

(For the B.Sc Physics / Mathematics students admitted during the academic year 2014-2015 batch onwards)

Sub Code	Paper title	L	P	T	Credits
UPH314A3	ALLIED CHEMISTRY - I	3	-	1	4

### Unit I: Chemical Bonding – I (12 hours)

1.1 Types of bonds – ionic bond- factors favouring ionic bond - covalent bond – orbital overlap – linear combination of orbitals -  $\sigma$  and  $\pi$  bond formation – polarity in covalent molecules - Fajan's rule – effects of polarization -coordinate bond - simple examples.

1.2 Molecular Orbital Theory – linear combination of orbitals –types of molecular orbitals- energy level diagrams-  $e^-$  filling in MO – bond order – MO diagrams of  $H_2, He_2, Li_2, Be_2, N_2$  and  $O_2$  molecules – mixing of orbitals – MO diagrams of CO, HF and NO molecules

1.3 Metallic Bond – properties of metals – free electron theory – merits and demerits – valence bond theory - band theory of solids (Primitive treatment only) – H-bonding – effects H bonding.

### Unit II: Chemical bonding – II (12 hours)

2.1 Hybridization – definition - geometry of the molecules-  $CH_4, C_2H_4, C_2H_2, C_6H_6$  -VSEPR theory – shapes of  $NH_3$  and  $H_2O$  molecules.

2.2 Coordination chemistry- nomenclature of complexes - Werner, Sidgewick and Pauling theories – Chelation – examples of complexes- Prussian Blue, Haemoglobin, Chlorophyll – applications of coordination chemistry in qualitative and quantitative analysis.

### Unit III: Fundamentals of reaction mechanism (12 hours)

3.1 Homolytic and heterolytic fissions – types of organic reactions – types of attacking reagents – inductive, electromeric, resonance and hyperconjugation effects.

3.2 Types of substitution reactions –  $S_N^1$  and  $S_N^2$  reactions – aromatic electrophilic substitution - mechanism – Mechanism of nitration, halogenation, alkylation, acylation, sulphonation – elimination reactions – mechanism, examples.

3.3 Addition reactions – types – nucleophilic and electrophilic additions- nucleiphilic additions to alkenes – Markovnikov rule – peroxide effect.

### Unit IV: Metals and Other conducting materials (12hours)

4.1 Metals -General methods of extraction of metals - types of ores-steps involved in metal extraction – ore dressing- methods concentrating ore – extraction methods – types of furnaces – reverberatory, blast and open hearth furnaces - roasting, smelting and calcination. Reduction methods – self reduction – aluminothermic process – electro reduction- methods of refining -Van Arkel, zone and electro refining.

4.2 Alloys and intermetallic compounds- Hume-Rothery Rule - Organic conducting materials-  $(\text{SN})_x$ -  $(\text{C}_2\text{H}_2)_x$  and related compounds- organic superconductors.

**Unit V: Industrial chemistry (12hours)**

5.1 Dyes – theory of colour and constitution - chromophore, auxochrome- classification of dyes – natural dyes (Indigo) – azo dyes (Methyl Orange, Bismark brown) – triphenyl methane dyes (Malachite Green, Crystal violet)

5.2 Polymers- types- addition polymerization – mechanisms-preparation, properties and uses of PE,PU, PMMA and SBR

5.3 Fertilizers - micro and macro nutrients - urea, ammonium sulphate, ammonium nitrate, potassium nitrate NPK fertilizer – eutrophication- organic manures – compost, vermiculate.

**Reference Books:**

1. Principles of Physical Chemistry – Puri & Sharma- Vishal Publishing Co, 42<sup>nd</sup> edition, 2007
2. Engineering Chemistry – Jain & Jain – Dhanpat Rai Publishing, 15<sup>th</sup> edition, 2008.
3. Fundamental concepts of Inorganic Chemistry - Asim.K.Das, CBS publishers & Distributors, 2<sup>nd</sup> edition, 2010.
4. Industrial Chemistry – B.K.Sharma – Krishna prakashan media (P) ltd., 8<sup>th</sup> edition, 1996.
5. Principles of Organic Chemistry – Bahl & Arun Bahl, S.Chand & Company, 16<sup>th</sup> edition, 2004

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Sub Code	Paper title	L	P	T	Credits
UPH414A4	ALLIED CHEMISTRY - II	3	-	1	4

**Unit I: Liquid state and solutions** (12 hours)

1.1 General properties of liquids – vapour pressure- definition, measurement – Trouton’s rule – surface tension – effect of T on surface tension – effects of surface tension – measurement – surfactants – viscosity- measurement of viscosity – effect of temperature, pressure on viscosity.

1.2 Solutions - types - Liquid in Liquid - Raoult’s law. Deviation from ideal behavior - Binary liquid mixtures- theory of fractional distillation – azeotropes.

1.3 Mesomorphic state – compounds forming liquid crystals – types of liquid crystals – applications of liquid crystals.

**Unit II: Chemical kinetics and catalysis** (12 hours)

2.1 Kinetics – terminology of kinetics - rate, law of mass action, rate law, order, molecularity, pseudo first order, half-life period -Determination of order – graphical, isolation and half-life time methods.

2.2 Kinetics of zero, first and second order reactions (both cases) – kinetics of hydrolysis of ester (both acid and alkaline)activation energy – importance of  $E_a$  – Arrhenius equation (derivation not expected)

2.3 Catalysis – requirements of a catalyst – types of catalysis and catalysts –theories of catalysis – enzyme catalysis –Fischer mechanism.

**Unit III: Stereoisomerism and Name reactions** (12 hours)

3.1 Stereoisomerism – types – geometrical isomerism – optical activity- condition for optical activity – symmetry elements –chirality -optical isomerism –R,S notation - diastereomers – optical activity of lactic and tartaric acids- racemization.

3.2 Name reactions - Mechanisms of aldol, Schmidt, Perkin, Knoevenagel, Cannizaro and benzoin condensation reactions.

**Unit IV: Biomolecules** (12 hours)

4.1 Amino Acids- Classification – preparation, properties - preparation of peptides. Classification of proteins - Primary and secondary structures of proteins – biosynthesis of proteins (basic idea only)

4.2. Carbohydrates – classification, preparation and properties of glucose and fructose- open ring structuresof glucose and fructose.

4.3 Antineoplastic agents – cancer – types of tumour – causes for cancer – treatment methods (concepts only)-antineoplastic agents- alkylating agents – cisplatin - mode of action

## **Unit V: Industrial materials (12hours)**

5.1 Lubricants – friction and wear – functions and types of lubricants –mechanism of lubrication – solid lubricants – selection of lubricants –cutting fluids.

5.2 Adhesives – adhesive action- factors affecting the adhesion- classification of adhesives.

5.3 Refractories and ceramics – characteristics-types – manufacture of refractories –Silica, fireclay and Magnesite bricks – Cement – manufacture of Portland cement –hardening of cement – Glass-manufacture – types ( Soda –lime and Potash – lime glasses only) and their uses.

### **Reference Books:**

1. Principles of Physical Chemistry – Puri & Sharma- Vishal Publishing Co, 42<sup>nd</sup> edition, 2007
2. Engineering Chemistry – Jain & Jain – Dhanpat Rai Publishing, 15<sup>th</sup> edition, 2008.
3. Fundamental concepts of Inorganic Chemistry - Asim.K.Das, CBS publishers & Distributors, 2<sup>nd</sup> edition, 2010.
4. Principles of Organic Chemistry – Bahl & Arun Bahl, S.Chand & Company,16<sup>th</sup> edition, 2004
5. Selected Topics In Inorganic chemistry – Madan,Malik and Tuli – S.Chand and Co., 7<sup>th</sup> edition, 2001.

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### **ALLIED CHEMISTRY PRACTICALS (3 HOURS PER WEEK)**

#### **I. VOLUMETRIC ANALYSIS: (any 10)**

1. Estimation of hydrochloric acid using standard oxalic acid.
2. Estimation of sodium hydroxide using standard sodium carbonate
3. Estimation of  $\text{Na}_2\text{CO}_3$  in washing soda
4. Estimation of carbonate and bicarbonate in a mixture
5. Estimation of ferrous sulphate- standard Mohr's salt solution.
6. Estimation of oxalic acid- standard Mohr's salt solution
7. Estimation of  $\text{H}_2\text{O}_2$  – using standard oxalic acid
8. Estimation of  $\text{MnO}_2$  in pyrolusite
9. Estimation of ferric iron standard oxalic acid (Zn reduction)
10. Estimation of ferric iron using standard  $\text{K}_2\text{Cr}_2\text{O}_7$
11. Estimation of ferric and ferrous iron in the given mixture
12. Estimation of  $\text{Cu}^{2+}$  by using standard  $\text{K}_2\text{Cr}_2\text{O}_7$
13. Estimation of  $\text{Cu}^{2+}$  by using standard  $\text{CuSO}_4$
14. Estimation of chloride ion in water
15. Estimation of hardness of water using EDTA.

#### **II. ORGANIC ANALYSIS: systematic analysis**

1. Detection of Elements (N, S, Halogens).
2. To distinguish between aliphatic and Aromatic.
3. To distinguish between saturated and unsaturated.
4. Functional group tests for phenols, acids (mono and di), aromatic primary amine, amide, diamide, carbohydrate, carbonyl compounds

Functional group(s) to be characterized by confirmatory tests.

#### **Reference Books:**

1. Advanced Inorganic Practicals- Gurudeepraj , Krishnaprakashan , 2<sup>nd</sup> edition, 2002.
2. Systematic Organic Analysis, Gnanaprakasham, B.Viswanathan publishers, 1<sup>st</sup> edition, 1979.