogenation, Benzylolation, Acylation, coupling reaction, Kolbe reaction, Gatterman reaction, Hauben-Hoesch reaction and Reimer-Tiemann reactions.


UNIT – II

Nitro Compounds and amines:-

2.1 Preparation of Nitro benzene – Reduction of Nitro benzene in neutral, acidic and alkaline media - TNT.

2.2 Amines: Relative basic characters of aliphatic and aromatic amines. – Ring substitution in aromatic amines – separation of amines by Hinsburg and Hofmann methods - diazotization and its mechanism - synthetic applications of benzene diazonium salts and diazomethane – diazoacetic esters.

2.3 Phenylene diamines – Preparation - sulphanilic acid, sulphanilamide, saccharin, chloramine-T and uses.

UNIT – III

Amino Acids and Proteins:-

3.1 Classification of amino acids – Definition of essential and non–essential amino acids. Preparation and properties of glycine and alanine. Zwitter ions, isoelectric points, polypeptides, End group analysis by Sanger’s method.

3.2 Proteins – Classification based on physical and chemical properties and on physiological functions. Primary, secondary and tertiary structures of proteins. Denaturation of proteins.


UNIT – IV

4. Molecular rearrangements:-

UNIT – V

5. Carbohydrates:

5.1 Classification, structural elucidation of glucose and fructose, Reactions of glucose and fructose - osazone formation - mutarotation and its mechanism - cyclic structure – and determination of ring size - configuration of monosaccharides. Epimerization, ascending and descending of aldoses and ketoses. Inter conversion of aldoses and ketoses.

5.2 Disaccharides – reactions and structural elucidation of maltose and sucrose polysaccharides starch and cellulose - properties, uses and structures.[structural elucidation not necessary].

References:

SEMESTER - VI             MAJOR BASED ELECTIVE - III             11UCH6503

INORGANIC CHEMISTRY –II

(75 Hours) (5hrs/ week)

Unit – I

Coordination chemistry:
1.1. Ligands – Classification, polydentate up to hexadentate, symmetrical and unsymmetrical ligands.
1.2. IUPAC nomenclature – Naming of complexes with all types of ligands – Bridging – Ambidentate ligands.
1.3. Isomerism in coordination compounds – Stereoisomerism – Geometrical and optical isomerism in 4 and 6 coordination compounds – Distinction between cis and trans isomers.

Unit – II

2.1 Theories of coordination – Werner’s, Sidgwick and Pauling theory as applied to Oₐ, Tₐ and square planar complexes. Limitations of Pauling theory, crystal field theory – splitting of d - orbitals in Oₐ, Tₐ and square planar complexes – CFSE of weak strong fields – Factors affecting 10 Dq – measurement of 10 Dq - Applications of CFT.
2.2 Molecular orbital theory applied to octahedral complexes.

Unit – III

3.3. SN₁ and SN₂ Reactions in Oₐ complexes – Acid hydrolysis – substitution reaction in square planar complexes.
3.4. Trans effect and its applications.

Unit – IV

4.1. Metal carbonyls – Mono and polynuclear carbonyls of Ni, Fe, Cr, Co and Mn – Preparation and properties – Application of EAN rules.
4.2. Nitrosyls – Classification, preparation and properties - Sodium nitroprusside – Preparation, properties, and uses.
4.3. Biologically important coordination compounds - Chlorophyll, haemoglobin, Vitamin B₁₂ - Structure and function.
Unit – V


5.2 **Actinides** - Transuranic elements - properties of actinides - oxidation states - ionic radii - colour of ions - formation of complexes - comparison with lanthanides – thorium – extraction - Properties - compounds of thorium.

5.3. **Metallurgy**: Occurrence of metals - concentration of ores- froth floatation, magnetic separation, calcinations, roasting, smelting, flux, aluminothermite process - purification of metals.

**References:**
Analysis of acid radicals:

Analysis of three acid radicals: (at least one must be interfering radical)

Oxalate, Phosphate, Borate, Fluoride, Sulphate, Bromide, Chloride, Nitrate, Arsenite, Sulphide, Carbonate, Arsenate.
INORGANIC QUALITATIVE ANALYSIS -II

Analysis of Any Three Basic Radicals:

Pb, Cu, Cd, Sn, Sb, Bi, Fe, Al, Mn, Ni, Zn, Co, Ca, Ba, Sr, Mg, NH₄
VOLUMETRIC ESTIMATION

1. Estimation of Sodium Hydroxide
   \((Na_2CO_3 \times HCl \times NaOH)\)

2. Estimation of Hydrochloric Acid
   \((H_2C_2O_4 \times NaOH \times HCl)\)

3. Estimation of Oxalic Acid
   \((FeSO_4 \times KMnO_4 \times H_2C_2O_4)\)

4. Estimation of Ferrous Sulphate
   \((H_2C_2O_4 \times KMnO_4 \times FeSO_4)\)

5. Estimation of KMnO4
   \((K_2Cr_2O_7 \times FAS \times KMnO_4)\)

6. Estimation of Ferric ion (Internal Indicator)
   \((K_2Cr_2O_7 \times Ferric Alum)\)

7. Estimation of Zinc by EDTA
   \((MgSO_4 \times EDTA \times ZnSO_4)\)

8. Estimation of Mg by EDTA
   \((ZnSO_4 \times EDTA \times MgSO_4)\)

9. Estimation of Cu by Iodometry
   \((K_2Cr_2O_7 \times Thio \times CuSO_4)\)

10. Estimation of Iodine
    \((K_2Cr_2O_7 \times Thio \times I_2)\)
GRAVIMETRIC ESTIMATION AND COMPLEXOMETRIC TITRATION:

Gravimetric Estimation:

**Sintered Crucible:**
1. Ni as Nickel dimethyl glyoxime
2. Zn as Zinc Oxinate
3. Pb as Lead Chromate
4. Ba as Barium Chromate
5. Ca as Calcium oxalate monohydrate

**Silica Crucible:**
1. Ca as Calcium Carbonate
2. Ca as Calcium Sulphate
3. Pb as Lead Sulphate
4. SO₄ as Barium Sulphate

Complexometric titration:

Estimation of Zn, Mg, Ca and Cu.
ORGANIC ANALYSIS AND PREPARATION

Organic Analysis:

Acids (Mono & Di Carboxylic acids), Phenols (Mono & Dihyrdric phenols)

Aldehydes, Ketones, Esters

Amines (Primary & Secondary), Amides (Mono & Di amides), Anilides

Carbohydrates, Nitro Compounds

Preparations:

1. Oxidation: (benzaldehyde to benzoic acid)
2. Acetylation: (aniline to acetanilide)
3. Bromination: (phenol to 2,4,6-tribromophenol)
4. Nitration: (nitrobenzene to 1,3- dinitrobenzene)
5. Hydrolysis: (ethyl benzoate to benzoic acid)
6. Diazotization: (aniline and beta naphthol coupling)

Determination of Melting point / Boiling point:


3. Determination of Molecular Weight of the solute by Rast method.

4. Determination of $K_f$ of the solvent by Rast method.

5. Ester Hydrolysis. (methyl acetate or ethyl acetate)

6. Transition temperature.

7. Phase Diagram.

8. Equilibrium constant of formation of $\text{KI}_3$

9. Partition coefficient of iodine between carbon tetrachloride and water
PHYSICAL CHEMISTRY PRACTICAL – II

1. Determination of equivalent conductance of strong electrolyte
2. Determination of strength of Strong acid by Conductometry
3. Determination of strength of a Strong base by Conductometry
4. Determination of strength of \( \text{K}_2\text{SO}_4 \) by Conductometry
5. Determination of strength of \( \text{FeSO}_4 \) by Conductometry
6. Determination of strength of Strong acid by Potentiometry
7. Determination of strength of Strong base by Potentiometry
8. Determination of pH of a buffer Solution by Potentiometry
9. Estimation of \( \text{FeSO}_4 \) by Potentiometry
Semester - I  ALLIED CHEMISTRY-I  11UCH1301

INORGANIC, ORGANIC AND PHYSICAL CHEMISTRY - I
(75 Hours) (5 hrs / week)

Unit – I  (15)
1.1 Periodic properties- ionization potential, electron affinity and electro negativity - variation in the periodic table
1.2 Molecular Orbital Theory: Some important basic concepts of molecular orbital theory – LCAO- Bonding , anti-bonding orbitals and bond order – applications of MO theory to H₂, He₂, O₂ and F₂ molecules
1.3 Industrial Chemistry:
Soap and detergents – An elementary idea of soap and detergent. Cleansing action of soap and detergents.

Unit – II  (15)
2.1 Carbohydrates:
Classification – Glucose and fructose – Preparation and properties – Sucrose – Manufacture and properties – Starch and cellulose – Properties and uses.
2.2 Amino Acids and Proteins:
Amino acids – Classification, preparation and properties. Peptides (Elementary treatment) – Proteins – Classification based on physical properties and biological functions.
2.3 Nucleic acid: DNA and RNA – functions (Structure not necessary)

Unit – III  (15)
3.2. Heterocyclic compounds: Furan, thiophene, pyrrole and pyridine – Preparation and properties.

Unit – IV  (15)
4.1 Chromatography: Principles of column, paper and thin layer chromatography.
4.3 **Phase Rule:** Phase, Component, Degree of freedom, Phase Rule – Definition. One component system – Water system.

**Unit – V**

5.1 **Electrochemistry:** Specific and equivalent conductance – their determination – Effect of dilution on conductivities – An elementary idea about ionic theory – Ostwald’s Dilution Law, Kohlrausch Law, Conductometric titrations.

5.2 **pH and Buffer:** Importance of pH and buffers in the living systems. pH determination by colorimetric and electrometric methods.

5.3 **Corrosion:** Types of corrosion, Prevention.

**REFERENCES:**
Semester II

ALLIED CHEMISTRY-II

11UCH2303

INORGANIC, ORGANIC AND PHYSICAL CHEMISTRY – II

(60 Hours) (5 hrs / week)

Unit – I


1.2. **Metallic Bond**: Electron gas, Pauling and Band Theories- Semiconductors- Intrinsic, n- and p-types.

1.3. **Compounds of Sulphur**: Peracids of sulphur and sodium thiosulphate – properties and uses.

Unit – II


2.2. **Aromaticity**: Conditions – Huckel’s rule - aromaticity of benzene.

2.3. **Substitution reactions**: Nitration, halogenation, sulfonation and alkynylation of benzene.

Unit – III

3.1 **Halogen containing compounds**: Preparation and uses of Dichloromethane, Chloroform, Carbon tetrachloride, DDT and BHC.

3.2. **Chemotherapy**: Structure and uses of Sulpha drugs – Sulpha pyridine, Sulpha thiazole and sulpho diazine – Antibiotics - Structure and uses of penicillin – G and Chloromycetin.

3.3. **Name reactions**: Benzoin, Perkin, Cannizaro, Claisen, Haloform, Carbylamine reactions – Biuret reaction.

Unit – IV

4.1 **Solid State**: crystal lattice – Unit cell. Elements of symmetry. Bragg’s equation, Weiss indices, Miller indices, Simple, Body centered and Face centered cubes.

4.2 **Energetics**: Second Law of thermodynamics - Carnot Theorem – Carnot Cycle.

Unit — V (12)

5.1 Chemical Equilibrium: Criteria of homogeneous and heterogeneous equilibria. Decomposition of HI and PCl₅.

5.2 Chemical Kinetics: Order, Rate, Molecularity of the reaction and rate constant. Determination of order of the reaction — Activation energy, Effect of temperature on reaction rate.

5.3 Catalysis: Catalysis — Types—Importance of catalysts, Homogeneous and heterogeneous catalysis —Industrial catalyst, catalyst carrier, catalyst promoter, catalyst inhibitor, catalytic poison, activity of catalyst - concept of acid-base and enzyme catalysis.

REFERENCES:

VOLUMETRIC ANALYSIS

1. Estimation of Sodium Hydroxide
   \((\text{Na}_2\text{CO}_3 \times \text{HCl} \times \text{NaOH})\)

2. Estimation of Hydrochloric Acid
   \((\text{H}_2\text{C}_2\text{O}_4 \times \text{NaOH} \times \text{HCl})\)

3. Estimation of Oxalic Acid
   \((\text{FeSO}_4 \times \text{KMnO}_4 \times \text{H}_2\text{C}_2\text{O}_4)\)

4. Estimation of Ferrous Sulphate
   \((\text{H}_2\text{C}_2\text{O}_4 \times \text{KMnO}_4 \times \text{FeSO}_4)\)

5. Estimation of KMnO
   \((\text{K}_2\text{Cr}_2\text{O}_7 \times \text{FAS} \times \text{KMnO}_4)\)

6. Estimation of Zn by EDTA
   \((\text{MgSO}_4 \times \text{EDTA} \times \text{ZnSO}_4)\)

7. Estimation of Mg by EDTA

8. Estimation of Cu by iodometry
   \((\text{K}_2\text{Cr}_2\text{O}_7 \times \text{thio} \times \text{CuSO}_4)\)

9. Estimation of Iodine
   \((\text{K}_2\text{Cr}_2\text{O}_7 \times \text{thio} \times \text{I}_2)\)
A study of reactions of the following organic compounds:

1. carbohydrate
2. amide
3. aldehyde
4. ketone
5. monocarboxylic acid
6. Dicarboxylic acid
7. Amine
8. monohydric phenol
9. Dihydric phenol
10. Ester
11. Nitro

The students may be trained to perform the specific reaction like test for element (Nitrogen only), Aliphatic or aromatic, saturated or unsaturated and functional group present and record their observation.
COMPUTER APPLICATIONS IN CHEMISTRY (30 Hours) (2 Hrs / Week)

UNIT – I  (6)


UNIT – II  (6)


UNIT –III  (6)


UNIT – IV  (6)


UNIT – V  (6)

5.1 Fundamentals of C: User friendly language – Character set – Keyword and Identifiers – Primary data types – Constants – Variables and simple operators. Simple C - Programming – Basic Structure of C-Programming – Conversion of temperature from Kelvin to Celsius – Calculation of pH of a buffer solution using Henderson’s equation.

REFERENCES:
SEMESTER III    NON MAJOR ELECTIVE - II  11UCH3601

FOOD AND NUTRITIONAL SCIENCE   (30 Hours) (2 Hrs / Week)

UNIT – I

1.2 Nutrients: Types of nutrients – Proteins, Carbohydrates, Fats, Minerals and Vitamins – Importance of nutrients.

UNIT – II

2.1 Minerals: Dietary sources, functions, Effects of deficiency and requirements of calcium, phosphorous, iron, fluorine, iodine, sodium and potassium.
2.2 Vitamins: Classification – vitamins – A, D, E, K, B₆, B₁₂, and C – Food sources, physiological functions, effects of deficiency and daily requirements.

UNIT – III

3.1 Meal planning for various age groups: Importance of meal planning – Importance of mother’s milk – Diets for school children - adolescents - pregnant and lactating women.
3.2 Diet during fever, dysentery, anemia, blood pressure, obesity and diabetes.

UNIT – IV

4.1 Food preservation: Definition, Principle and importance – Food Spoilage – Causes of food spoilage – Fermentation, rancidity, autolysis and putrefaction – food poisoning.
4.2 Methods of food Preservation: Freezing, canning, pickling, salting, smoking, bottling, sterilization, refrigeration, dehydration, heating, radiation and preservative agents.

UNIT – V

5.1 Food adulteration: Definition – Common adulteration in food and their ill effects – Intentional and incidental adulterants – Packing hazards.

REFERENCES:
SEMESTER - V SKILL BASED ELECTIVE – II 11UCH5702
CHEMISTRY IN EVERY DAY LIFE (60 Hours) (4 Hrs / Week)

UNIT-I
Perfumes and Flavours:
1.1 Perfumes:

1.2 Flavours:
Definition of flavours – chemical composition – common characteristics, classification, formulation and hazards.

UNIT-II
Cosmetics:
2.1 Basic Cosmetic Skin Care Products: Emulsions, Cream and Lotions. Speciality products- Sun protection and Skin lightening, Herbal Cosmetics- Cosmacueticals and ISI Guidelines.

2.2 Face creams: toilet powders, hand lotions and creams, makeup preparations – nail lacquers – lacquer removers and nail bleaches – composition and preparations.

2.3 Toilet soaps: detergents and shaving creams – hair oils, tonics, shampoos, hair dyes – composition, preparations and hazards.

UNIT-III
Plastics and Rubber:


UNIT-IV
Dairy Chemistry:
4.2 Role of Dairying in national economy, Sanitary and hygienic conditions in Animal farm, Establishment of Dairy farm.

UNIT-V

**Fuels for Home and Fire Protection:**

5.1 **Fuels**: Definition, classification, requirements of good fuel, efficient utilization of fuels – important properties of fuels – health hazards of fuels – important consideration in the use of fuels – criteria for choice of fuels for home – fuels for the future.

5.2 Fire Protection - Major causes of fire in homes, prevention and fire fighting in homes – methods of extinguishing fire, chemical fire extinguishers - merits and demerits. Automatic fire detection cum control, high rise building and means of escapes electrical fire - causes and fire fighting.

**REFERENCES:**

 Semester V  
MAJOR BASED ELECTIVE – I  
11UCH5501  
ANALYTICAL CHEMISTRY  
(60 Hours) (4 Hrs / Week)  

UNIT – I  
(12)  

1.1 Laboratory hygiene and safety:  
Storage and handling of chemicals, handling of ethers, Toxic and poisonous chemicals, general precautions for avoiding accidents, first aid techniques – acid and alkali on eye, acid and alkali burn – Bromine burns - cut by glasses – Heat burns – Inhalation of toxic vapours– Poisoning – Treatment for specific poisons – acids, alkalis, acetone, arsenic and copper compounds, cyanides - universal antidote.  

1.2 Error and Data Analysis:  

UNIT – II  
(12)  

2.1 Volumetric analysis:  

2.2 Organic estimations:  

UNIT – III  
(12)  

3.1 Gravimetric analysis:  

UNIT – IV  
(12)  

4.1 Purification Techniques:  
Desiccant – types – drying power and choice of desiccants – Distillation - Principles and techniques of fractional distillation, steam distillation and azeotropic distillation – Hot filtration, removal of colouring matter during recrystallisation, precautions. Sublimation -

UNIT – V (12)

5.1 Chromatography:

REFERENCES:

1.2 **Refractories**: Definition – classification, properties of refractories – manufacture of refractories, fire clay bricks manufacture, uses of fire clay refractories – High alumina refractories – uses – silicon carbide refractories – properties and uses.

 UNIT – II (12)


 UNIT-III (12)


3.2 **Dyes**: Dyes - colour and constitution – classification of dyes - based on application and chemical structure – nitro and nitroso dyes - triphenyl methylene dyes - malachite green, crystal violet, Azo dyes - Aniline yellow, methyl orange – phthaleins – Phenolphthalein, fluorescein – preparation properties and uses.
UNIT-IV

4.1 **Portland Cement:**

4.2 **Pulp and Paper:**

UNIT – V

5.1 **Corrosion:**

5.2 **Batteries:**

REFERENCES:
Jamal Mohamed College, was founded in 1951, an autonomous institution, affiliated to the Bharathidasan University, Tiruchirappalli. The college is administered by the Society of Jamal Mohamed College, is established in a sprawling land area of 87 acres, as a religious minority institution, with the primary objective of providing higher education to the downtrodden and socially backward sections of the society in general and Muslim minority in particular. The college is Re-accredited (3rd Cycle) with 'A' grade by NAAC. The college has been identified as the "College with Potentia PG and Research Department of Chemistry, Jamal Mohamed College (Autonomous), Affiliated to Bharathidasan University, Tiruchirappalli - 620 020 (India). Article Publishing History Article Received on: Article Accepted on: Article Metrics. ABSTRACT: Heterocyclic compounds containing b-lactum structure with different hetero atoms are found to show biological activities. Mohamed M. I. F, Mubarak M. S, Dar M. A, Abuthair A, Devi R. R. Synthesis and Characterisation of new Spiro Heterocycles. Orient J Chem 2011;27(1). Copy the following to cite this URL: Mohamed M. I. F, Mubarak M. S, Dar M. A, Abuthair A, Devi R. R. Synthesis and Characterisation of new Spiro Heterocycles. Orient J Chem 2011;27(1). Available from: http://www.orientjchem.org/?p=24892.