

PG AND RESEARCH DEPARTMENT OF CHEMISTRY
JAMAL MOHAMED COLLEGE (AUTONOMOUS), TIRUCHIRAPPALLI – 20
UG COURSE STRUCTURE FROM 2011-2012

	SUBJECT CODE	PART	COURSE	SUBJECT TITLE	HRS / WEEK	CREDIT	INT. MARK	EXT. MARK	MARK
I	11U1LA1/H1/T1/F1/U1	I	Language-I		6	3	25	75	100
	11U1LE1	II	English-I		6	3	25	75	100
	11UPH1301	III	Allied-I	Allied Physics Theory - I	5	3	25	75	100
	11UPH1302:1P	III	Allied-I-Practical	Allied Physics Practical – I	3	2	20	30	50
	11UCH1401	III	Core-I	Inorganic, organic and physical chemistry	5	5	25	75	100
	11UCH1402:1P	III	Core-II-Practical-I	Inorganic qualitative analysis-I	3	2	20	30	50
	11U19	IV	Environmental Studies		2	2	25	75	100
					30	20	165	435	600
II	U2LA2/H2/T2/F2/U2	I	Language-II		6	3	25	75	100
	U2LE2	II	English-II		6	3	25	75	100
	11UPH2303	III	Allied-II	Allied Physics Theory – II	4	3	25	75	100
	11UPH2302:2P	III	Allied-II Practical	Allied Physics Practical-II	3	2	20	30	50
	11UCH2403	III	Core-III	Inorganic and organic chemistry	6	5	25	75	100
	11UCH2402:2P	III	Core-II Practical-II	Inorganic qualitative analysis-II	3	2	20	30	50
	11UCH2601	IV	Non-major Elective-I	Computer applications in chemistry	2	2	25	75	100
					30	20	165	435	600
III	11U3LA3/H3/T3/F3/U3	I	Language-III		6	3	25	75	100
	11U3LE3	II	English-III		6	3	25	75	100
	11UMA3304:2	III	Allied-III	(or)	Allied Mathematics - I	5	3	25	75
	11UMA3305:2	III	Allied-IV		Allied Mathematics - II	3	2	25	75
	11UBO3304	III	Allied-III	Allied Botany-I	5	3	25	75	100
	11UBO3305:1P	III	Allied-III Practical	Allied Botany Practical-I	3	2	20	30	50
	11UCH3404	III	Core-IV	organic and physical chemistry	6	5	25	75	100
	11UCH3601	IV	Non-major Elective-II	Food and Nutritional Science	2	2	25	75	100
	11U310	IV	Value Education		2	2	25	75	100
					30	20	175 / 170	525 / 480	700 / 650
IV	11U4LA4/H4/T4/F4/U4	I	Language-IV		6	3	25	75	100
	11U4LE4	II	English-IV		6	3	25	75	100
	11UMA4306:2	II	Allied-V	(or)	Allied Mathematics - III	7	5	25	75
	11UBO4306	III	Allied-IV		Allied Botany-II	5	3	25	75
	11UBO4305:2P	III	Allied-IV Practical	Allied Botany Practical-II	2	2	20	30	50
	11UCH4405	III	Core-V	Inorganic and physical chemistry	4	4	25	75	100
	11UCH4406: P	III	Core-VI Practical	Volumetric Estimation	3	2	40	60	100
	11U411	V	Extension	-----	-	1	-	-	-
11UCH4701	IV	Skill based elective-I	Soft Skill and Personality Development.	4	4	25	75	100	
					30	22	165 / 185	435 / 465	600 / 650
V	11UCH5407	III	Core-VII	Inorganic Chemistry-I	5	5	25	75	100
	11UCH5408	III	Core-VIII	Organic Chemistry-I	5	5	25	75	100
	11UCH5409	III	Core-IX	Physical chemistry-I	5	5	25	75	100
	11UCH5410: 1P	III	Core-X practical-1	Gravimetric Estimation and Complex Preparation	4	4	40	60	100
	11UCH5410: 2P	III	Core-X practical-2	Physical Chemistry Practical -I	3	3	20	30	50
	11UCH5501	III	Major based elective-I	Analytical Chemistry	4	4	25	75	100
	11UCH5702	IV	Skill based elective-II	Chemistry in every day life	4	4	25	75	100
					30	30	185	465	650
VI	11UCH6411	III	Core-XI	Physical chemistry-II	6	5	25	75	100
	11UCH6412:P	III	Core-XII practical	Organic Analysis and Preparation	6	5	40	60	100
	11UCH6413:P	III	Core-XIII practical	Physical Chemistry Practical -II	3	3	20	30	50
	11UCH6502	III	Major based elective-II	Organic Chemistry-II	5	5	25	75	100
	11UCH 6503	III	Major based elective-III	Inorganic Chemistry-II	5	5	25	75	100

	11U6 12	V	Gender studies	-----	1	1	25	75	100
	11UCH6703	IV	Skill based elective-III	Industrial Chemistry	4	4	25	75	100
TOTAL					30	28	185	465	650
GRAND TOTAL					180	140	1040 / 1055	2760 / 2745	3800

Semester I

CORE - I

11UCH1401

Inorganic, Organic and Physical Chemistry

(75 Hours) (5 hrs / week)

UNIT-I

(15)

- 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

(15)

- 2.1. **Chemical bonding :** Ionic bond - formation – characteristics - covalent bond - atomic orbital overlap - concept of covalency - polarity of covalent bond - covalent character of ionic bond - Polarization of ions - Fajan's rules - effects of polarization - dipole moment - bond length, bond angle.
- 2.2. **Theories of Chemical Bonding:** Concept of Valence bond theory - molecular orbital theory - bonding and antibonding molecular orbitals - energy level diagram for molecular orbitals - mixing of orbitals – bond order, bond energy – M.O. diagrams of homonuclear and heteronuclear (CO, NO, HF) diatomic molecules - comparison between VBT and MOT. Hydrogen bond - consequences of hydrogen bond - intermolecular forces.

UNIT – III

(15)

- 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

(15)

- 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

(15)

Gaseous State:

- 5.1 Gas Laws-Kinetic of theory gases, Kinetic equation of gases, Derivation of gas laws from Kinetic equation – Temperature of gas, Molecular velocity, Maxwell's law of distribution of molecular velocities.
- 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:

1. R.D Madan – “Modern Inorganic Chemistry” , S. Chand & Co Pvt Ltd (2009).
2. B.R. Puri & L.R. Sharma – “Principles of Inorganic Chemistry” , Shoban Lal, Nagin Chand &Co., New Delhi (2000).
3. P.L. Soni – “Text book of Inorganic Chemistry. S. Chand & Co., New Delhi (1999).
4. Morrison and Boyd – “Organic Chemistry” – 6th Edition., (1998) – Prentice_Hall of India Pvt. Ltd., New Delhi.
5. Bahl and Arun Bahl – “Advanced Organic Chemistry” – 19th Edition., (2005) – Sulthan and Chand company, New Delhi.
6. M.K. Jain – “Organic Chemistry” – 12th Ed., (2003) Sulthan and Chand Company, New Delhi.
7. B.S. Bahl., G.D. Tuli & Arun Bahl – “Essentials of Physical Chemistry”, (1999), S.Chand & Co., New Delhi.
8. R.L. Madan, G.D. Tuli – “Simplified Course in Physical Chemistry”, (1999), S.Chand & Co., New Delhi.

Semester - II

Core-II

11UCH2403

Inorganic and Organic Chemistry

(90 Hours)(6 hrs / week)

UNIT-I

(18)

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)

- 2.1. **Halogen family** - comparative study of halogens and their compounds - Oxides and oxyacids of halogens (structure only) - estimation of available chlorine in bleaching powder. Basic properties of halogens – Chemistry of Astatine.
- 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)

- 3.1. **Oxygen family** - comparative study - oxygen fluorides – Ozone - preparation – properties structural elucidation and uses – Green House effect - ozone hole and protection of ozone layer.
- 3.2. Hydrogen peroxide – preparation - properties – estimation - structure and uses - Peracids of sulphur - their preparations – properties - uses and structures.
- 3.3. Thionic acids - their preparation – properties - uses and structures - sodium hyposulphite and sodium thiosulphate – preparation – properties - uses.

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

(18)

- 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 KMnO_4 – 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 HgSO_4 – Halogens – Hydrogen halides – oxidation by KMnO_4 – Ozonolysis and Hydroboration.

REFERENCES:

1. R.D Madan – “Modern Inorganic Chemistry”, S. Chand & Co Pvt Ltd (2009).
2. B.R. Puri & L.R. Sharma – “Principles of Inorganic Chemistry”, Shoban Lal, Nagin Chand & Co., New Delhi (2000).
3. P.L. Soni – “ Text book of Inorganic Chemistry. S. Chand & Co ., New Delhi (1999).
4. Bahl and Arun Bahl – “Advanced Organic Chemistry” – 19th Ed., (2005) – Sulthan and Chand company, New Delhi.
5. P.L. Soni and H.M. Chawla – “Text Book of Organic Chemistry” – 28th Ed., (1999) - Sulthan and Chand company, New Delhi.

1.1 **Alcohols:**

Classification – isomerism – general methods of preparation - properties – Distinction between primary, secondary and tertiary alcohols by oxidation, Lucas and Victor Meyer methods – Glycol, Glycerol - preparation, properties and uses.

1.2 **Ethers:**

Simple and mixed ethers – isomerism – general methods of preparation of aliphatic ethers – Anisole – Preparation, properties and uses – Thio ether and mustard gas.

1.3 **Alkyl halides:**

Preparation – properties – Vicinal and gem dihalides - Grignard reagent – preparation and synthetic applications. Aliphatic Nucleophilic substitution reaction - mechanism of SN_1 , SN_2 , SN_i reactions – Elimination reactions - mechanisms of E1, E2 reactions – Saytzeff's and Hofmann rules.

UNIT -II (18)

Carbonyl Compounds:

2.1 General methods of preparation of aliphatic and aromatic carbonyl compounds - carbonyl polarization – Reactivity of Carbonyl group – activity of alpha hydrogen.

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

2.3 Mechanisms of reduction reaction: Clemmenson, Rosenmund, Wolf-Kishner and MPV reduction. Haloform reaction, Michael addition and Oppenauer oxidation.

UNIT - III (18)

3.1 **Aromaticity:**

Aromaticity – Definition – Huckel's rule - aromaticity of benzenoid compounds.

3.2 **Aromatic Electrophilic substitution reactions:**

General mechanism of electrophilic reactions – Halogenation, Nitration, Chlorination, Bromination, sulphonation, Fridel-Craft's alkylation and acylation reactions. Orientation effects of various substituents – ortho - para ratio. Nuclear and side chain halogenations of toluene.

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.

- 4.3 Colloids – types of colloidal systems , Electrical properties – Electrophoresis – Electroosmosis, protection of colloids – Gold number – Theories of protection – stabilities of Sols.

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:

1. A.K. Srivastava – “Organic Chemistry” – 1st Ed.,(2002) – New Age International Publishers, New Delhi.
2. Morrison and Boyd – “Organic Chemistry” – 6th Ed., (1998), Prentice Hall of India Pvt., Ltd., New Delhi.
3. Bahl and Arun Bahl – “Advanced Organic Chemistry” – 19th Ed., (2005) – Sulthan and Chand company, New Delhi.
4. Dr. Jagadamba Singh – “Undergraduate Organic Chemistry” UGC Curriculum Vol. I & Vol. II, Pragati Ed., (2007) – Pragati Prakashan, Meerut
5. B.S. Bahl., G.D. Tuli & Arun Bahl – “Essentials of Physical Chemistry”, (1999), S.Chand & Co., New Delhi.
6. J.N.Gurtu & Snehi – “Advanced Physical Chemistry”, Pragathi Prakashan, Meerut, 1998.
7. Jagdamba singh and S.Anandvardhan, “ A logical approach to modern organic chemistry”, Pragathi Prakashan, 2011.

SEMESTER-IV

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

11UCH4405

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 PH_3 , P_2O_5 and H_3PO_4 .
- 2.2. **Volumetric analysis:** Basic requirements of titration - standard solutions - primary and secondary – types of titrimetric reactions – redox, precipitation titrations. Indicators – neutralization – mixed and fluorescent indicators.

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, K_w , 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(K_h), relation between K_h , K_a and K_w , degree of hydrolysis - salt of weak acid-strong base, salt of weak base - strong acid, salt of weak acid - weak base.

Unit – V

(12)

- 5.1 Energy of activation and its significance, influence of temperature, Arrhenius Rate Equation and its significance. Theories of reaction rates – simple collision theory - Absolute Reaction Rate Theory (ARRT) to simple uni-molecular and bimolecular processes - Comparison of collision & ARRT. - Lindemann's theory - Hinshelwood theory - treatment of ARR theory, Slater's treatment.
- 5.2 Principles of microscopic reversibility, steady state approximation - Kinetics of opposing, consecutive and parallel reactions. Chain reactions -thermal and photochemical reactions between hydrogen and halogens, gas phase auto oxidations, explosions - hydrogen - oxygen reaction.

REFERENCES:

1. R.D Madan – “Modern Inorganic Chemistry”, S. Chand & Co Pvt Ltd, (2009).
2. B.R. Puri & L.R. Sharma – “Principles of Inorganic Chemistry”, Shoban Lal, Nagin Chand & Co., New Delhi (2000).
3. P.L. Soni – “Text book of Inorganic Chemistry. S. Chand & Co., New Delhi (1999).
4. B.S. Bahl., G.D. Tuli & Arun Bahl – “Essentials of Physical Chemistry”, (1999), S.Chand & Co., New Delhi.
5. J.N.Gurtu & Snehi – “Advanced Physical Chemistry”, Pragathi Prakashan, Meerut (1998).
6. B.R. Puri, L.R. Sharma and M.S. Pathania – Principles of Physical Chemistry, Vishal Publications, Jalandhar, (2002).

Semester - V

Core-VII
INORGANIC CHEMISTRY –I

11UCH5407
(75 Hours)(5 hrs / week)

UNIT-I (15)

- 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_2O_5 , MnO_2 - commercial forms of Iron.

UNIT-II (15)

- 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 (15)

- 3.1. **Acids and Bases:** Arrhenius concept, concept of Lowry and Bronsted, Lux - Flood concept, Lewis concept. Relative strengths of acids and bases. Hard and Soft acids and bases. Pearson's concept - bonding in hard – hard and soft - soft combinations, HSAB principle- basis for hard - hard and soft – soft interactions.
- 3.2 **Non-aqueous solvents:** liq. NH_3 , liq. SO_2 , liq. HF , N_2O_4 and CH_3COOH .

UNIT-IV (15)

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 α , β and γ rays – properties - detection and measurements- Wilson cloud chamber and G.M. Counter.

UNIT- V (15)

Nuclear chemistry:

- 5.1. Disintegration - Modes of decay – group displacement law, rate of disintegration - half life and average life - radioactive series.
- 5.2. Artificial radioactivity: Definition – examples – preparation of transuranic elements.
- 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:

1. R.D Madan – “Modern Inorganic Chemistry” (1987), S. Chand & Co Pvt Ltd.
2. B.R. Puri & L.R. Sharma – “Principles of Inorganic Chemistry” , Shoban Lal, Nagin Chand &Co., New Delhi (2000).
3. P.L. Soni – “Text book of Inorganic Chemistry. S. Chand & Co., New Delhi (1999).
4. H.J. Arnikaar – “Essential of Nuclear Chemistry”, 4th Ed., Wiley Eastern Limited, 1986.
5. Maheshwar Sharon and Madhuri Sharon, “ Nuclear Chemistry”, Ane Books (p) Ltd, 2009.

Semester V

CORE - VIII
ORGANIC CHEMISTRY –I
UNIT – I

11UCH5408
(75 Hours)(5 hrs / week)
(15)

Stereochemistry – I

- 1.1 Stereoisomerism – Definition – classification - Optical isomerism - Optical activity – conditions for optical activity. Asymmetric centre – Chirality – Elements of symmetry - Optical activity of lactic and tartaric acids - Racemization – Resolution - Various methods of resolving a racemic mixture – Asymmetric synthesis, Walden’s inversion.
- 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

(15)

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

(15)

3.1 Heterocyclic compounds

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.

- 3.2 **Polynuclear hydrocarbons:** Naphthalene – anthracene and phenanthrene – preparation – properties and uses.

UNIT – IV

(15)

4.1 Monocarboxylic acids and Dicarboxylic acids:

Acetic acid – preparation from acetylene – properties of acetic acids and uses. Ionization of carboxylic acids – Acidity constant – Comparison of acid strengths of substituted benzoic acids – Hammett equation.

- 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 .

- 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:

1. A.K. Srivastava – “Organic Chemistry” – 1st Ed.,(2002) – New Age International Publishers, New Delhi.
2. Dr. Jagadamba Singh – “Undergraduate Organic Chemistry” UGC Curriculum Vol. I & Vol. II, Pragati Ed., (2007) – Pragati Prakashan, Meerut
3. M.K.Jain and S.C.Sharma, “Organic Chemistry for B.Sc students of Indian universities” vishal Publications.
4. P.S. Kalsi – “Stereochemistry conformation and mechanism” – 6th Ed., (2005), New Age International (P) Ltd., New Delhi.
5. Bahl and Arun Bahl – “Advanced Organic Chemistry” – 19th Ed., (2005) – Sulthan and Chand company, New Delhi.
6. Raj K. Bansal – “A Text Book of Organic Chemistry” – Revised 4th Ed., (2005) - New Age International Publishers, New Delhi.
7. I.L. Finar – “Stereochemistry and the Chemistry of Natural Products” – vol. II, 5th Ed., (2006), Dorling Kindersley (India) Pvt. Ltd.
8. Jie Jack Li, “ Name in Heterocyclic Chemistry, kay printers,2010.
9. V.K.Ahluwalia, “Terpenoids”, Ane books (p) Ltd, 2009.
10. V.K.Ahluwalia, “Alkaloids”, Ane books (p) Ltd, 2009.

SEMESTER – V

**CORE –IX
PHYSICAL CHEMISTRY-I**

**11UCH5409
(75 Hours)(5 hrs / week)**

UNIT – I

(15 hrs)

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 – C_p and C_v . Joule-Thomson effect – definition, Joule Thomson co-efficient and inversion temperature. Calculation of ΔU , ΔH , q and w for ideal gases, calculation of ΔU , ΔH , 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

(15 hrs)

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

(15 hrs)

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_2O , CO_2 , and Sulphur systems, two components system – Simple eutectic system - $Pb-Ag$, freezing mixture, compound formation with congruent melting points - $FeCl_3-H_2O$ system, compound formation with incongruent melting points - $Na_2SO_4-H_2O$ system.

UNIT – IV

(15 hrs)

Solutions of Non-Electrolytes

- 4.1. Solution of liquids in liquids – Definition, concentration units, Raoult's Law and Henry's Law, ideal and non-ideal solutions, vapour pressure of ideal solution, activity and activity co-efficients component in an ideal and non-ideal solutions, chemical potential of ideal and non-ideal solution – Gibbs – Duhem - Margules equation.
- 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

(15 hrs)

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

1. Kuriacose and Rajaram, Thermodynamics for students of Chemistry, Shoban Lal Nagin Chand & Co. Delhi, 1996 .
2. B.R. Puri, L.R. Sharma and M.S. Pathania – Principles of Physical Chemistry, Vishal Publications, Jalandhar, 2000.
3. N.Kundu and S.K.Jain, Physical Chemistry, S.Chand & Co. Ltd.1998, New Delhi.
4. Gurtu and Snehi, Advanced Physical Chemistry, Pragati Prakashan, 2002, Meerut.
5. Peter Atkins, "Physical Chemistry", New Z.A.Publishers, 8th Edn, 2009.

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 Ψ and Ψ^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 electro-magnetic 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_2O) molecules - Stretching and bending vibrations, selection rules, expression for vibration frequency, calculation of force constant - finger print 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_2O 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.
- 4.2. Transport of ions in solution – Debye-Huckel-Onsager (DHO) theory – assumption and mathematical form - Validity of DHO equation, drawbacks of DHO equation, Extension of Debye-Huckel-Onsager theory to strong electrolytes.
- 4.3. Activity of ions in solutions – Mean ionic activity and activity coefficient, ionic strength, Debye-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 ΔG , ΔH , ΔS 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:

1. C.N. Banwell, Fundamentals of Molecular Spectroscopy, 4th Edition, Tata McGraw-Hill Publishing Company Ltd, 1995.
2. Manas Chanda, Structure and Chemical bonding including molecular spectra, Tata McGraw-Hill Publishing company Ltd., 2000, New Delhi-2.
3. B.R. Puri, L.R. Sharma and M.S. Pathania, Principles of Physical Chemistry, Vishal Publications, 2005, Jalandhar.
4. N.Kundu and S.K.Jain, Physical Chemistry, S.Chand & Co. Ltd. 1998, New Delhi.
5. Gurtu and Snehi, Advanced Physical Chemistry, Pragati Prakashan, 2002, Meerut.

ORGANIC CHEMISTRY – II

(75 Hours) (5 hrs / week)

UNIT - I

(15)

- 1.1 **Phenols:** Nomenclature – preparation of phenols, properties and acidic character – comparative acidic strengths of alcohols and phenols – resonance stabilization of phenoxide ion.
- 1.2 **Reactions of phenols** – Esterification, Nitration, Sulphonation, Halogenation, Benzoylation, Acylation, coupling reaction, Kolbe reaction, Gatterman reaction, Hauben-Hoesch reaction and Reimer-Tiemann reactions.
- 1.3 **Dihydric Phenols and Naphthols:** Catechol – resorcinol and quinol - preparation and reactions. Preparation – properties – electrophilic substitution reactions of α and β - naphthols.

UNIT – II

(15)

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

(15)

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.
- 3.3 **Nucleic acids:** Structures of Nucleobases like adenine, guanine, thymine, uracil and cytosine – nucleosides and nucleotides – polynucleosides – types of nucleic acids – DNA and RNA - biological functions.

UNIT – IV

(15)

4. **Molecular rearrangements:-**

Pinacole – Pinacolone rearrangement - migratory aptitude. Beckmann, Benzidine, Hofmann, Curtius, Benzilic acid rearrangement (Sigmatropic rearrangement) Claisen, para- Claisen, Fries rearrangement, Cope rearrangement and Dienone – Phenol rearrangements.

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:

1. A.K. Srivastava – “Organic Chemistry” – 1st Ed.,(2002) – New Age International Publishers, New Delhi.
2. Morrison and Boyd – “Organic Chemistry” – 6th Ed., (1998) – Prentice Hall of India Pvt. Ltd., New Delhi.
3. Bahl and Arun Bahl – “Advanced Organic Chemistry” – 19th Ed., (2005) – Sulthan and Chand company, New Delhi.
4. Gurdeep Chatwal – “Organic Chemistry of Natural Products” – Vol. – I & Vol. II, Revised fifth ed., (2005) – Himalaya Publishing House.
5. O.P.Agarwal – “Reactions and Reagents in Organic Chemistry” – 5th Ed., (2005) – Goel Publishing House, Meerut.
6. Raj K. Bansal – “A Text Book of Organic Chemistry” – Revised 4th Ed., (2005) - New Age International Publishers, New Delhi.
7. S.P.Bhutani, “ Amino acids, Peptides & Proteins”, Ane books (p) Ltd,2010.
8. S.P.Bhutani, “Carbohydrates”, Ane books (p) Ltd,2010.
9. P.N.Mukherjee, “ A textbook of organic reaction mechanism”, Dominant publishers & Distributors (p) Ltd, 2011.

SEMESTER - VI

MAJOR BASED ELECTIVE - III

11UCH6503

INORGANIC CHEMISTRY –II

(75 Hours) (5hrs/ week)

Unit – I

(15)

Coordination chemistry:

- 1.1. Ligands – Classification, polydentate upto 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.
- 1.4. Application of coordination complex in qualitative and quantitative analysis – Detection of K^+ ions – Separation of Cu^{2+} and Cd^{2+} ions – Estimation of Ni^{2+} ions using DMG and Al^{3+} using oxine, structure of EDTA and its complexes – Applications.

Unit – II

(15)

- 2.1 Theories of coordination – Werner's, Sidgwick and Pauling theory as applied to O_h , T_d and square planar complexes. Limitations of Pauling theory, crystal field theory – splitting of d - orbitals in O_h , T_d 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

(15)

- 3.1. Chelates – Characteristics – Classification – Factors influencing the stability of metal chelates – Detection of Chelates.
- 3.2. Stability of complexes in aqueous solution – Stability and instability constants – Labile and inert complexes – Thermodynamic and kinetic stability.
- 3.3. SN_1 and SN_2 Reactions in O_h complexes – Acid hydrolysis – substitution reaction in square planar complexes.
- 3.4. Trans effect and its applications.

Unit – IV

(15)

- 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 B_{12} - Structure and function.

Unit – V

(15)

- 5.1. **Lanthanides** - Properties of lanthanides - electronic configurations - oxidation states ionic radii - lanthanide contraction – colour - magnetic properties - extraction of Uranium and Plutonium - separation of lanthanides.
- 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:

1. R.D.Madan – “ Modern Inorganic Chemistry” (1987), S.Chand & Co Pvt Ltd., New Delhi
2. B.R. Puri & L.R. Sharma – “Principles of Inorganic Chemistry” , Shoban Lal, Nagin Chand &Co., New Delhi (2000).
3. P.L. Soni – “ Text book of Inorganic Chemistry. S. Chand & Co ., New Delhi (1999).

Semester I

CORE -II

PRACTICAL-I

11UCH1402:1P

INORGANIC QUALITATIVE ANALYSIS-I

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.

Semester – II

CORE -II

PRACTICAL-II

11UCH2402:2P

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 X HCl X NaOH)
2. Estimation of Hydrochloric Acid
($\text{H}_2\text{C}_2\text{O}_4$ X NaOH X HCl)
3. Estimation of Oxalic Acid
(FeSO_4 X KMnO_4 X $\text{H}_2\text{C}_2\text{O}_4$)
4. Estimation of Ferrous Sulphate
($\text{H}_2\text{C}_2\text{O}_4$ X KMnO_4 X FeSO_4)
5. Estimation of KMnO_4
($\text{K}_2\text{Cr}_2\text{O}_7$ X FAS X KMnO_4)
6. Estimation of Ferric ion (Internal Indicator)
($\text{K}_2\text{Cr}_2\text{O}_7$ X Ferric Alum)
7. Estimation of Zinc by EDTA
(MgSO_4 X EDTA X ZnSO_4)
8. Estimation of Mg by EDTA
(ZnSO_4 X EDTA X MgSO_4)
9. Estimation of Cu by Iodometry
($\text{K}_2\text{Cr}_2\text{O}_7$ X Thio X CuSO_4)
10. Estimation of Iodine
($\text{K}_2\text{Cr}_2\text{O}_7$ X Thio X I_2)

Semester-V

Core - X PRACTICAL -I

11UCH5410:1P

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. SO_4 as Barium Sulphate

Complexometric titration :

Estimation of Zn, Mg, Ca and Cu.

Semester – VI

Core – XII PRACTICAL

11UCH6412: P

ORGANIC ANALYSIS AND PREPARATION

Organic Analysis:

Acids(Mono & Di Carboxylic acids), Phenols (Mono & Dihydric 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:

Semester – V

Core – X

Practical-II

11UCH5410:2P

PHYSICAL CHEMISTRY PRACTICAL – I

1. Critical Solution temperature of Phenol Water System.
2. Determination of the strength of the electrolyte using Phenol-Water System.
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 KI_3
9. Partition coefficient of iodine between carbon tetrachloride and water

Semester – VI

Core XIII

Practical

11UCH6413:P

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 K_2SO_4 by Conductometry
5. Determination of strength of $FeSO_4$ 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 $FeSO_4$ by Potentiometry

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:**
Fuel gases – Water gas, Producer gas, L.P.G., Gobar gas and Natural gas. Fertilizers – N.P.K and mixed fertilizers.
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)

- 3.1. **Synthetic polymers** – Teflon, Alkyl and Epoxy resins, Polyesters – definitions and uses
Types of polymerization – Thermosetting and thermoplastics.
- 3.2. **Heterocyclic compounds:** Furan, thiophene, pyrrole and pyridine – Preparation and properties.
- 3.3. **Stereoisomerism:** Optical isomerism – lactic and tartaric acid – Racemic mixture and resolution – Geometrical isomerism –maleic and fumaric acid.

Unit – IV (15)

- 4.1 **Chromatography:** Principles of column, paper and thin layer chromatography.
- 4.2 **Photochemistry:** Photochemical reaction – Lambert’s law – Beer’s law – Absorbtion, Extinction Coefficient – The law of Photochemical equivalence, Quantum efficiency, Some Photochemical reactions and their quantum yeild.

- 4.3 **Phase Rule:** Phase, Component, Degree of freedom, Phase Rule – Definition. One component system – Water system.

Unit – V

(15)

- 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:

1. Bahl and Arun Bahl – “Advanced Organic Chemistry” – 19th Edition., (2005) – Sulthan and Chand company, New Delhi.
2. M.K. Jain – “Organic Chemistry” – 12th Ed., (2003) Sulthan and Chand Company, New Delhi.
3. R.D. Madan, J.S. Tiwari and G.L. Mudhara – A Textbook of First Year B.Sc. Chemistry: S.Chand and Co, 2002.
4. B.R. Puri and L.R. Sharma – Principles of Inorganic Chemistry: Shoban Lal Nagin Chand and Co., New Delhi (2000).
5. B.R. Puri, L.R. Sharma and S. Pathania – Principles of Physical Chemistry: Shoban Lal Nagin Chand and Co., New Delhi, 2001.

Semester II

ALLIED CHEMISTRY-II

11UCH2303

INORGANIC, ORGANIC AND PHYSICAL CHEMISTRY – II

(60 Hours) (5 hrs / week)

Unit – I

(12)

- 1.1. **Coordination Chemistry:** Nomenclature of mononuclear complexes – Werner, Sidgwick and Pauling's Theory. Biological role of Haemoglobin and Chlorophyll. Application of complexes in qualitative and quantitative analysis.
- 1.2. **Metallic Bond:** Electron gas, Pauling and Band Theories- Semiconductors- Intrinsic, n - and p-types.
- 1.3. **Compounds of Sulphur:** Peroxides of sulphur and sodium thiosulphate –properties and uses.

Unit – II

(12)

- 2.1 **Electron Displacement Effects-** Inductive effect – Relative strength of aliphatic acid and alkyl amines. Resonance – Condition for resonance - Consequences of resonance. Hyper conjugation – definition and examples- steric effect..
- 2.2. **Aromaticity** – Conditions – Huckel's rule - aromaticity of benzene.
- 2.3. **Substitution reactions-** Nitration, halogenation, sulfonation and alkylation of benzene.

Unit –III

(12)

- 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 sulpha diazine –Antibiotics - Structure and uses of penicillin – G and Chloromycetin.
- 3.3.**Name reactions:** Benzoin, Perkin, Cannizzaro, Claisen, Haloform, Carbylamine reactions – Biuret reaction.

Unit – IV

(12)

- 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.

- 4.3 **Colloids:** Types and Classification of colloidal systems, Lyophilic and Lyophobic Sols — Dialysis, Electro-dialysis, Ultrafiltration. Emulsion –types- preparation- emulsifier- Deemulsification. Gels-types- thixotrophy, synerisis, imbibition.

Unit – V

(12)

- 5.1 **Chemical Equilibrium:** Criteria of homogeneous and heterogeneous equilibria. Decomposition of HI and PCl_5 .
- 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:

1. R.D Madan – “Modern Inorganic Chemistry” (1987), S. Chand & Co Pvt Ltd.
2. P.L. Soni – “Text book of Inorganic Chemistry. S. Chand & Co., New Delhi (1999).
3. A.K. Srivastava – “Organic Chemistry” – 1st Ed.,(2002) – New Age International Publishers, New Delhi.
4. P.L. Soni and H.M. Chawla - “Text Book of Organic Chemistry” - 28th Ed.(1999) - Sulthan and Chand company, New Delhi.
5. B.R. Puri and L.R. Sharma – Principles of Inorganic Chemistry: Shoban Lal Nagin Chand and Co., New Delhi (2000).
6. B.R. Puri, L.R. Sharma and S. Pathania – Principles of Physical Chemistry: Shoban Lal Nagin Chand and Co., New Delhi (2000).

Semester I

Allied Chemistry Practical - I

11UCH1302:1P

VOLUMETRIC ANALYSIS

1. Estimation of Sodium Hydroxide
(Na_2CO_3 X HCl X NaOH)
2. Estimation of Hydrochloric Acid
($\text{H}_2\text{C}_2\text{O}_4$ X NaOH X HCl)
3. Estimation of Oxalic Acid
(FeSO_4 X KMnO_4 X $\text{H}_2\text{C}_2\text{O}_4$)
4. Estimation of Ferrous Sulphate
($\text{H}_2\text{C}_2\text{O}_4$ X KMnO_4 X FeSO_4)
5. Estimation of KMnO_4
($\text{K}_2\text{Cr}_2\text{O}_7$ X FAS X KMnO_4)
6. Estimation of Zn by EDTA
(MgSO_4 X EDTA X ZnSO_4)
7. Estimation of Mg by EDTA
8. Estimation of Cu by iodometry
($\text{K}_2\text{Cr}_2\text{O}_7$ X thio X CuSO_4)
9. Estimation of Iodine
($\text{K}_2\text{Cr}_2\text{O}_7$ X thio X I_2)

Semester II

Allied Chemistry Practical – II

11UCH2302 : 2P

ORGANIC ANALYSIS

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)

- 1.1 **Introduction to Computer** – History of computer – Characteristics of computers – Difference between computer and calculator - Organization of a computer – Secondary storage devices – Computer languages – Low level, high level languages – software – System and application – Applications of computer – Algorithms and flow charts.

UNIT – II (6)

- 2.1 **Operating System:** MS-DOS, simple DOS commands – MS-Windows - Components of Windows – Desktop, My Computer, Recycle Bin, Taskbar, My briefcase and Network Neighborhood – Windows Accessories – Calculator, games, Windows media player, Notepad and Imaging – Windows Explorer.

UNIT –III (6)

- 3.1 **Fundamentals of Computer Networks:** Importance – Mode of Connections – Protocol – Network Topologies – Bus, Ring and Star topologies – Network Architecture - Network components – Hubs , cables, repeaters, routers and bridges.

UNIT – IV (6)

- 4.1 **Internet and Intranet:** Type of Networks – World Wide Web – Internet Architecture – Domains – Applications of Internet – PDF files, HTML files, conversion into word file – Electronic mail – Electronic Commerce – Electronic date Interchange – Electronic payments – E-Journals – Search engines.

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:

1. Kishor Arora –“Computer Application in Chemistry” -1st Edition (2004) – Anmol Publications Pvt. Ltd.
2. Andrews Tenenbaum – “Computer Networks” – 4th Edition (2000) – Prentice-Hall of India Pvt.Ltd – New Delhi -110 001.
3. E. Balagurusamy – “Programming in ANSI C” 3rd Edition (2003) – Tata McGraw-Hill- New Delhi.

4. K.V. Raman, Computer in Chemistry I edition 2000, TMH – Hill Publishing Company Limited - New Delhi.
5. Douglas E. Corner, The internet book, PHI learning (p) Ltd, IV Edn, 2007.

SEMESTER III

NON MAJOR ELECTIVE - II

11UCH3601

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

UNIT – I (6)

- 1.1 **Food:** Definition –classification and function – Energy yielding – Body building and protective foods – functions.
- 1.2 **Nutrients:** Types of nutrients – Proteins, Carbohydrates, Fats, Minerals and Vitamins – Importance of nutrients.

UNIT – II (6)

- 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 (6)

- 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 (6)

- 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 (6)

- 5.1 **Food adulteration:** Definition – Common adulteration in food and their ill effects – Intentional and incidental adulterants – Packing hazards.
- 5.2 **Practical rules for good sanitation of food:** food laws and standards – Bureau of Indian standards – AGMARK – Consumer Protection act.

REFERENCES:

1. Dr.M. Swaminathan –“Handbook of food and Nutrition” 5th edition (2007), Bangalore printing and publishing Co Ltd., Bangalore.
2. B. Srilakshmi – “Food Science” – 3rd edition, (2005) New Age international (P) Ltd. – New Delhi.
3. Jayashree Ghose – “Fundamental concepts of applied chemistry” – 1st edition (2006) S. Chand and Company (P) Ltd. –New Delhi.
4. Morris B. Jacobs – “The chemical analysis of foods and food Products” – 3rd Ed.,(1993), CBS Publishers and Distributors, New Delhi.
5. K. Bagavathi Sundari – “ Applied Chemistry ” - MJP publishers, Chennai, 1st Edition 2006.
6. M.Raheena Begum, A text book of Foods,Nutrition & Dietetics, Sterling publishers, Delhi, 2010.

SEMESTER - V

SKILL BASED ELECTIVE – II

11UCH5702

CHEMISTRY IN EVERY DAY LIFE (60 Hours) (4 Hrs / Week)

UNIT-I

(12)

Perfumes and Flavours:

1.1.Perfumes:

Requirements of a good perfume – composition of perfumes, classification of perfumery materials –synthetic and semi-synthetic perfumery formulations and blending of perfumes. Basic Alcoholic Perfumery, Functional perfumery, Manufacturing and Packaging processes of Perfumes.

1.2. Flavours:

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

UNIT-II

(12)

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

(12)

Plastics and Rubber:

3.1 Plastic: Definition, classification – development of plastics – usage – Sources of plastic materials, synthetic resins, elastomers, fibres and plastics – classification of synthetic polymers – principle of polymerization – general properties of polymers – examples – hazards of plastics.

3.2 Rubber: Origin – Histroical. Classification of rubber. Natural rubber; Rubber plants, Collection of latex, Composition and properties of latex, chemical nature of rubber – vulcanization – processing – elastomers – structures – properties and uses.

UNIT-IV

(12)

Dairy Chemistry:

4.1 Milk and milk product – Composition of milk – milk lipids – chemical and physical properties – milk proteins – whey proteins – enzymes – lactose – vitamins – minerals - properties of milk – flavour – aroma density – viscosity – effect of heat on milk – milk processing – classification – pasteurization – homogenized milk – whole milk – milk powder – butter – ice cream – sweetness – stabilizers – emulsifiers.

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

UNIT-V

(12)

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:

1. Industrial chemistry by B.K.Sharma, Goel Publishing House 1995.
2. A textbook of applied chemistry by Thangammal Jacob, Mecomillan Company Ind Ltd 1979.
3. Fundamental concepts of applied chemistry by Jayashree Ghosh, First Edition (2006) S.Chand Company Ltd – New Delhi.
4. Applied Chemistry K.Bagavathi Sundari MJP publishers Chennai, First Edition 2006.

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:

Errors in Chemical Analysis – Definition – Classification of Errors –determination of errors – Minimizing errors – Precision – methods of expressing Precision. Accuracy – methods of expressing accuracy – confidence limits, rejection of results – significant figures. Mean, Median – mean deviation, standard deviation and linear regression.

UNIT – II (12)

2.1 Volumetric analysis:

Standard solution, titration, equivalence point, end point, indicators, primary and secondary standards, expressing concentrations of standard solutions – Normality, Molarity, Molality and mole fraction. Volumetric titrations – Acid base titrations – theory – strong acid Vs strong base, strong acid Vs weak base. Redox titrations – theory – Mohr salt Vs KMnO_4 , complexometric titrations – theory – EDTA titrations.

2.2 Organic estimations:

Estimation of aniline and phenols – Bromination method –Estimation of ketone-Iodination method, Estimation of Glucose – Benedict's method, determination of the Iodine value and Saponification value of an oil, RM value-definition.

UNIT – III (12)

3.1 Gravimetric analysis:

Precipitation – mechanism of precipitation, desirable properties of gravimetric precipitates – large particle size – factors affecting the particle size. Low solubility – factors affecting the solubility of precipitates – co-precipitation – post precipitation – precipitants – selective and specific precipitants - precipitation from homogeneous solution, masking and demasking agents – Digestion of the precipitate, filtration, washing and drying.

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 -

techniques – advantages. Criteria and tests for purity – melting point, boiling point, refractive index – definition – determination.

UNIT – V

(12)

5.1 Chromatography:

Introduction – classifications – Partition, adsorption, ion exchange and exclusion. Electrophoresis – principles, types, working and applications. Column chromatography, Thin layer chromatography and Paper chromatography - principles, techniques, and applications.

REFERENCES:

1. R. Gopalan, P.S. Subramanian, K. Rangarajan – “Elements of Analytical Chemistry”, Sultan Chand & Sons, 1995.
2. B.K. Sharma - “Instrumental methods of Analysis”,(2000), Geol Publications.
3. H. Kaur – “Instrumental methods of Chemical Analysis”, Pragathi prakasan Publications(1987), Meerut.
4. Puri, Sharma, Kalia – “Principles of Inorganic Chemistry” — Shoban lal Nagin Chand & Co.2000.
5. S.M. Khopkar, “Basic concept of Analytical Chemistry”(1998) Wiley Eastern Ltd.,
6. S.C. Datta & Namita K.Johar-Under graduate chemistry, Vol.I, Ane books (p) Ltd,2011.

Semester VI

SKILL BASED ELECTIVE – III

11UCH6703

INDUSTRIAL CHEMISTRY (60 Hours) (4 Hrs / Week)

UNIT – I

(12)

- 1.1 **Glass and Ceramics :** Glass – General properties of glass – types of glasses – manufacture of glass – Ceramics – classification – clay products – white wares – chemical store wares – plasticity of clay – manufacture of white pottery, glazing, Earthen wares.
- 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)

- 2.1 **Paints and varnishes :** Paint – definition – classification of paints based on their applications – constituents – Requisites of a good paint – emulsion paints. Varnishes - Definition – constituents of varnish – characteristics of a good varnish – uses – Japan varnish . Enamel – definition – Types – Ingredients and uses.
- 2.2 **Pigments :** Definition – composition, characteristics and uses of white lead, Zinc oxide, Lithopone and TiO_2 – Blue pigments – Ultra marine blue – characteristics – uses. Red pigments – red lead – characteristics and uses. Green pigments – chrome green, Guigwet's green and chromium oxide – characteristics and their uses.

UNIT-III

(12)

- 3.1. **Soap and Detergents :** Soap - Definition – General consideration in soap making – manufacture of soap – Hot and Cold process - transparent soaps – properties. Detergents - Definition – classification of face active agents – anionic detergents - cationic detergents – properties of detergents – Health hazards.
- 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

(12)

4.1 Portland Cement:

Introduction – types of cements – High alumina cement, Pozzolona cement, Portland cement- manufacture and quantitative requirements, Setting of Cement and uses.

4.2 Pulp and Paper:

Introduction – manufacture of pulp – mechanical process – chemical process – sulphate, sulphite, soda, rag pulp. Beating, Refining, filling, sizing and colouring, manufacture of paper, types of paper and uses.

UNIT – V

(12)

5.1 Corrosion:

Introduction – Dry and Wet Corrosion – Electrochemical theory of Corrosion – Mechanism – Galvanic corrosion, Concentration cell corrosion Waterline Attack – Pitting – passivity – stress corrosion - Corrosion control methods..

5.2 Batteries:

Fundamentals of Batteries – Classification of Batteries – Sizes of Batteries – Primary Batteries – Le'clanche dry cell – Magnesium dry cell – Secondary batteries –Lead acid battery – Alkaline Storage Batteries. Fuel cells (hydrogen – oxygen)

REFERENCES:

1. J.C. Kuriacose, J.Rajaram – “Chemistry in Engineering and Technology –Vol – 2. Tata McGraw-Hill Publishing Company Limited – New Delhi – 1979.
2. P.C.Jain & Monika Jain – “Engineering Chemistry”, 15th Ed., (2005), Dhanpath Rai Publishing Company, New Delhi.
3. B.K. Sharma – “Industrial Chemistry”, 1st Ed., (1984), Goel Publishing House – Meerut.
4. P.L. Soni, H.M. Chawla – “Text Book of Organic Chemistry”, (1994), Sultan Chand & Sons, New Delhi.
5. Arun Bahl and B.S. Bahl – “Text Book of Organic Chemistry”, 11th and 18th Ed., (2006), S. Chand, New Delhi.
6. Krishnamoorthy, P. Vallinayakan & K. Jaya Subramanian – “Applied Chemistry”, 2nd Ed., (1999, 2001), Tata MaGraw –Hill Publishing Co. Ltd., New Delhi.

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