B.Sc Chemistry

Syllabus

(with effect from June 2015)

DEPARTMENT OF CHEMISTRY
The Gandhigram Rural Institute – Deemed University
Gandhigram – 624 302 Tamil Nadu

Semester-wise Credit Distribution for B. Sc. Chemistry-2015

Course code	Title of the Course	Credits	Hours		Max marks		
			Theory	Practical	CFA	ESE	Total
FIRST SEMESTER							
15TAMU0101 / 15HIDU0101 / 15MALU0101/ 15FREU0101	Tamil/Hindi/ Malayalam/ French	3	3	-	40	60	100
15ENGU01X1	English	3	3	-	40	60	100
15CHEU0101	Basics of Chemistry - I	3	3	-	40	60	100
15CHEU0102	Inorganic Qualitative Analysis-Practical I	1	-	3	60	40	100
15MATU01A1	Allied Maths-I	4	4	-	40	60	100
15NSSU0001 / 15SHSU0001 / 15FATU0001 / 15SPOU0001	NSS/Shanti Sena/Fine Arts / Sports	1	1	-	50	-	50
15YOGU0001	Yoga	1	1	-	50	-	50
15EVSU0101	Environmental Studies	3+1	3	2	40	60	100
Total		**20**	**18**	**5**			
SECOND SEMESTER							
15TAMU0202/ 15HIDU0202/ 15MALU0202/ 15FREU0202	Tamil/Hindi/ Malayalam/ French	3	3	-	40	60	100
15ENGU02X2	English	3	3	-	40	60	100
15CTAU0001 / 15CHIU0001	Core Tamil / Core Hindi	2	2	-	20	30	50
15CHEU0203	Basics of Chemistry - II	3	3	-	40	60	100
15CHEU0204	Volumetric Analysis-Practical II	1	-	3	60	40	100
15MATU02A2	Allied Maths-II	4	4	-	40	60	100
15GTPU0001	Gandhi's Life, Thought and Work	2	2	-	20	30	50
15EXNU0001	Extension Education	2	2		20	30	50
15ENGU00C1	Communication & Soft Skills	2	2	-	20	30	50
Total		**22**	**19**	**5**			

THIRD SEMESTER							
15TAMU0303/ 15HIDU0303/ 15MALU0303/ 15FREU0303	Tamil/Hindi/ Malayalam/ French	3	3	-	40	60	100
15ENGU03X3	English	3	3	-	40	60	100
15CTAU0002 / 15CHIU0002	Core Tamil / Core Hindi	2	2	-	20	30	50
15CHEU0305	Inorganic Chemistry- I	3	3	-	40	60	100
15CHEU0306	Applied Chemistry-Practical III	1	-	3	60	40	100
15PHYU03A1	Allied Physics-I	3	3	-	40	60	100
@	Allied Physics Practical-I		-	3			
15CSAU03A1	Computer Fundamentals and office automation	3+1	3	2	24+24	36+16	100
15EXNU03V1	VPP	2	-	-	50	-	50
15CHEU03F1	Extension / Field visit	-	-	2	50	-	50
Total		**21**	**17**	**10**			
FOURTH SEMESTER							
15CHEU0407	Organic Chemistry-I	3	3	-	40	60	100
15CHEU0408	Inorganic Chemistry-II	3	3	-	40	60	100
15CHEU0409	Physical Chemistry-I	3	3	-	40	60	100
15CHEU0410	Inorganic Quantitative Analysis-Practical IV	2	-	5	60	40	100
15PHYU04A2	Allied Physics-II	3	3	-	40	60	100
@15PHYU04A3	Allied Physics Practical-II	2	-	3	60	40	100
15CHEU04EX	Major Elective	3	3	-	40	60	100
	Non Major Elective	3	3	-	40	60	100
15CHEU04F2	Extension / Field visit	-	-	2	-	-	-
Total		**22**	**18**	**10**			
FIFTH SEMESTER							
15CHEU0511	Inorganic Chemistry-III	4	4	-	40	60	100
15CHEU0512	Organic Chemistry - II	4	4	-	40	60	100
15CHEU0513	Physical Chemistry - II	4	4	-	40	60	100
15CHEU0514	Organic Qualitative Analysis - Practical - V	2	-	5	60	40	100
15CHEU05EX	Major Elective	3	3		40	60	100

15CHEU05SX	Skill based Elective	2	2	-	50	-	50
	Non Major Elective	3	3	-	40	60	100
15CHEU05F3	Extension / Field Visit	-	-	2	50	-	50
Total		**22**	**20**	**7**			
SIXTH SEMESTER							
15CHEU0616	Organic chemistry –III	4	4	-	40	60	100
15CHEU0617	Physical Chemistry- III	4	4	-	40	60	100
15CHEU0618	Analytical Chemistry	4	4	-	40	60	100
15CHEU0619	Physical Chemistry - Practical	2	-	5	60	40	100
15CHEU06MX	Modular Course	2	2	-	50	-	50
15CHEU06MY	Modular Course	2	2	-	50	-	50
15CHEU0620	Project	4	-	8	40	40+20*	100
Total		**22**	**16**	**13**			
Grand Total		**129**	**108**				

* 40 for external evaluation and 20 for concurrent Viva-Voce evaluation.

@ evaluation at the end of semester IV

LIST OF MAJOR ELECTIVE COURSES OFFERED

Course code	Course Title	Credit
15CHEU04E1	Environmental Chemistry	3
15CHEU04E2	Industrial Chemistry	3
15CHEU04E3	Elements of Spectroscopy	3
15CHEU05E1	Chemistry of Natural Products	3
15CHEU05E2	Polymer Chemistry	3

NON-MAJOR ELECTIVES OFFERED

Course code	Course Title	Credit
15CHEU04N1	Polymer Science	3
15CHEU04N2	Organic Chemistry for Home Science	3
15CHEU04N3	Chemistry in the Service of Mankind	3
15CHEU05N1	Pollution and its Control Measures	3
15CHEU05N2	Chemistry of Food	3

SKILL BASED ELECTIVES OFFERED

Course code	Course Title	Credit
15CHEU05S1	Clinical Chemistry	2
15CHEU05S2	Forensic Science	2
15CHEU05S3	Pharmaceutical Chemistry	2

MODULAR COURSES OFFERED (Any two)

Course code	Course Title	Credit
15CHEU06M1	Cosmetic Chemistry	2
15CHEU06M2	Nanoscience and its Applications	2
15CHEU06M3	Agricultural chemistry	2
15CHEU06M4	Water Quality Analysis	2

B.Sc. CHEMISTRY (I SEMESTER)

15CHEU0101 BASICS OF CHEMISTRY – I (3 Credit)

Objectives: *The objective of the course is to develop an understanding of both structure and chemical bonding of inorganic compounds, behavior of gases, solutions and the chemistry of alkane, alkenes and alkynes.*

Specific learning outcomes: *After successful completion of the course, students will be able to*

- *Describe atomic structure, orbital concepts, chemical bonding and their properties in inorganic molecules.*
- *Appreciate the concept of hybridization, behavior of gases, solutions, laws associated with them,*
- *Evaluate the mechanism of halogenations, Baeyer's angle strain theory, conformation of alkane and cyclohexane.*
- *Describe the chemistry of unsaturated organic molecules like alkenes and alkynes.*

Unit I - Atomic Structure

Rutherford atomic model – Bohr theory of hydrogen atom – Sommerfeld theory - Particle and wave character of electrons – de Broglie's equation – Davisson-Germer experiment - Heisenberg's uncertainty principle Compton effect – Schrödinger wave equation – Eigen values and Eigen functions – quantum numbers – Pauli's exclusion principle –Orbits and Orbitals.

Unit II - Chemical Bonding

Types of bonds – ionic, covalent, coordinate and metallic bonds - condition for the bond formation - concept of hybridization – hybridization involving s-, p- and d-orbital – properties of ionic, covalent and coordinate compounds – valence bond theory –VSEPR theory.

Molecular orbital theory – molecular orbital configurations of simple homo nuclear and hetero nuclear diatomic molecules – comparison between VBT and MOT – basic concept of resonance.

Unit III - Gaseous State and Solutions

Kinetic theory of gases – Maxwell's distribution of molecular velocities (derivation omitted) – collision diameter – collision number, collision frequency – mean free path – real and ideal gases – van der Waal's equation.

Various units of expressing concentrations of solutions – solutions of liquid in liquids – ideal and non-ideal solutions – Raoult's law – vapour pressure of non-ideal solutions – vapor pressure composition and boiling point composition curves – fractional distillation of binary liquid solutions – steam distillation – solutions of gases in liquid.

Unit IV - Alkanes

Conformation of ethane , propane and butane - mechanism of halogenation - orientation of halogenation - relative stabilities of alkane towards halogenation - stabilities of free radicals - ease of formation of free radicals - transition state - orientation and stability - reactivity and selectivity - non- rearrangement of free radicals.

Cycloalkanes - Baeyer's strain theory, heats of combustion and relative stability of cycloalkanes, orbital structure of angle strain - factors affecting stability of conformation, conformation of cyclohexane - equatorial and axial bonds- mono and dimethyl cyclohexane.

Unit V - Alkenes and Alkynes

Elementary idea of cis-trans isomerism – E, Z nomenclature, preparation of alkenes involving dehydrohalogenation, dehydration, dehalogenation and reduction of acetylene, elimination reactions - Saytzeff''s rule (Mechanism of E_1 and E_2 omitted) - reactions of alkenes - addition of halogens, HX, Markovnikov's rule, peroxide effect, addition of H_2O, hypohalous acid, hydroxylation with H_2O_2, alkaline $KMnO_4$, hydroboration, oxidation, ozonolysis, allylic substitution.

Dienes-stability of isolated and conjugated double bonds - 1,2 and 1,4-addition - Diels-Alder reaction.

Alkynes: Acidity of alkynes.

References

1. Principles of Physical Chemistry, B. R. Puri, L.R. Sharma and M. S. Pathania, Vishal Publishing Co., 46th Ed., 2013.
2. Modern Inorganic Chemistry, R. D. Madhan and Sathya Prakash, 4th Ed., 1996.
3. A New Concise Inorganic Chemistry, J. D. Lee, ELBS 5th Ed., 2002.
4. Organic Chemistry R. T. Morrison and R. N. Boyd., Prentice Hall of India Pvt. Ltd., New Delhi, 7th Ed., 2011.

B.Sc. CHEMISTRY (I SEMESTER)

PRACTICAL - I

15CHEU0102 INORGANIC QUALITATIVE ANALYSIS (1 credit)

Objectives: *The practical course is designed to develop skill in semi-micro inorganic analysis.*

Specific learning outcomes: *After successful completion of the course, students will be able to*

- *Analyze inorganic salts qualitatively and systematically eliminate interfering radicals*
- *Identify elements in a given inorganic mixture by semi-micro qualitative analysis.*

Semi-micro qualitative analysis of inorganic mixtures containing two of the following cations and one of the interfering acid radicals and a simple acid radical.

Cations: Pb, Bi, Cu, Sn, Fe, Al, Cr, Ni, Co, Zn, Mn, Ca, Ba, Sr, Mg and NH_4^+.

Anions: Acetate, oxalate, tartarate, borate, chromate, chloride, iodide, bromide, nitrate, carbonate, sulphide, sulphate and phosphate.

References

1. Practical Chemistry by A.O. Thomas, Scientific Book Centre, Cannanore, 2003.
2. Basic Principles of Practical Chemistry, V. Venkateswaran, R. Veeraswamy, A. R. Kulandaivelu, Sultan Chand & Sons, New Delhi, 2nd Ed., 2004.

B.Sc. CHEMISTRY (II SEMESTER)

15CHEU0203 BASICS OF CHEMISTRY - II (3 Credit)

***Objectives**: The objective of the course is to understand the basics of organic reactions, to know the chemistry of benzenes and arenes, to know the basic principles of metallurgy, to understand the chemistry of s-block elements, to know solid state and concept of conductor.*

***Specific learning outcomes:** After successful completion of the course, students will be able to*

- *Predict the reactive intermediates in a particular organic reaction*
- *Describe the types of reagents in organic reactions*
- *Predict the product of the electrophilic aromatic substitution and nuclear substitution reactions.*
- *Describe various metallurgical processes*
- *Justify the general and anomalous properties of s- block elements*
- *Differentiate crystalline and amorphous solids and describe the types of solids, symmetry elements, unit cell, powder-X-ray diffraction method and the concept of conductors.*

Unit I - Basics of Organic Reactions

Homolytic and heterolytic bond fissions - types of reagents - electrophiles and nucleophiles - types of organic reactions, addition, elimination, substitution, rearrangement, oxidation, reduction, polymerization - energy consideration - reaction intermediates - elementary idea of carbocations, carbanions, free radicals and carbene intermediates - elementary idea of inductive, mesomeric, hyper conjugation and steric effect.

Unit II - Benzene and Arenes

Aromaticity- Huckel's rule- nomenclature of benzene derivatives-structure of benzene – Electrophilic aromatic substitution reactions -mechanism of halogenation, sulphonation, and nitration - Friedel-Crafts alkylation and Friedel-Crafts acylation. Theory of orientation – classification of substituent groups – effect of substituent groups.

Arenes - side-chain and nuclear substitution reactions - orientation and reactivity -alkenyl benzenes - addition to conjugated alkenyl benzenes – orientation.

Unit III - Process of Metallurgy

Definition for minerals and ores - ore dressing – gravityseparation - froth flotation-magnetic separation - chemical separation- calcination and roasting.

Extraction of metal-chemical reduction-auto reduction-electrolytic reduction-metal displacement. Refining methods - distillation - fractional crystallization - van Arkel method - electrolytic refining - vapour phase refining-ion exchange method-muffle furnace.

Unit IV - s-Block Elements

General characteristics - anomalous behaviour of lithium and beryllium - diagonal relationships of lithium with magnesium and beryllium with aluminium.

Preparation, properties and uses of lithium hydride, sodium peroxide, potassium iodide, calcium-carbide, super phosphate of lime, Plaster of Paris and lithopone.

Unit V - Solid State

Differences between crystalline and amorphous solids -symmetry in crystal systems -law of interfacial angles -law of rational indices - Miller indices - space lattice and unit cell- Bravis lattices-Bragg's equation - powder method.

Packing in crystals - types of crystals - structure of sodium chloride - concept of conductor, semiconductor and superconductor- band theory.

References

1. A New Concise Inorganic Chemistry, J. D. Lee, ELBS 5th Ed., 2002.
2. Text book of Inorganic Chemistry, P. L. Soni, Sultan Chand & Sons, New Delhi, 20th Edn., 2000.
3. Organic Chemistry R. T. Morrison and R. N. Boyd., Prentice Hall of India Pvt. Ltd., New Delhi, 7th Edn., 2011.
4. Principles of Physical Chemistry, B.R. Puri, L.R. Sharma and M.S. Pathania Shobanlal Nagin Chand & Co., Jalendhar 41th Edn., 2001.
5. Selected Topics in Inorganic Chemistry, Malik, Tuli, Madan, S. Chand & Co., New Delhi, 2006.

B.Sc. CHEMISTRY (II SEMESTER)

PRACTICAL - II

15CHEU0204 VOLUMETRIC ANALYSIS (1 credit)

Objectives: *The practical course is designed to understand basics and gain knowledge on laboratory reagents and their uses in volumetric analysis.*

Specific learning outcomes: *After successful completion of the course, students will be able to*

- *Prepare standard solutions*
- *Carry out quantitative estimation of inorganic substances*

1 Preparation of standard solutions
2 Acidimetry -alkalimetry
3 Permanganometry
4 Redox titrations involving dichrometry
5 Complexometry titration
6 Iodometry
7 Iodimetry
8 Precipitation titration.
9 Estimation of ferrous iron by external indicator.
10 Estimation of ferric iron by reduction method.

References

1. Practical Chemistry by A.O. Thomas, Scientific Book Centre, Cannanore, 2003.
2. Basic Principles of Practical Chemistry, V. Venkateswaran, R. Veeraswamy, A. R. Kulandaivelu, Sultan Chand & Sons, New Delhi, 2nd Edn., 2004.

B.Sc. CHEMISTRY (III SEMESTER)

15CHEU0305 INORGANIC CHEMISTRY - I (3 credit)

Objectives*: The objective of the course is to understand the chemistry of p-block elements, to know the chemistry of halogens and inert gases and to understand radioactivity, transmutation, nuclear reactions and the applications of isotopes.*

Specific learning outcomes: *After successful completion of the course, the students will able to*

- *Describe general characteristics, preparation of derivatives and structure of p-block elements, interhalogen compounds and inert gases.*
- *Explain the chemistry of radioactivity, types of nuclear reactions and application of isotopes in chemistry, agriculture and in medicine.*

Unit I - p-Block Elements I

General characteristics of elements-diagonal relationship of boron with silicon. Preparation, properties and structure of orthoboric acid, borax and diborane-Borax bead test.

Alums- zeolites–ultramarines-china clay – mica- aluminium mordants.

Classification of carbides. Preparation, structure and uses of silicones-classification and structure of silicates. Relative strengths of boron trihalides as Lewis acids.

Unit II - p-Block Elements II

Preparation, properties and structure of nitrogen dioxide, nitric acid, phosphorous pentoxide, orthophosphoric acid and ozone.

Nomenclature and structure of oxyacids of phosphorus and sulphur. Chemistry of sulphur dioxide, arsenious oxide and selenium dioxide.

Unit III - Halogens and Inert Gases

General characteristics, comparison of oxidizing action of halogens. Nomenclature and structure of oxy acids of halogens. Preparation, properties and structure of interhalogen compounds. Inert gas-position in the periodic table-electronic configuration and reactivity-chemistry of xenon hexafluoride, xenon oxyfluoride and xenon trioxide.

Unit IV - Nuclear Chemistry - I

Radioactivity- types of radioactivity- types of radioactive rays -nuclear stability-n/p ratio - magic numbers- nuclear binding energy- mass defect- nuclear shell model - groups displacement law - decay constant - half life period - radioactive equilibrium- transmutation-artificial transmutation- applications of artificial transmutation-radioactive series.

Unit V - Nuclear Chemistry - II

Nuclear reactions types: fission and fusion reactions-principle and working of nuclear reactors.

Isotopes: Separation of isotopes- identification of isotopes- isotopes of hydrogen-isotope effect- application of isotopes in chemistry, agriculture and medicine - carbon dating - nuclear isomerism.

References

1. A New Concise Inorganic Chemistry, J.D.Lee, ELBS 5th Edn., 2002.
2. Text book of Inorganic Chemistry, P.L. Soni, Sultan Chand & Sons, New Delhi, 20th Edn., 2000.

B.Sc. CHEMISTRY (III SEMESTER)

PRACTICAL III

15CHEU0302 APPLIED CHEMISTRY (1 Credit)

Objectives: *The objective of the practical course is to enhance knowledge in basic principles of titrimetry, to develop skill in titrimetric analysis, to gain practical knowledge in oil analysis and to develop skill in identification of water quality parameters.*

Learning outcome*: After successful completion of the course, students will be able to gain experience in estimation of compounds by titrimetric method, able to identify free fatty acid, saponification value, iodine value of oil and water quality parameters.*

Specific learning outcomes: *After successful completion of the course, students will be able to*

- *Estimate certain organic compounds by titrimetry*
- *Analyze free fatty acids*
- *Calculate saponification value and iodine value*
- *Estimate water quality parameters*

1. Estimation of Phenol.
2. Estimation of Glucose (Fehling's method).
3. Estimation of Glucose (Bertrand's method).
4. Determination of iodine value of oil.
5. Determination of saponification value.
6. Determination of free fatty acid.
7. Estimation of total solids in H_2O.
8. Estimation of chloride in H_2O.
9. Estimation of fluoride in H_2O.
10. Alloy analysis.

Reference

1. Basic Principles of Practical Chemistry, V. Venkateswaran, R. Veeraswamy, A. R. Kulandaivelu, Sultan Chand & Sons, New Delhi, 2nd Edn., 2004.

B.Sc. CHEMISTRY (IV SEMESTER)

15CHEU0407 ORGANIC CHEMISTRY - I (3 Credit)

Objectives: *The objective of the course is to understand the chemistry of organic molecules based on the spatial orientation of constituent atoms or groups, to understand the chemistry of organo-halogen compounds, to know the chemistry of alcohols, ethers and epoxides, to understand the chemistry of carbonyl compounds and to understand the chemistry of polynuclear aromatic compounds and active methylene compounds.*

Specific learning outcomes: *After successful completion of the course, the students will able to*

- *Describe commonly used terms in stereochemistry*
- *Predict the configuration of a chiral organic molecule*
- *Demonstrate the detailed mechanism and stereochemistry of S_N1, S_N2, E1 and E2 reactions, electrophilic substitution and nucleophilic displacement reactions*
- *Describe the methods of preparation of alcohols, aldehydes and ketones*
- *Demonstrate the reactions of aldehydes, ketones and polynuclear aromatic compounds.*

Unit I – Stereochemistry

Optical isomerism- Optical activity, specific rotation, definition of optical isomerism – elements of symmetry, chirality, optical isomerism of compounds containing asymmetric carbon atoms – lactic and tartaric acids – enantiomers and diastereoisomers – racemic mixtures –Walden inversion – asymmetric synthesis – absolute configuration by R/S – notation, optical activity of compounds without asymmetric carbon atoms – allenes, spiranes and biphenyl compounds.

Unit II – Alkyl and Aryl Halides

Mechanism and stereochemistry of S_N1, S_N2 and E1 and E2 reactions (detailed study included).

Electrophilic aromatic substitution in aryl halides– nucleophilic displacement.

Unit III – Alcohols and Ethers

Preparation –Oxymercuration and demercuration – Hydroboration and Oxidation – orientation, stereochemistry and mechanism of hydroboration –Grignard synthesis of alcohols.

Glycols – per-iodic acid oxidation.

Ethers- Williamson's synthesis – preparation of substituted ethers.

Epoxides: Preparation – acid and base catalyzed cleavage of epoxides.

Unit IV – Aldehydes and Ketones

Nomenclature, preparation, reactions of – nucleophilic addition reactions, reduction, Cannizarro reaction – acidity of α-hydrogen-reactions involving carbanions, base promoted and acid catalysed halogenation of ketones – aldol condensation, crossed aldol condensation, Claisen condensation, Perkin condensation and Knoevenagal reaction.

Unit V – Polynuclear Aromatic Compounds and Active Methylene Compounds

Naphthalene – anthracene, phenanthrene – reduction and substitution reactions – Haworth's synthesis –Aromatization, orientation in polynuclear compounds.

Synthetic uses of acetoacetic ester – decarboxylation of keto acids, Keto–enol tautomerism. Preparation and synthetic uses of malonic ester.

References

1. Organic Chemistry R. T. Morrison and R. N. Boyd., Prentice Hall of India Pvt. Ltd., New Delhi, 7th Edn., 2011.
2. Organic Chemistry, I.L. Finar, ELBS, Vol1. 6th Edn., 2002 (for Unit III only)

B.Sc. CHEMISTRY (IV SEMESTER)

15CHEU0408 INORGANIC CHEMISTRY II (3 Credit)

Objectives: *The objective of the course is to understand the basic concepts of acids and bases, classification of solvents and their reactions, to learn the general characteristics of d- and f-block elements, to realize the chemistry of metal carbonyls and to gain knowledge of the functions of metal ions in biological systems.*

Specific learning outcomes: *After successful completion of the course, the students will able to*

- *Describe basic concepts of acids and bases*
- *Classify solvents and demonstrate reactions in non-aqueous solvents*
- *Predict the properties of d- and f-block elements*
- *Demonstrate the preparation and properties of few d- and f- block elements*
- *Classify and demonstrate the methods of preparation of organometallic compounds*
- *Describe the role of metals in biological systems such as enzymes and demonstrate the metal toxicity.*

Unit I - Acids and Bases

Lewis concept – Classification of Lewis acids – Lux-Flood concept – Hard-Soft acid base concept and its applications. Non- aqueous solvents- Classification of solvents- Neutralization reaction and solvolysis in liquid ammonia- Metal- ammonia solutions. Neutralisation, solvolysis and redox reactions in liquid sulphur dioxide.

Unit II - d-Block elements

General characteristics- electronic configuration, metallic character, ionization energy, variable valency, reducing property, colour, magnetic property, non-stoichiometric compounds, catalytic properties and tendency to form complexes. Preparation, properties and uses of potassium dichromate, potassium permanganate and manganese dioxide. Anamalous behaviour of mercury. Stability of oxidation states using standard electrode potential.

Unit III - f- Block elements

General characteristics- electronic configuration- oxidation states- colour and magnetic properties. Lanthanide and actinide contraction and their consequences. Separation methods- fractional crystallization, oxidation- reduction, ion-exchange method and chromatographic separation. Comparison between d-and f-block elements- uses of lanthanide compounds.

Unit IV - Organometallic Compounds

Metal carbonyls- definition and classification- General methods of preparation- effective atomic number rule- structure and bonding of mononuclear carbonyls of nickel, iron and chromium, binuclear carbonyls of iron, cobalt and manganese and trinuclear carbonyls of iron and osmium. Tetra nuclear carbonyls of iridium. Zeigler-Natta catalyst.

Unit V - Bio Inorganic Chemistry

Metals in biology-bulk and trace metals-biological role of Myoglobin and hemoglobin-Metallo enzymes- carboxy peptidase and peroxidase-sodium and potassium ion pump- Biological functions and toxicity of chromium, manganese, cobalt, nickel, copper, arsenic, iodine and mercury. Nitrogen fixation-methods.

References

1. Concise Inorganic Chemistry 4th Ed., J. D. Lee, Chapmen & Hall, London, 1992.
2. Text Book of Inorganic Chemistry, P. L. Soni, Sultan Chand & Sons, New Delhi, 1996.
3. Selected topics in Inorganic Chemistry, W. U. Malik, G. D. Tuli and R. D. Madan, S. Chand & Co. Ltd., New Delhi, 2012.

B.Sc. CHEMISTRY (III SEMESTER)

15CHEU03A1 ALLIED CHEMISTRY - I (3 Credit)

Objectives*: The objective of the course is to understand the structure and bonding of molecules, to have knowledge in crystal structures and their symmetry, to know basics of solutions and their properties, and to understand the chemistry of oxides.*

Specific learning outcomes: *After successful completion of the course, students will be able to*

- *Describe basic concepts in chemical bonding*
- *Assign the structure of simple chemical molecules*
- *Interpret the types of crystal and symmetries present in molecules.*
- *Describe the terms used in dilute solutions*
- *Describe the basics of nuclear chemistry and functions of nuclear reactors*
- *Identify the crystal structures of semiconductors.*

Unit I - Chemical Bonding

Ionic bond, characteristics of ionic compounds, inert pair effect; Fajan's rule, covalent bond. The Octet rule - characteristics of covalent compounds, coordinate bond -characteristics of coordinate complexes - basic concepts of hydrogen bond. Sigma and pi-bonds. Concept of hybridization, structures of BeH_2, BCl_3, CH_4, PCl_5, and SF_6 - VSEPR Theory.

Unit II - Solid State

Types of solids, symmetry of crystals, Miller Indices, unit cell, space lattice, Bragg's equation, classification of crystals on the basis of bonds, ionic crystals, molecular crystals, covalent crystals and metallic crystals. Structure of CsCl and NaCl, concept of liquid crystals.

Unit III - Dilute Solutions

Ways of expressing concentrations of solutions, solutions of gases in liquids, Henry's law, solutions of solids in liquids, solubility and equilibrium concept. Colligative properties, definition, measurement of lowering of vapour pressure, elevation of boiling point, depression of freezing point and osmotic pressure, Raoult's law- derivation.

Unit IV - Nuclear Chemistry and Radioactivity

Types and properties of radiations, the group displacement law, rate of radioactive decay, half-life period, nuclear fission and fusion reactions, artificial radioactivity, mass defect- n-p ratio and nuclear stability, nuclear reactor.

Unit V – Semiconductors

Synthesis and crystal structures of TiO_2, ZnO, SnO_2, Properties of semiconductors, valence band, conduction band, band gap calculation, photon absorption by semiconductor. Organic semiconductors: antharacene, perylene, phthalocyanine, graphene.

References

1. Text book of Inorganic Chemistry, P.L. Soni, Sultan Chand & Sons, New Delhi, 20th Ed., 2000.
2. Essentials of Physical Chemistry, B. S. Bahl, G. D. Tuli and Arun Bahl, S. Chand & Company Ltd, New Delhi, 12th Ed., 2011.

B.Sc. ALLIED CHEMISTRY (III SEMESTER)
ALLIED CHEMISTRY PRACTICAL - I
15CHEU03A2 INORGANIC QUALITATIVE ANALYSIS (1 credit)

Objectives: *The practical course is designed to develop skills in identification of elements by semi-micro inorganic qualitative analysis.*

Specific learning outcomes: *After successful completion of the course, students will be able to*

- *Analyze inorganic salts qualitatively and identify cations and anions present in a given unknown mixture of salts.*

Semi-micro qualitative analysis of inorganic salts containing the following cations and anions.

Cations: Pb, Cu, Al, Fe, Zn, Mn, Ca, Ba, Mg and ammonium.
Anions: Oxalate, Borate, Acetate, Fluoride, Chromate and Phosphate.

References

1. Practical Chemistry by A.O. Thomas, Scientific Book Centre, Cannanore, 2003.
2. Basic Principles of Practical Chemistry, V. Venkateswaran, R. Veeraswamy, A. R. Kulandaivelu, Sultan Chand & Sons, New Delhi, 2nd Ed., 2004.

B.Sc. CHEMISTRY (IV SEMESTER)
15CHU0409 Physical Chemistry – I (3 credit)

Objectives: *The objective of the course is to understand basic principles, applications of thermodynamics, to understand basics of surface chemistry and surface phenomena, to impart the knowledge of basic interactions between molecules and to gain familiarity of the forces existing in molecular systems.*

Specific learning outcomes: *After successful completion of the course, the students will able to*

- *Solve problems in thermodynamics and describe the concepts of thermochemistry*
- *Interpret the concepts and theories of surface chemistry*
- *Analyze surfaces using BET theory*
- *Describe the interactions between molecules.*

Unit I - Thermodynamics-I and Thermochemistry

Objectives – terminology – types of systems - state variables - thermodynamic equilibrium - extensive and intensive properties - types of process - first law of thermodynamics – statements of internal energy – enthalpy - heat capacity - relation between Cp and Cv - expansion of ideal gas – isothermal expansion - reversible and irreversible adiabatic expansion – Joule-Thomson effect and Joule-Thomson coefficient. Heat changes in chemical reactions - enthalpy of formation - enthalpy of composition - enthalpy of solution - enthalpy of dilution - enthalpy of neutralization - relation between enthalpy of a reaction at constant volume and at constant pressure - Kirchhoff equation - bond energies.

Unit II - Thermodynamics – II

Limitations of first law - spontaneous and cyclic process – irreversible processes – Carnotcycle – the second law of thermodynamics – efficiency of heat engine – Carnot's theorem – concept of entropy – entropy changes in isothermal expansion of ideal gas – entropy changes in reversible and irreversible processes. Statement of second law in terms of entropy changes – physical significance of entropy – Gibbs–Helmholtz free energies and equations – partial molar properties – chemical potential - Clausius–Clapeyron equation.

Unit III - Chemical Equilibrium and Colligative Properties

Law of mass action –equilibrium constant K, K_p and K_c, relation between K_p and K_c – LeChatelior principle and its application to $N_2 + 3H_2 \rightarrow 2NH_3$ system. Colligative properties – definition – measurement of lowering of vapour pressure – elevation of boiling point – depression of freezing point – osmotic pressure – reverse osmosis.

Unit IV- Surface Chemistry

Physisorption – chemisorption – Fruendlich and Langmuir adsorption isotherms – BET theory multilayer adsorption – BET equation (derivation omitted) – determination of surface using BET theory – Adsorption from solution - Gibbs adsorption isotherm - applications of adsorption.

Unit V - Molecular Interactions

Electric properties of molecules – electric dipole moments – polarizabilities – relative permittivities – refractive index. Interaction between molecules – interaction between dipoles – repulsive and total interactions – molecular interaction in gases and liquids – hydrophilic and hydrophobic effects.

References

1. Principles of Physical Chemistry, B.R. Puri, L.R. Sharma and M.S. Pathania, Shoban lal Nagin Chand and Co. Jalendhar 41st Edn., 2001.
2. Physical Chemistry, Peter Atkins and Julio de Paula, Oxford University Press, 9th Edn., 2011.
3. Essentials of Physical Chemistry, B. S. Bahl, G. D. Tuli and Arun Bahl, S. Chand & Co. Ltd, New Delhi, 12th Edn., 2011.
4. A Text Book of Physical Chemistry, A.S. Nagi and S.C. Anand, Wiley Eastern Ltd, New Delhi, 7th Edn., 2000.

B.Sc. ALLIED CHEMISTRY (IV SEMESTER)

15CHEU04A1 ALLIED CHEMISTRY – II (3 credit)

Objectives*: The objective of the course is to understand the nature of fuels, energy sources, to understand different types of polymers and its applications, to gain knowledge of amino acids and proteins, to know the basics of chemical kinetics and to understand the basic concepts of acids and bases.*

Specific learning outcomes: *After successful completion of the course, students will be able to*

- *Categorize fuels and energy sources*
- *Describe the types of polymerization methods as well as preparation and uses of few well-known polymers*
- *Describe the method of preparation and properties of amino acids*
- *Classify protein and demonstrate the primary and secondary structure of proteins.*
- *Solve the problems in chemical kinetics*
- *Differentiate strong and weak acids and bases*
- *Calculate the pH of a solution*

Unit I - Fuels and Energy Sources

Classification, calorific value, characteristics of a good fuel, comparison between solid, liquid and gaseous fuels. Petroleum - classification - origin - refining of crude oil - cracking - synthetic petrol -knocking. Rocket propellants- solid, liquid, gas and hybrid propellants.

Unit II - Polymer Chemistry

Introduction – nomenclature, types of polymerization - plastics - classification of resins - uses of cellulose derivatives – preparation, properties and uses of polyethylene, PVC, PVA , PVAc and Nylon -6:6, PET, PAN. Conducting polymers-doping, types of doping, conductivity and its measurement.

Unit III – Amino Acids and Proteins

Amino acids, Zwitter ion, isoelectric point, preparation methods and properties. Proteins – Peptide linkage, classification of protein, properties of proteins, colour tests, primary and secondary structure of proteins.

Unit IV – Chemical Kinetics and Catalysis

Chemical Kinetics: reaction rates - rate, order and molecularity, pseudo first order reactions, integrated rate equation for first order reaction, half-life period, determination of order of reaction, simple collision theory, effect of temperature, Arrhenius equation (derivation omitted). Catalysis: Types of catalysis - homogeneous, heterogeneous and enzyme catalysis.

Unit V – Solubility Product and Acids and Bases

Solubility and ionic equilibria, the solubility product, applications of solubility product. Acids – bases, Arrhenius, Bronsted- Lowry and Lewis concepts and relative strength of acids and bases, the pH scale, buffer scale, buffer action, Henderson equation, acid base indicators, theory of indicators.

References

1. A Text Book of Organic Chemistry, B. S. Bahl and Arun Bahl, S. Chand & Co. Ltd., New Delhi, 21st Edn., 2012.
2. Essentials of Physical Chemistry, B. S. Bahl, G. D. Tuli and Arun Bahl, S. Chand & Co. Ltd., New Delhi, 12th Edn., 2011.
3. Physics of Organic Semiconductors, Eds**:** Wolfgang Brütting, Chihaya Adachi, John Wiley & Sons, 1st Edn., 2012.
4. Fundamentals of Semiconductors: Physics and Materials Properties, Peter YU, Manuel Cardona, Springer Heidelberg Publishers, New York. 2010.

B.Sc. ALLIED CHEMISTRY (IV SEMESTER)

ALLIED CHEMISTRY PRACTICAL - II

15CHEU04A2 VOLUMETRIC ANALYSIS (1 Credit)

Objectives: *The objective of the practical course is to get expertise in the preparation of standard solutions, to understand basic principles and develop skill in titrimetric analysis.*

Specific learning outcomes: *After successful completion of the course, students will be able to*

- *Prepare standard solutions*
- *Demonstrate the principles of titrimetry*
- *Analyze titrimetric data systematically and estimate the amount of inorganic substances in a given solution.*

1. Preparation of standard solutions
2. Estimation of sodium hydroxide
3. Estimation of hydrochloric acid
4. Estimation of oxalic acid
5. Estimation of potassium dichromate
6. Estimation of ferrous ammonium sulphate
7. Estimation of Zinc
8. Estimation of available chlorine
9. Estimation of hardness of water

References

1. Practical Chemistry by A.O. Thomas, Scientific Book Centre, Cannanore, 2003.
2. Basic Principles of Practical Chemistry, V. Venkateswaran, R. Veeraswamy, A. R. Kulandaivelu, S. Chand & Sons, New Delhi, 2nd Edn., 2004.

B.Sc. CHEMISTRY (IV SEMESTER)

15 CHEU0410 INORGANIC QUANTITATIVE ANALYSIS – PRACTICAL IV (2 Credit)

Objectives*: The objective of the practical course is to understand the chemistry of inorganic quantitative analysis, to acquire skills in inorganic quantitative estimation methods, to get trained in quantitative estimation methods, and to gain knowledge in the preparation of some inorganic complexes.*

Specific learning outcomes: *After successful completion of the course, students will be able to*

- *Demonstrate the principles of inorganic quantitative estimation methods*
- *Plan and execute an experiment to prepare metal complexes and gravimetrically analyze certain metal complexes.*

1. Argentometry: Estimation of Chloride (Mohr's method)
2. Complexometry: Estimation of Zinc
3. Colorimetry:
    i) Estimation of iron (III)
    ii) Estimation of copper (II)
4. Gravimetric analysis
    i) Estimation of lead as lead chromate
    ii) Estimation of nickel as Ni-(DMG)
    iii) Estimation of aluminium as aluminium oxinate
    iv) Estimation of calcium as calcium oxalate.
    v) Estimation of barium as barium sulphate
5. Preparation
    i) Tetrammine copper(II) sulphate
    ii) Tris(ethylenediamine) nickel(II) chloride
    iii) Prussion blue
    iv) Hexamminecobalt(III) Chloride

References

1. Practical Chemistry by A.O. Thomas, Scientific Book Centre, Cannanore, 2003.
2. Basic Principles of Practical Chemistry V. Venkateswaran, R. Veeraswamy, A. R. Kulandaivelu, S. Chand & Sons, New Delhi, 2nd Edn., 2004.

B.Sc. CHEMISTRY (V SEMESTER)

15CHEU0511 INORGANIC CHEMISTRY III (4 Credit)

Objectives: *The objective of the course is to learn the basic concepts of coordination chemistry, to understand different theories and applications of coordination compounds, to understand the properties of coordination compounds and to gain knowledge in mechanical aspects of coordination compounds.*

Specific learning outcomes: *After successful completion of the course, students will be able to*

- *Describe basic concepts and theories of coordination chemistry*
- *Predict the properties of coordination compounds*
- *Demonstrate the applications of coordination compounds*
- *Predict the reaction mechanisms in coordination complexes.*
- *Determine the stability constant by Job's and Bjeruum methods*

Unit I - Introduction to Coordination Chemistry

Double salts- complex compounds- complex ion and coordination number- Ligands and their classification- chelates and their uses- coordination number and stereochemistry of complexes- IUPAC Nomenclature of coordination compounds. Isomerism: ionization, hydrate, ligand, linkage, coordination, position, geometrical and optical isomerisms.

Unit II - Theories of Coordination Compounds

Werner's theory- Sidwick's electronic interpretation- EAN concept- valence bond theory- outer and inner orbital complexes- Limitations of VBT- crystal field theory- Crystal field splitting in octahedral, tetragonal, square planar and tetrahedral complexes- High spin and Low spin complexes.

Unit III - Theories and Applications

Factors affecting crystal field splitting, John Teller distortion- Crystal field stablisation energy- calculation and uses- Limitations of crystal field theory. Applications of copper and silver complexes in qualitative analysis. Applications of Ca-EDTA and Ni-DMG complexes in quantitative analysis.

Unit IV - Properties of Complexes

Magnetic susceptibility-origin of magnetism-Dia and Para magnetism-magnetic moments-Spin only formula-Gouy's experimental method. Color of transition metal complexes-visible spectrum of aqueous Ti (III) ion. Stability of complexes-overall and stepwise formation constants-Factors affecting stability-Determination of stability constant by Job's and Bjeruum's method.

Unit V - Reaction Mechanism in Complexes

Lability and inertness-Ligand substitution reactions in octahedral complexes-Basic concepts of dissociation, association and SN_1CB mechanism-substitution reactions in square planar complexes, trans- effect-applications of trans effect. Electron transfer reactions-Basic concepts of outer sphere and inner sphere mechanism-Factors affecting the rates of outer sphere electron transfer reactions.

References

1. A New Concise Inorganic Chemistry, J. D. Lee, ELBS, Edn., 1995.
2. Principles of Inorganic Chemistry, B. R. Puri, L. R. Sharma and K. C. Kalia, Shoban Lal Nagin Chand & Co., New Delhi, 2001.
3. Text Book of Inorganic Chemistry, P. L. Soni, S. Chand & Sons, New Delhi, 1993.
4. Selected Topics in Inorganic Chemistry, Malik, Tuli, Madan, S. Chand & Co., New Delhi, 2002.

B.Sc. CHEMISTRY (V SEMESTER)

15CHEU0512 ORGANIC CHEMISTRY II (4 Credit)

Objectives: *The objective of the course is to understand the chemistry of carboxylic acids and their derivatives, to understand the chemistry of amines and quaternary ammonium salts, to know the chemistry of phenols and organonitrogen compounds, to know the chemistry of five and six membered heterocyclic compounds and to understand organic chemical reactions that involve structural changes.*

Specific learning outcomes: *After successful completion of the course, students will be able to*

- *Describe the preparation, properties and reactions of carboxylic acids, amines, phenols and certain heterocyclic compounds.*
- *Demonstrate the synthetic uses of diazonium salts*
- *Predict the mechanism of certain organic rearrangements.*

Unit I - Carboxylic Acids and Their Derivatives

Structure -Industrial sources, preparation, Grignard synthesis, nitrile synthesis, reactions-acidity of carboxylic acids, effect of substituents on acidity, conversion into acid chlorides, esters, amides- reduction of acids to alcohols, Hell Volhard Zelensky reaction. Dicarboxylic acids - action of heat on dicarboxylic acids. Hydroxy acids- Reformatsky reaction, action of heat on hydroxy acids.

Functional derivatives of carboxylic acids - nucleophilic acyl substitution, nucleophilic substitution: alkyl vs. acyl. Hydrolysis of amides, acid and alkaline hydrolysis of esters, trans esterification.

Unit II -Amines

Preparation-Hofmann degradation- synthesis of secondary and tertiary amines -basicity of amines -basicity constant -structure and basicity, Effect of substituent on basicity -Hofmann rearrangement.

Quaternary ammonium salts: Exhaustive methylation, Hoffmann elimination -conversion of amines into substituted amides-ring substitution in aromatic amines.

Unit III - Phenols and Nitrogen Compounds

Nomenclature, preparation, properties -salts of phenols, acidity of phenols, effect of substituents on acidity -Formation of esters -Fries rearrangement - Kolbes synthesis of phenolic acids, Reimer -Tiemann reaction –reaction with HCHO; phenol -formaldehyde resins.

Nitrocompounds- reduction of nitrobenzene in various media- Diazonium salts: preparation and reactions –Sandmeyer reactions, synthetic uses of diazonium salts.

Unit IV - Heterocyclic Compounds

Preparation and properties of Furan, pyrrole, thiophene, pyridine and quinoline-aromatic nature, electrophilic substitution, basicity of pyridine -Skraup synthesis.

Unit V - Molecular Rearrangements

Molecular rearrangements: Mechanism of the following selected rearrangements - Benzidine, Wagner-Meerwin, Beckmann, Pincol-pinacolone, Favorski and Claisen rearrangements.

Reference

1. Organic Chemistry R.T.Morrison and R.N.Boyd., Prentice Hall of India Pvt. Ltd., New Delhi, 7th Edn., 2011.

B.Sc. CHEMISTRY (V SEMESTER)

15CHEU0513 PHYSICAL CHEMISTRY II (4 Credit)

Objectives: *The objective of the course is to understand basic terminologies of electrochemistry, to know the theories of strong electrolytes, to be familiar with the fundamentals of different types of electrochemical cells, to understand phase rule for one and two component systems and to be familiar with the principles of rotational and vibrational spectroscopies.*

Specific learning outcomes: *After successful completion of the course, students will be able to*

- *Describe the basics of electrochemistry*
- *Analyze and interpret phase diagram of one and two component systems*
- *Demonstrate the basics of vibrational and rotational spectroscopic techniques*

Unit I - Electrochemistry I

Faraday's law of electrolysis, specific, molar and equivalent conductance and its variation with dilution, cell constant, transport number-determination by moving boundary method, Kohlrausch's law, applications of Kohlrausch's law, conductance measurements-applications.

Unit II - Electrochemistry II

Theory of strong electrolytes, Arrhenius theory, limitations, Debye-Huckel theory of strong electrolytes, Onsager equation (no derivation), solubility product and its applications, pH scale and buffer action.

EMF of cells, reversible cells, types of reversible electrodes, single electrode potential, reference electrodes, cell reaction and e.m.f. - thermodynamic relationship, Nernst equation, electrode concentration cells, electrolyte concentration cells.

Unit III - Electrochemistry III

Applications of e.m.f. measurements, determination of transport number, solubility, pH and potentiometric titrations, Fuel cells (basic concept), principle and applications of polarography.

Electrochemical theory of corrosion, corrosion due to dissimilar metal cells and concentration cells, Pilling Bedworth rule, passivity.

Unit IV - Phase Rule

Phase, component and degree of freedom, derivation of phase rule, one component systems-water system, sulphur system, two component systems- Lead-Silver system, zinc-Magnesium system, formation of compounds with incongruent and congruent melting points-ferric chloride-water system, sodium sulphate-water system.

Unit V - Molecular Spectroscopy

Rotational spectra, rigid diatomic rotator, non-rigid rotator, selection rule, vibrational spectra, simple harmonic oscillator, anharmonic oscillator, selection rule, electronic spectra, Frank-Condon principle.

References

1. Principles of Physical Chemistry, B.R. Puri, L.R. Sharma andM.S. Pathania, Shoban Lal Nagin Chand and Co., New Delhi, 2001.
2. Essentials of Physical Chemistry, B.S.Bahl, GD. Tuli and Arun Bahl, S.Chand &Co. Ltd, New Delhi, 12th Edn., 2011.
3. A Text Book of Physical Chemistry, A.S. Nagi and S.C. Anand Wiley Eastern Ltd, New Delhi, 7th Edn., 2000.

B.Sc. CHEMISTRY (V SEMESTER)

PRACTICAL - V

15CHEU0514 ORGANIC QUALITATIVE ANALYSIS (2 credit)

Objectives: *The objective of the practical course is to understand the principles of organic qualitative analysis and to develop skill in single stage preparation of organic compounds.*

Specific learning outcomes: *After successful completion of the course, students will be able to*

- *Analyze mono and bifunctional organic compounds qualitatively*
- *Synthesize organic compounds and their derivatives*
- *Recrystallize and purify the products of organic reactions*
- *Determine the physical constants of the products*

1. Qualitative Analysis of organic compounds -Analysis of mono and bifunctional organic compounds. Preparation of derivatives, recrystallization, and determination of physical constants.

2. Single stage preparation of organic compounds involving acylation, oxidation, hydrolysis, nitration, esterification, condensation and bromination.

References

1. Text Book of Practical Organic Chemistry, A.I.Vogel, ELBS, London, 5th Edn., 2010.
2. N.S.Gnanaprakasam and G.Ramamoorthy, "Organic Chemistry Lab Manual", S.Viswanathan Company Pvt. Ltd., 1998.

B.Sc. CHEMISTRY (V SEMESTER)

15CHEU0507 SKILL BASED ELECTIVE (2 Credit)

(One of the three courses has to be chosen by the students)

B.Sc. CHEMISTRY (VI SEMESTER)

15CHEU0616 ORGANIC CHEMISTRY- III (4 Credit)

Objectives: *The objective of the course is to understand the chemistry of carbohydrates, to know the chemical aspects of amino acids, to understand the basic principles involved in organic photochemistry and also have an elementary idea of pericyclic reactions, to know the chemistry of selected alkaloids and terpenes, to know the synthetic utility of selected oxidizing and reducing organic reagents and also synthetic uses of selected organic name reactions.*

Specific learning outcomes: *After successful completion of the course, students will be able to*

- *Describe the chemistry of carbohydrates*
- *Classify protein and demonstrate the primary and secondary structure of proteins.*
- *Draw Jablonski diagram and demonstrate the mechanism of Norrish type I and II reactions*
- *Determine the structures of selected alkaloids and terpenes*
- *Identify suitable reagents for selected organic reactions*

Unit I - Carbohydrates

Introduction - classification - interrelationship among monosaccharides, oxidation - effect of alkali, periodic acid oxidation - osazone formation, epimers - mutarotation and its mechanism – cyclic structure -pyranose and furanose forms - determination of ring size, haworth projection formula, configuration and conformational analysis of monosaccharides- epimerisation - lengthening of carbon chain in aldoses – Killiyani-Fischer synthesis of aldoses – Ruff degradation

Interconversion of aldoses and ketoses and vice versa, interconversion of aldoses to their epimers - introduction to simple disaccharides (Maltose and Sucrose only).

Unit II -Amino Acids and Proteins

Classification - synthesis - structure of amino acids, Dipolar ions, isoelectric point, reactions of amino acids, peptides - structure of peptides- Sangers and Edmond method, terminal residue analysis, synthesis of peptides - role of protective groups (carbobenzoxy, phthaloyloxyl) - classical method - its limitations - proteins - classification - denaturation - primary, secondary structure of proteins. Colour reactions of proteins.

Unit III - Organic Photochemistry

Principles - Jablonski diagram - absorption of electromagnetic radiation - excited state - photochemical processes - photosensitisation, photochemical reactions - photoreduction, photooxidation, photolysis of ketones - Norrish type I and type II reactions.

Pericyclic reactions - characteristics of concerted reactions - electrocyclic, cycloaddition and sigmatropic reactions. (Elementary idea only)

Unit IV - Terpenes and Alkaloids

Terpenes - general methods of determination of structure - Isoprene rule, isolation of terpenes - structure and constitution of menthol, limonene, and camphor.

Alkaloids - alkaloidal reagents - general methods of determination of structure of alkaloids - structure and synthesis of nicotine, piperine and atropine.

Unit V - Reagents and Reactions

Synthetic uses of organic reagents - NBS, OsO_4, $LiAlH_4$, DCC and $NaBH_4$.

Synthetic uses of Mannich reaction, Micheal addition reaction, Birch reduction, Willkinson reaction and Stobbe reaction.

References

1. Organic Chemistry R.T.Morrison and R.N.Boyd., Prentice Hall of India Pvt. Ltd., New Delhi, 7th Edn., 2011.
2. Organic Chemistry, I.L. Finar, ELBS, Vol. I, 6th Edn., 2002.

B.Sc. CHEMISTRY (VI SEMESTER)

15CHEU0617 PHYSICAL CHEMISTRY - III (4 Credit)

Objectives: *The objective of the course is to understand the basic terminologies of chemical kinetics, to understand the theories of reaction rates and catalysis, to understand the basics and concepts of photochemistry, to have an introduction of group theory and to become familiar with the fundamentals of quantum chemistry.*

Specific learning outcomes: *After successful completion of the course, students will be able to*

- *Determine the order of the reaction*
- *Calculate the half-life of the reaction*
- *Describe the theories of reaction rates and Lambert-Beer law of photochemistry*
- *Draw and explain Jablonski diagram*
- *Predict the symmetry elements and point groups of small molecules*
- *Demonstrate the photoelectric effect, Compton effect, Heisenberg's uncertainty principle and Schrodinger wave equation*

Unit I - Chemical Kinetics I

Introduction, order and molecularity, zero, first, second and fractional order reactions, determination of orders- pseudo unimolecular reaction, half-life of a reaction, temperature dependence of reaction rates, Arrhenius equation.

Unit II - Chemical Kinetics II

Theories of reaction rates, collision theory, absolute reaction rate theory (derivation not included), significance of the free energy of activation and entropy of activation, unimolecular reactions, Lindmann theory.

Catalysis, types of catalysis, characteristics of catalytic reactions, theories of catalysis, enzyme catalysis, Michaelis-Menton equation.

Unit III - Photochemistry

Introduction, Lambert-Beer law, Jablonski diagram, law of photochemical equivalence, quantum yield, experimental determination, photosensitized reactions, steady state approximation, photochemical reactions of H_2-Cl_2, H_2-Br_2 and dimerization of anthracene.

Phosphorescence, fluorescence and chemiluminescence.

Unit IV - Group Theory and Its Applications

Mathematical group – group multiplication tables - symmetry elements-symmetry operations – point group of simple molecules (H_2, HCl, CO_2, H_2O, BF_3 and NH_3)

Unit V - Quantum Mechanics

Failure of classical mechanics, black body radiation, photoelectric effect, Compton effect, Heisenberg's uncertainty principle, Schrodinger wave equation, eigen values and eigen functions, significance of wave function, orthogonality and normalisation postulates of quantum mechanics, particle in one dimensional box.

References

1. Principles of Physical Chemistry, B.R. Puri, L.R. Sharma and M.S. Pathania, Shobanlal Nagin Chand & Co. Jalendhar 41st Edn., 2001.
2. Essentials of Physical Chemistry, B.S. Bahl, G.D. Tuli and Arun Bahl, S.Chand & Co. Ltd, New Delhi, 12th Edn., 2011.
3. A Text Book of Physical Chemistry, A.S. Nagi and S.C. Anand, Wiley Eastern Ltd., New Delhi, 7th Edn., 2000.

B.Sc. CHEMISTRY (VI SEMESTER)

15CHEU0618 ANALYTICAL CHEMISTRY (4 Credit)

Objectives: *The objective of the course is to understand laboratory safety measures, error analysis and the theory of complexometric titration, to emphasize the basic principles of different electroanalytical techniques, To learn the basic principles, instrumentation and applications of spectrochemical, thermal and radiochemical techniques, and to know the basic principles and applications of separation techniques.*

Specific learning outcomes: *After successful completion of the course, students will be able to*

- *Handle toxic and poisonous chemicals safely*
- *Provide first-aid in case of small laboratory accidents*
- *Communicate scientific data and conclusions with accuracy and minimum error*
- *Describe the principles, applications and instrumentation of potentiometric and conductometric titrations*
- *Describe the principles, applications and instrumentation of UV-Vis spectrophotometry and IR spectrophotometer*
- *Identify the thermoanalytical method to be used for a particular study*
- *Describe methods to separate compounds such as TLC, column chromatography and solvent extraction.*

Unit I - Laboratory Safety, Error Analysis and Complexometry

Storage and handling of corrosive, toxic and poisonous chemicals-simple first aid procedure for acid and alkali in eye, acid and alkali burns, heat burns and cut by glasses.

Accuracy, precision, classification of errors, minimization of errors, standard deviation, coefficient of variance and significant figures. Complexometric titrations, principle and experimentation. Metal ion indicators and its applications.

Unit II - Electroanalytical Techniques

Potentiometry-principle, potentiometric titrations-conductometric titrations-principle, applications and instrumentation. Amperometry-different types of titrations and its applications-Electrogravimetry-principle and applications.

Unit III - Spectrochemical Techniques

UV-visible spectrophotometry, principle, Beer's law, applications-deviations from Beer's law. Photometric titrations-instrumentation, single and double beam spectrophotometer.

Instrumentation of IR spectrophotometer-sample handling techniques in IR, applications-Theory of atomic absorption spectroscopy, flame emission spectroscopy-applications.

Unit IV - Thermal and Radiochemical Techniques

Principles and applications of thermogravimetry, differential thermal analysis, differential scanning calorimetry. Theromogram of copper sulfate pentahydrate. Radiometric titrations-types-complex formation and precipitate formation- activation analysis- absolute and comparative methods and applications.

Unit V - Separation Techniques

Principles and applications of column, paper and thin layer chromatography. Ion-exchange methods, principle and applications. Brief idea of solvent extraction techniques, Gas chromatography-principle and applications.

References

1. H.W. Willard, L.I. Merrit, J.A. Dean and P.A. Settle, Instrumental Methods of Analysis, CBS Publishers, 7th Edn., 1996.
2. B.K. Sharma, Instrumental Methods of Analysis, Goel Publishers, 1993.
3. Vogel's Text Book of Quantitative Chemical Analysis, ELBS, 1996.

B.Sc. CHEMISTRY (VI SEMESTER)

PRACTICAL-VI

15CHEU0619 PHYSICAL CHEMISTRY (2 Credit)

Objectives: *The objective of the practical course is to learn the applications of colligative properties, to carry out experiments based on phase rule, to acquire skills based on chemical kinetics experiments and to understand electrochemistry through experiments.*

Specific learning outcomes: *After successful completion of the course, students will be able to*

- *Determine molecular weight by Rast's Macro method and transition temperature measurement method*
- *Construct phase diagram of a simple eutectic system*
- *Determine critical solution temperature of phenol-water system*
- *Determine distribution coefficient of Iodine between water and organic solvent*
- *Determine rate constant of acid catalysed hydrolysis of an ester*
- *Determine the pKa of a weak acid*
- *Determine the viscosity of mixture of liquids by using Ostwald Viscometer.*

1. Determination of Molecular Weight by Rast's Macro method.
2. Determination of Molecular Weight by Transition Temperature measurement method.
3. Construction of phase diagram of a simple eutectic system.
4. Determination of Critical Solution Temperature of Phenol-Water system. (Determination of concentration of a salt solution through miscibility temperature measurement).
5. Determination of distribution coefficient of Iodine between water and organic solvent.
6. Determination of rate constant of acid catalysed hydrolysis of an ester.
7. Conductometric titration of strong acid vs. strong base.
8. Determination of pKa of a weak acid.
9. Determination of degree of dissociation through conductance measurement.
10. pH-metric titration between a strong acid and a strong base.
11. Potentiometric titration between Fe^{2+} and Cr^{6+}.
12. Determination of viscosity of mixture of liquids by using Ostwald Viscometer.

References

1. Practical Chemistry by A.O. Thomas, Scientific Book Centre, Cannanore, 2003.
2. Basic Principles of Practical Chemistry, V. Venkateswaran, R. Veeraswamy, A. R. Kulandaivelu, Sultan Chand & Sons, New Delhi, 2nd Edn., 2004.

B.Sc. CHEMISTRY (VI SEMESTER)

PROJECT (4 Credit)

15CHEU04E1 ENVIRONMENTAL CHEMISTRY (3 credit)

Objectives: *The objective of the course is to give an overview of water, air, soil, radioactive and noise pollution including methods for prevention, control measures and management of the pollution, to understand how chemistry can help in understanding contemporary environmental issues, and possible solutions to environmental problems and to develop an understanding of chemicals and their effects on the environment.*

Specific learning outcomes*: After successful completion of the course, students will be able to*

- *Assess various types of pollution including the cause, consequence and cure*
- *Describe ozone layer depletion and its impact on global environment*
- *Communicate the impact of air, water, soil pollutants and greenhouse gases to generate awareness*

Unit I - Water Pollution

Hydrosphere - Hydrological cycle - water quality parameters - significance of these parameters over the quality of water – Types of water pollutants - organic, inorganic, toxic metal (Cr, Ar, Hg, Pb), sediments, plant nutrients, oil spills, disease causing agents, radioactive wastes and thermal pollution - experimental determination of DO, BOD, COD and TOC.

Unit II - Air Pollution

Structure of atmosphere - composition of air- primary air pollutants- oxides of carbon, nitrogen and sulphur - sources and effects. Global warming, acid rain, photochemical smog, depletion in ozone layer- particulate pollution - Inorganic, Organic and Metallic particulates - sources and effects.

Unit III - Soil Pollution and Pollution Due to Pesticides

Soil profile - Bio Indicators - Sources and effects of soil pollution. Organochlorine pesticides, insect resistance to DDT, biomagnifications of DDT, effects of organo chlorine compounds - organo phosphorus compounds and carbamates as pesticides - Alternatives to pesticides.

Unit IV - Radioactive and Noise Pollution

Radioactive pollution - types of radiation - Sources - natural sources of radiation - electromagnetic radiations and particulate radiations - Anthropogenic sources - X-rays, radioisotopes, nuclear reactors, nuclear power plants - effects of ionising and non-ionising radiations on man. Sources and effects of noise pollution

Unit V - Pollution Control Measures

Sources, effects and treatment methods of some specific water pollutants - Fluoride, iron and chromium. Control of air pollution - source correction methods - operational changes, cleaning of gaseous effluents - adsorption on solids, catalytic conversion - control of particulate pollutants. Remedial measures for soil pollution.

References

1. Environmental Chemistry by B.K. Sharma and H. Kaur, Goel Publishing House.1996.
2. Environmental Chemistry by A.K. De, New Age International (P) Ltd. Publishers, 2000.
3. Environmental Chemistry by Tyagi and Mehra, Anmol Publisheres. 1996.

15CHEU04E2 INDUSTRIAL CHEMISTRY (3 credit)

Objectives: *The objective of the course is to enable the student to understand the concepts of fuels and energy resources, generation of energy from various types of fuels, to understand the use of chemicals in the improvement of agricultural crops, to learn the manufacturing processes of iron, steel, alloys, glass, ceramics and refractories and to understand the process of surface coatings.*

Specific learning outcomes: *After successful completion of the course, students will be able to*

- *Categorize fuels and energy sources*
- *Describe the types of polymerization methods as well as preparation and uses of few well-known polymers*
- *Describe the composition and manufacturing process of cements and fertilizers*
- *Demonstrate the manufacturing process and applications of iron, steel, alloys, glass, ceramics and refractories*
- *Categorize the types of surface coatings*

Unit I - Fuels and Energy Resources

Petroleum - origin of petroleum, composition, refining of petroleum fractionation - composition of various fractions, cracking - catalytic and thermal cracking, synthetic petrol, knocking, octane and cetane numbers, anti knocking agents, coal gas, producer gas, methane production from biomass, alcohol as fuel.

Unit II - Cement and Fertilizers

Cement - manufacture of Portland cement - composition - setting of cement - special cements - Aluminium cement - white Portland cement - water proof cement.

Fertilizers - nitrogeous fertilizers - ammonium sulphate- urea - manufacture and action - potassium fertilizers - potassium sulphate - manufacture - phosphate fertilizers - superphosphate - manufacture.

Unit III - Iron, Steel and Alloys

Manufacture of pig iron by blast furnace, wrought iron by puddling processes - steel by Bessemer's process - Heat treatment of steel.

Alloys-purpose of making alloys - preparation of alloys by fusion method - electro deposition and reduction method - effects of carbon, silicon, phosphorus and sulphur - application of alloy steels.

Unit IV - Glass, Ceramics and Refractories

Glass, raw materials and colouring agents - chemical reaction involved in glass manufacture - some special glasses (borosilicate, alkali silicate, optical glass, sodalime glass, their properties and applications)

Ceramics - various classes of ceramics, general properties, porous and non-porous wares, raw materials for ceramics, uses.

Refractories - manufacture of refractories - properties and uses of common refractory bricks - silica bricks - fire clay bricks, magnesite bricks and dolomite bricks.

Unit V - Surface Coatings

Pretreatment of the surface, metallic coating, galvanizing, tinning - Inorganic coatings, organic coatings, oil paints, water paints, special paints, varnishes, enamels and lacquers.

References

1. Engineering Chemistry by P.C. Jain and Monica Jain, Dhanphatrai and Sons, 15th Edn., 2006.
2. Industrial Chemistry, B.K. Sharma, Goel Publishing House, 2011.
3. A Text Book of Engineering Chemistry, S.S. Dara, S. Chand & Co., New Delhi, 15th Edn., 2006.

15CHEU04E3 ELEMENTS OF SPECTROSCOPY (3 credit)

Objectives: *The objective of the course is to impart the knowledge of UV-vis spectroscopy, to familiarize with the calculation of absorption maximum, to impart knowledge of infrared and Raman spectroscopies, to gain expertise of assigning experimental values to the different vibrations, to understand the basis of NMR spectroscopy and solving simple organic molecules, to impart basic knowledge of mass spectrometry and to gain the knowledge of magnetism and its interaction with external field and concept in electron spin resonance.*

Specific learning outcomes: *After successful completion of the course, students will be able to*

- *Demonstrate principles of UV-Vis spectroscopy*
- *Interpret IR spectra and describe the instrumentation of IR spectrophotometer*
- *Demonstrate principles of NMR spectroscopy and interpret NMR spectra of simple molecules*
- *Interpret mass spectra and describe the instrumentation of Mass spectrometer*
- *Analyze the interaction of odd electrons with nuclei and interpret the ESR spectra*

Unit I - UV -Vis Spectroscopy

Electronic excitation levels – Woodward rule for calculation of the λ_{max} for dienes and unsaturated carbonyl compounds – simple applications.

Unit II - Vibrational Spectroscopy

Infrared Spectroscopy: Principle – applications of IR spectroscopy to carbonyl compounds – amino compounds – hydroxyl compounds – inter and intermolecular hydrogen bonding.

Unit III - NMR Spectroscopy

Introduction – number of signals – equivalent and non-equivalent protons – position of signals – chemical shift – peak area and proton coupling. Splitting of signals – spin-spin coupling – coupling constant – NMR spectra of simple organic compounds.

Unit IV - Mass Spectrometry

Introduction – instrumentation – mass spectrum – molecular ion peak – molecular formula calculation – mass spectrum of simple molecules (cyclohexene, ethyl benzene and methylpropyl ketone).

Unit V - Electron Spin Resonance Spectroscopy

Magnetic moment of an unpaired electron – energy level diagram of electron – hyperfine splitting – structure of hydrogen atom and methyl radical.

References

1. Organic Spectroscopy, William Kemp, 3rd Edn., Palgrave Publications, New York, 2008.
2. Spectroscopy of Organic Compounds, P. S. Kalsi, New Age International Publishers, 6th Edn., 2009.
3. Applications of Absorption Spectroscopy of Organic Compounds, J. R. Dyer, Prentice Hall of India Pvt. Ltd., New Delhi, 1991.
4. Spectrometric Identification of Organic Compounds, Robert M. Silverstein and Francis X. Webster, 6th Edn., John Wiley and Sons, 2003.
4. Principles of Physical Chemistry, B.R. Puri, L.R. Sharma and M.S. Pathania, Shobanlal Nagin Chand & Co. Jalendhar 41st Edn., 2001.

15CHEU05E1 CHEMISTRY OF NATURAL PRODUCTS (3 credit)

Objectives: *The objective of the course is to give an introduction to chemistry of natural products like carbohydrates, steroids, terpenoids, alkaloids, aminoacids and proteins and to give an introduction to synthesis of some important heterocyclic compounds.*

Specific learning outcomes: *After successful completion of the course, students will be able to*

- *Describe the chemistry of carbohydrates, steroids, terpenoids and alkaloids*
- *Determine the structures of selected alkaloids and terpenes*
- *Classify protein and demonstrate the primary and secondary structure of proteins.*
- *Describe the synthesis of selected heterocycles*

Unit I - Carbohydrates

Classification -chemistry of monosaccharides (glucose &fructose) - elementary idea of chemistry of disaccharides (sucrose &lactose) - chemistry of polysaccharides, starch andcellulose - glycogen, insulin - industrial applications of starch &cellulose -elementary idea of glucosamine.

Unit II - Steroids and Terpenoids

Steroids - colour reactions of -elementary idea of – sex hormones - bile acids. Terpenoids - classification of - isoprene rules – general methods of extraction of - chemistry of α-pinene and camphor (synthesis not included).

Unit III - Alkaloids

Definition of-classification of-colour reactions of-general methods of extraction of - chemistry of - piperine - nicotine.

Unit IV - Amino Acids and Proteins

Classification of amino acids - essential and non-essential amino acids - optical activity of amino acids - synthesis of α-aminoacids - properties of amino acids- peptides -terminal residue analysis.

Proteins - classification of - colour reactions of – properties of - structure of - industrial importance of proteins.

Unit V - Heterocycles

Synthesis and reactivity of - pyrrole, pyridine, indole, pyrazole, imidazole, carbazole, quinoline and isoquinoline.

References

1. Advanced Organic Chemistry, B.S. Bahl and Arun Bahl, S.Chand & Co. Ltd., New Delhi, 2002.
2. Organic Chemistry, I.L.Finar, Vol. II, Stereochemistry and the Chemistry of Natural Products, 5th Edn., Pearson Education, 2003.

15CHEU05E2 POLYMER CHEMISTRY (3 credit)

Objectives: *The objective of the course is to understand the importance of polymers and an exposure to polymer chemistry, to understand various polymerization techniques and characterization of polymers, to enable a student to understand polymer structure, properties, and to know the polymer processing techniques and properties of commercially available polymers.*

Specific learning outcomes: *After successful completion of the course, students will be able to*

- *Classify polymers and describe different types of polymerizations reactions*
- *Characterize polymers based on available experimental data*
- *Describe the structure and properties of polymers*
- *Demonstrate the properties of commercially available polymers*

Unit I – Polymerization Reactions and Techniques

Importance of polymers – basic concept – degree of polymerization – classification of polymers – polymerization reactions – addition and condensation polymerization – mechanism – polymerization techniques – bulk, solution, suspension and emulsion methods.

Unit II – Polymer Characterization

The concept of number and weight averages – the practical significance of molecular weight– measurement of molecular weight – end group, viscosity, light scattering, osmotic pressure and ultra-centrifugation methods – testing of polymers – tensile strength, fatigue, impact strength, tear resistance, hardness and abrasion resistance.

Unit III – Polymer Structure and Properties

Polymer structure and physical properties – the relationship between T_g and T_m – crystal structure – significance – stereo regularity. Polymer degradation – types – mechanical, thermal and photo degradation – management of polymers.

Unit IV – Polymer Processing and Additives

Plastics, elastomers and fibres, processing techniques – calendaring, compounding injection moulding, transfer moulding and extrusion moulding, spinning – melt – Dry and Wet methods. Polymer additives: Plasticizers, fillers, antioxidants, fire retardants and thermal stabilizers.

Unit V – Chemistry of Important Commercial Polymers

Polyethylene, PVC, polyamides, polyesters, phenolic resins, and epoxy resins. Silicon rubber, conducting polymer, biomedical polymer – contact lens, dental polymers and artificial heart.

References

1. Polymer Science and Technology, Goel R. Fried, Prentice-Hall of India, New Delhi, 2nd Edn., 2003.
2. Polymer Science and Technology of Plastics and Rubbers by Premamoy Ghosh, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2009.
3. Polymer Science by V.R. Gowariker, N.V. Viswanathan and Sadadeve Sreedhar, New Age International (P) Ltd. Publishers, 2003.
4. "Text Book of Polymer Science" by Fred W. Billmeyer, J.R. John Wiley Publishers, 3rd Edn., 2003.

15CHEU04N1 **POLYMER SCIENCE (3 credit)**

Objectives: *The objective of the course is to impart knowledge about the importance of polymers, to understand various polymerization techniques and characterization of polymers, to enable a student to understand polymer structure, properties and to know the polymer processing techniques and properties commercially available polymers.*

Specific learning outcomes: *After successful completion of the course, students will be able to*

- *Classify polymers and describe different types of polymerizations reactions*
- *Characterize polymers based on available experimental data*
- *Describe the structure and properties of polymers*
- *Demonstrate the properties of commercially available polymers*
- *Describe the types of polymer processing methods*

Unit I - Basics

Basic concepts: Monomers, repeat units, degree of polymerization - Linear, branched and network polymers. Classification of polymers. Polymerization: condensation, addition, radical chain-ionic and co-ordination and co-polymerization.

Unit II - Polymer Characterization

Average molecular weight concept. Number, weight and viscosity-average molecular weights. The practical significance of molecular weight. Measurement of molecular weights. viscosity, and light scattering methods.

Unit III - Structure and Properties

Configurations of polymer chain. Morphology of crystalline polymers, strain-induced morphology. Polymer structure and physical properties-chain flexibility and other steric factors. Branching and cross linking.

Unit IV - Polymer Processing

Processing techniques: Calendering, die casting, rotational casting, film casting, injection moulding, blow moulding, extrusion moulding, thermo forming, foaming, reinforcing and fibre spinning.

Unit V - Properties of Commercial Polymers

Fire retarding polymers and electrically conducting polymers. Biomedical polymers-contact lens, dental polymers, artificial heart, kidney, skin and blood cells.

References

1. Textbook of Polymer Science, F.W.Billmeyer, Johny Eastern Ltd., 1992
2. Polymer Science, V.R. Gowariker, N.V. Viswanthan and J.Sreedhar. Wiley-Eastern, 1988.

15CHEU04N2 ORGANIC CHEMISTRY FOR HOME SCIENCE (3 credit)

Objectives: *The objective of the course is to develop an understanding of food components such as carbohydrates, aminoacids, proteins, to obtain preliminary knowledge on dyes, leathers, fibers, to provide comprehensive introduction to sulpha drugs, antibiotics, fuels and to know synthesis and applications of polymers.*

Specific learning outcomes: *After successful completion of the course, students will be able to*

- *Describe the chemistry of carbohydrates*
- *Determine the structures of selected alkaloids and terpenes*
- *Classify protein and demonstrate the primary and secondary structure of proteins*
- *Classify dyes and describe the synthesis of most popular dyes*
- *Demonstrate the tanning process*
- *Describe the mode of action of sulpha drugs and antibiotics*
- *Classify fuels and energy sources*
- *Classify polymers and describe different types of polymerizations reactions*
- *Demonstrate the properties of commercially available polymers*

Unit I - Carbohydrates

Introduction – classification-preparation and properties of glucose and fructose structure of glucose (configuration-not expected) mutarotation- interconversion of aldose and ketose. Increasing and decreasing the length of the carbon chain in sugars – polysaccharides-preliminary study of starch and cellulose. Industrial applications of starch and cellulose.

Unit II -Amino Acids and Proteins

Classification-preparation and properties of amino acids, isoelectronic point-tests for amino acids-polypeptides, peptide linkage, proteins – classification-denaturation of proteins, colour reactions, biological significance of proteins, structure of proteins, primary structure of proteins, end group analysis, preliminary study of secondary structure, introduction to DNA and RNA.

Unit III - Dyes, Leather and Fibers

Introduction-structural features of a dye-classification of dyes, preparation of methyl orange, fluoresce in, malachite green, alizarin and uses (both textile and non-textile). Leather: Basic principles in tanning and dyeing of leather, types of tanning (chrome and vegetable tanning) Fibers: Synthetic fibers derived from cellulose, nylon and terylene.

Unit IV - Sulpha Drugs, Antibiotics and Fuels

Introduction to sulpha drugs - sulphanilamide, sulphameracine,sulphaguanidine-preparation, mode of action of sulpha drugs.

Antibiotics very brief study of chloramphenicol, penicillin andtetracycline-their uses (detailed chemistry not required).

Fuels: Classification, characteristics of a good fuel. Composition and uses of LPG, producer gas, water gas, method of production of gobar gas. Petroleum – knocking-use of tetraethyl lead diesel-octane and cetane number. Synthetic petrol, Bergius process.

Unit V - Polymers

Different types of polymerization-addition, condensation, ionic and free radical polymerization-mechanisms, synthesis and applications of the following polymers-PVC, polyester, polythene, Teflon, and polystyrene – rubber-natural rubber, vulcanization of rubber-synthetic rubber-neoprene.

References

1. Bahl and Arun Bahl, Text book of Advanced Organic Chemistry, S. Chand & Co., New Delhi, 1991.

15CHEU04N3 CHEMISTRY IN THE SERVICE OF MANKIND (3 credit)

Objectives: *The objective of the course is to provide comprehensive overview of fuels and energy sources, to familiarize with polymers, polymerization techniques and fertilizers, to provide an overview of vitamins and drugs, to understand the types of surface coatings, to have the knowledge about small and large scale industrial processes*

Specific learning outcomes: *After successful completion of the course, students will be able to*

- *Classify fuels and energy sources*
- *Describe the chemistry of some important polymers and fertilizers*
- *Categorize vitamins and drugs*
- *Categorize the types of surface coatings methods*
- *Describe small and large scale industrial processes*

Unit I - Fuels and Energy Resources

Types of fuels - liquid fuels - petroleum products – gaseous fuel - coal gas, producer gas and bio gas - Rocket fuels - solid and liquid propellants - nuclear fuels - difference between nuclear and chemical fuels. Renewable sources of energy - solar energy, wind energy and tidal energy.

Unit II - Polymers and Fertilizers

Chemistry of some important polymers - synthetic fibres -nylons, polyester - synthetic rubber - polyurethane rubber – reclaimed rubber - sponge, foam rubber, thermocole - polymerization techniques- bulk, solution, suspension, emulsion polymerization.

Plant nutrients - need and requirements - natural and artificial fertilizer - urea, triplesuper phosphate, muriate of potash – complex fertilizers.

Unit III – Vitamins and Drugs

Vitamins - Water soluble vitamins - Vitamin B and C - fat soluble vitamins - A, D, E & K - sources - physiological functions and deficiency symptoms.

Drugs - some important drugs – antibacterials – sulphonamide - antipyretics - aspirin - antimalarials - paludrine - antibiotics - penicillin.

Unit IV - Surface Coatings

Pretreatment of the surface metallic coating, galvanizing, tinning, inorganic coatings, organic coatings, oil paints, water paints, special paints, enamels and lacquers.

Unit V - Industrial Processes

Small scale units - manufacture of candles, safety matches, soap and naphthalene balls, shoe polish, cum paste, writing/fountain pen ink, Chalk crayons, plaster of paris and silicon carbide crucibles.

Large scale units - manufacture of pulp and paper, sugar, glass, ceramics and cement.

References

1. Industrial Chemistry by B.K. Sharma, Goel Publishing House, 12th Edn., 2001.
2. Engineering Chemistry by P.C. Jain and Monica Jain, Dhanphatrai and Sons, 15th Edn., 2006.
3. Chemical Process Industries by Shrive, George and T Austin, McGraw Hill Book Co., 1984.

15CHEU05N1 POLLUTION AND ITS CONTROL MEASURES (3 credit)

Objectives: *To provide comprehensive introduction to air pollution, water pollution, noise and nuclear pollution and their control measures.*

Specific learning outcomes: *After successful completion of the course, students will be able to*

- *Classify pollution*
- *Communicate and create awareness about pollution and their control measures*
- *Analyze air and water quality parameters*

Unit I – Air Pollution

Major regions of the atmosphere – composition of air – specific air pollutants and their effects – CO, CO_2, SO_2, SO_3, NO and NO_2 – ozone depletion – acid rain – photochemical smog.

Unit II – Water pollution

Criteria for potable water – major water pollutants – organic, inorganic, heavy metals – (As, Cr, Fe, Pb, Cd, Hg) oil spills – sources – effects.

Unit III – Soil and Pesticide Pollution

Sources, effects of various oil pollutants – pesticides – classification. Toxicity of DDT, BHC, malathion, parathion, carbamates. Alternative sources for pesticides.

Unit IV – Noise and Nuclear Pollution

Noise pollution – sources and effects – nuclear pollution – genetic and somatic effects – nuclear disasters and major accidents.

Unit V – Analysis and control methods

Sampling of air and water pollutants – analysis of DO, BOD, COD and TOC in water – Analysis of CO by GC, NO by chemiluminescence and CO_2 by spectrometry. Treatment of water for domestic and industrial purpose – primary, secondary and tertiary treatment methods.

References

1. Environmental Chemistry, A. K. De, 5th Edn., New Age International Publisher, 2005.
2. Environmental Chemistry, B. K. Sharma, 11th Edn., Krishna Prakashan media Limited, 2007.

15CHEU05N2 CHEMISTRY OF FOOD (3 credit)

Objective: *To provide comprehensive introduction to chemistry of food and to understand functional properties of carbohydrates, proteins, aminoacids and lipids, to understand the chemical changes in food components during processing and storage, to understand the importance and sources of fats and oils in foods, to understand the sources, chemical structures and effect of processing and storage of vitamins, to provide comprehensive introduction of food additives, pigments, flavoring agents and preservatives.*

Specific learning outcomes: *After successful completion of the course, students will be able to*

- *Describe chemical and functional properties as well as the importance of carbohydrates, proteins, aminoacids and lipids*
- *Demonstrate the effect of processing and storage of food components and vitamins*
- *Describe food additives, pigments, flavoring agents and preservatives.*

Unit I - Introduction to Food Chemistry and Carbohydrates

Introduction to Food Chemistry-Water activity and its influence on food quality and stability-Various methods for removal of water from foods – concentration and dehydration.

Carbohydrates-Chemical reactions and functional properties of sugars and polypeptides in foods-chemistry and structure of homosachharides and heterosachharides.

Unit II - Proteins, aminoacid and lipids

Protein and amino acids: structure, classifications, sources, denaturation and functional properties of proteins-Maillard browning.

Lipids: Various types of lipids – Simple, conjugated, phospholipids and their occurrence in foods, physical and chemical properties, effects of processing on functional properties.

Unit III - Fats and Oils

Importance of fats and oils in foods - Sources of fats and oils-Extraction of fats and oils – rendering, pressing, solvent extraction-Poly-unsaturated Fatty Acids- hydrogenation and rancidity; Saponification number, iodine value, Reichert-Meissl number, Polenske value-Lipids of biological importance like cholesterol and phospholipids.

Unit IV - Minerals and Vitamins

Sources and structures of minerals & vitamins - Effect of processing and storage of vitamins-Pro vitamins A & D; Vitamins as antioxidants.

Unit V - Food additives, Pigments, Flavouring Agents and Preservatives

Food additives-Antioxidants-Colouring agentsand emulsifiers-Flavour and flavour enhancers-Flour improvers-Humectants and anticaking agents-Leavening agents-pH control agents – Preservatives-stabilizers and other additives.

References

1. Essentials of Food & Nutrition by Swaminathan, Vol. 1 & 2.
2. Hand Book of Analysis of fruits & vegetables by S. Ranganna. Food Science (5^{th} Edn.,), Potter & Hotchkiss, CBS Publishers & Distributors

15CHEU05S1 CLINICAL CHEMISTRY (2 credit)

Objectives: *To understand the basics of human organ functions and to impart knowledge on clinical biochemistry and laboratory practices.*

Specific learning outcomes: *After successful completion of the course, students will be able to*

- *Describe the basic anatomy of human body*
- *Interpret laboratory results of blood and urine samples*
- *Measure total cholesterol, serum LDL and blood glucose level*

Unit I - Basics of Human Metabolism

Basics of Human Organ Functions - Plasma proteins in disease - Liver function and disease - Carbohydrate metabolism and its disorders - Disorders of detoxification and excretory mechanisms – renal function, Acid base disorders, Electrolyte and water Balance.

Unit II - Laboratory Techniques

Introduction to Clinical Laboratories - Laboratory Work Flow cycle - Phlebotomy equipments -Identification of Blood Collection Tubes &Preparation of Blood Plasma and Serum, Reticulocyte Count - Preparation of Blood Film -Blood staining, Liver Function Tests - Measurement of Serum ALT &AST, Liver Function Tests, Measurement of Serum Bilirubin (Total, direct &indirect).

Unit III - Renal Function

Renal Function Tests, Measurement of Serum BUN -Renal Function Tests -Measurement of Serum Creatinine Clearance -lipid Profile, - Routine Urine Analysis & Identification of Normal Physical and Chemical Urine Constituents.

Unit IV - Urine Analysis

Identification of Pathological Physical and Chemical Urine Constituents & Microscopic examination of Urine, Quantitative Determination of Urine Protein Proteinuria & Micro albuminuria Quantitative Determination of Urine Uric Acid Quantitative Determination of Urine Creatinine

Unit V - Blood Analysis

Measurement of Serum Total cholesterol, Measurement of Serum LDL-C, Measurement of Serum HDL-C,-Measurement of Serum TG, Diabetic Profile Tests Measurement of Blood Glucose.

References

1. Practical Clinical Biochemistry: Methods and Interpretations, R. Chawla, 3rd Edn., Jaypee Brothers Medical Publishers, New Delhi, 2003.
2. Fundamentals of Practical Clinical Biochemistry, B. Mohanty and S. Basu, B. I. publishers, New Delhi, 2006.

15CHEU05S2 FORENSIC SCIENCE (2 credit)

Objectives: *To understand the basics of Forensic Science, to impart awareness to the students on crime investigations and cyber crimes.*

Specific learning outcomes: *After successful completion of the course, students will be able to*

- *Demonstrate the basic concepts and terminologies of forensic science*
- *Analyze and interpret forensic samples*

Unit I - Introduction

History and introduction to forensic science- crime-types of crimes-The crime scene-physical evidence-definition- types of physical evidences- identification and comparison of physical evidences-Method of analysis in forensic science- spectrometry-microscopy.

Unit II - Traces at Crime Scene

Fiber- collection of fiber evidence-comparison of man-made fibres- forensic examination of paint-collection and preservation of paint evidence- collection and preservation of glass evidence-comparison of glass fragments- forensic characteristics of soil- comparison of soil specimens- density gradient tube techniques- collection and preservation of soil evidence. Firearms-types – mechanism of operation – traces at crime scene-bullet comparison- cartridge cases- Gun powder residues- serial number restoration- Tool marks- other impressions- impact of fire arms on victim's body.

Unit III - Human Specific Physical Evidences and analysis - I

Hair- collection of hair evidence-morphology of hair- identification and comparison of hair – Finger prints- classifications- methods of detecting- preserving developed finger prints-foot prints and lifting- foot wear and tire impressions. Hand writing comparison- genuine and forged writing- collection of samples- detection.

Unit IV - Human Specific Physical Evidences and Analysis – II

Blood group - forensic characterization of blood stains - paternity testing - forensic characterization of semen- collection of rape evidences- DNA analysis. Toxicology of alcohol- breath test instruments (breath analyzer) techniques used in toxicology - heavy metal poisoning - CO-poisoning- classification of drugs- drug identification- collection and preservation of drug evidence-snake poisoning.

Unit V - Cyber Crimes

The emergence of internet or cyber crime-common types of cyber crimes-Hacking, steeling of data, damage to personal data-abusing of personal data. Forensic investigation of cyber crime- Recovery and protection of computer crime evidences.

References

1. Saferstein, Richard, Criminalistics- An Introduction to Forensic Science, Prentice Hall, Fifth edition.

15CHEU05S3 PHARMACEUTICAL CHEMISTRY (2 credit)

Objectives: *To understand the basic concepts and strategies in drug design and synthesis, to provide preliminary introduction to anticancer drugs and their synthesis and recent developments in cancer therapy, to provide preliminary introduction to cardiovascular diseases, cardiovascular drugs and their synthesis, to provide preliminary knowledge on anti-infective drugs, antibiotics and their synthesis.*

Specific learning outcomes: *After successful completion of the course, students will be able to*

- *Demonstrate the strategies involved in drug design and synthesis of drugs*
- *Classify drugs, describe structure and its uses*

Unit I - Drug Terminology and Classification

Drug action, Terminologies used – Pharmacy, Pharmacology, Pharmacognosy- Pharmacophore- Pharmacodynamics- Antimetabolites – Chemotherapy – Pharmacopoeia.

Classification of Drugs – Biological and Chemical classification – Roots of drug administration, Mechanism of drug action, Metabolism of drugs- Biotransformation, Absorption of drugs , Factors affecting the absorption.

Unit II – Analgesics, antiseptics and disinfectants

Analgesics - Definition, Classification, Action of analgesics, Aspirin, Paracetamol, Narcotic analgesics.

Antiseptics and Disinfectants - Definition and Distinction, Uses of Phenols, Dyes, Chloroamine, Formaldehyde and Cationic surface active agents.

Unit III – Anesthetics

Anesthetics - Definition and Classification, Uses of Volatile anesthetics - Ether, Chloroform, Halothanes, Trichloroethylene, Ferguson Principle.

Gaseous anesthetic - Cyclopropane, Nitrous Oxide.

Non-Volatile anesthetics – Thiopental sodium.

Local anesthetics – Classification, Structure and uses of Procaine, Cocaine and Amethocaine.

Unit IV – Diabetics

Diabetics and Hypoglycemic drugs – Oral hypoglycemic agents, Sedatives and Hyponotics – Barbiturates.

Unit V – Diagnostic agents

Diagnostic agents – Radio Opaques, Preservatives, anti-oxidants, Sweetening agents, Emulsifying agents, Oniment bases, Colouring agents.

References

1. Jayashree Ghosh, A Text book of Pharmaceutical Chemistry, S. Chand & Co., New Delhi, 2009.
2. Ashutosh kar, Medicinal Chemistry, New Age International Publisher, New Delhi, 3rd Edn., 2006.

15CHEU06M1 COSMETIC CHEMISTRY (2 credit)

Objectives: *To create awareness among the undergraduate students about the role of chemistry in day- to- day life, to know more about the cosmetics and other chemicals that they use, to obtain adequate knowledge and scientific information regarding basic principles of cosmetic chemistry.*

Specific learning outcomes: *After successful completion of the course, students will be able to*

- *Choose cosmetics upon checking harmless chemical ingredients from various products available in the market*
- *Judiciously use cosmetics and other related chemicals.*

Unit I - Hair Care Products

Shampoos – principal constituents – thickeners and foam stabilizers – perfumes – preservatives – conditioning agents – antidandruff shampoos.

Hair cream – composition – hair dyes – types – constituents – dye removals

Unit II - Skin Care Product

Skin cleansers – classifications – cold cream – cleansy milk – moisturizers – hand and body lotions – sun screen lotions – constituents

Unit III - Colour Cosmetics

Lipstick – constitutions – manufacturing method – lip glosses – nail polish – formulation – manufacture – face powder – constitution.

Unit IV - Dental Product

Oral care product – product categories – toothpaste – toothpowder – oral rinses – mouth washes.

Unit V - Bath Preparation

Bath powders – soap and detergents – constituents – manufacture.

References

1. Modern Technology of Cosmetics, Asia Pacific Business Press Inc., New Delhi, 2004.

15CHEU06M2 NANOSCIENCE AND ITS APPLICATIONS (2 credit)

Objectives: *To introduce some of the fundamentals and current state-of-the-art in nanotechnology, to get familiarized with the synthesis, characterization and applications of nanomaterials.*

Specific learning outcomes: *After successful completion of the course, students will be able to*

- *Recognize state of the art developments in the field of nanotechnology*
- *Describe useful properties of nanotubes, quantum dots and nanoparticles.*

Unit I - Introduction to Nanoscience

Definition of terms-nanoscale, nanomaterials, nanoscience, nanotechnology-scale of materials-natural and manmade-nanoscience practiced during ancient and modern periods-contributors to the field of nanoscience.

Unit II - Synthesis of Nanomaterials

Top down and bottom up approaches-synthesis of carbon nanotubes, quantum dots, gold and silver nanoparticles.

Unit III - Characterization of Nanomaterials

Electron microscopy techniques-scanning electron microscopy, transmission electron microscopy, atomic force microscopy.

Unit IV - Application of Nanomaterials

Solar cells-smart materials-molecular electronics-biosensors-drug delivery and therapy-detection of cancerous cells.

Unit V - Nanotechnology in Nature

The science behind the nanotechnology in lotus effect-self cleaning property of lotus-gecko foot-climbing ability of geckos-water strider-antiwetting property of water striders-spider silk-mechanical properties of the spider silk.

References

1. T. Pradeep, Nano: The Essentials: Understanding Nanoscience and Nanotechnology, McGraw-Hill Professional Publishing, 2008.
2. J. Dutta, H.F. Tibbals and G.L. Hornyak, Introduction to Nanoscience, CRC press, Boca Raton, 2008.

15CHEU06M3 AGRICULTURAL CHEMISTRY (2 credit)

Objectives: *The objective of the course is to know the importance of agricultural chemistry and an exposure to analyze and find a suitable method to cultivate and to promote agricultural methods.*

Specific learning outcomes: *After successful completion of the course, students will be able to*

- *Describe the basics of soil*
- *Classify and explain plant nutrients and fertilizers*
- *Predict the mechanism of pesticides and herbicides*
- *Describe the structure and functions of plant growth regulators*

Unit I - Chemistry of soil

Composition of soil - Organic and Inorganic constituents. - Chemical aspects of soil - acid, alkali and saline soil. Nitrogen fixation in soils - biological nitrogen fixation.

Unit II - Plant Nutrients and Fertilizers

Plant nutrients - Sources and roles of macro and micro nutrients in plant growth - Nutritional deficiency in plants - symptoms, corrective measures - Fertilizers - classification of NPK fertilizers - natural and synthetic.

Unit III - Pesticides

Definition – Classification – organic and inorganic pesticides and its mechanism of action – Safe handling of pesticides, Fungicides - definition – classification – mechanism of action – sulfur, copper and mercury compounds.

Unit IV - Herbicides

Definition – classification – mechanism of action – Arsenic and boron compounds – urea compounds, nitro compounds and chloro compounds.

Unit V - Plant Growth Regulators

Definition - Classification - Structure and functions of - Abscisic acid - Auxins - Cytokinins - Ethylene - Gibberellins.

References:

1. Tisdale, S.L., Nelson, W.L. and Beaton, J. D. Soil Fertility and Fertilizers, Macmillian Publishing Company, New York, 1990
2. Hesse,P.R. A Textbook of Soil Chemical Analysis, John Murray, New York, 1971.
3. Buchel, K.H. Chemistry of Pesticides, John Wiley & Sons, New York, 1983
4. Sree Ramula, U. S. Chemistry of Insecticides and Fungicides, Oxford and IBH Publishing Co., New Delhi, 1979.

15CHEU06M4 WATER QUALITY ANALYSIS (2 credit)

Objectives: *The objective of the course is to give an in-depth understanding of water quality parameters, ground water and surface water pollution and its control measures. In addition, the students will also learn the water treatment methods, sewage and industrial effluent treatment methods and water resources management.*

Specific learning outcomes*: At the end of the course students will be able to:*

- *Analyze water samples*
- *Evaluate pollutants and their effect on environment and on human health*
- *Suggest water treatment methods for domestic and industrial purposes*
- *Describe the methods of sewage and industrial effluent treatment and water resource management*

Unit I - Water quality parameters and their determination

Physical, chemical and biological standards significance of these contaminants over the quality and their determinations - Electrical conductivity - turbidity - pH, total solids, TDS - alkalinity - hardness - chlorides - DO - BOD- COD - TOC - nitrate – sulphate, fluoride.

Unit II - Ground water and surface water pollution and control measures

Surface water and ground water pollution - Harmful effects-pollution of major rivers - protecting ground water from pollution - ground water pollution due to Fluoride, Iron, Chromium and Arsenic ~ sources, ill effects and treatment methods.

Unit III - Water treatment methods

Treatment for community supply - screening, sedimentation, coagulation, filtration - removal of micro organisms - chlorination, adding bleaching powder, UV irradiation and ozonation.

Unit IV - Sewage and industrial effluent treatment

Sewage - characteristics - purpose of sewage treatment - methods of sewage treatment - primary - secondary and tertiary - Role of algae in sewage treatment. Types of industrial wastes - treatment of effluents with organic and inorganic impurities.

Unit V - Water Management

Water resources management - rain water harvesting methods - percolation ponds - check dams - roof top collection methods - water management in industries.

References

1. Chemical and Biological Methods for Water Pollution Studies, R.K. Trivedy and P.K. Goel, Environmental Publications, 1986.
2. Engineering Chemistry, P.c. Jain and Monica Jain, Dhanpat Rai and Sons, 1993.
3. Environmental Chemistry, B.K. Sharma, Goel Publishing House,
4. Water Quality and Defluoridation Techniques, Rajiv Gandhi National Drinking Water Mission Publication, 1994.

Courses offered to B. Tech Civil Engineering programme

15CHEUCE01-ENGINEERING CHEMISTRY

Objectives:

The objective of the course is to emphasize the importance of water and its treatment methods for industrial applications, to give an overview of various types of fuels including their refining methods, to stress the importance of corrosion of metals and methods needed to protect the metallic materials, to make the students understand the need of high polymers and other engineering materials.

Specific learning outcomes: *Upon completion of the course, the students will be able to*

- *Describe the water treatment methods for industrial applications*
- *Categorize various types and sources of fuels*
- *Demonstrate methods to prevent corrosion of metallic materials*
- *Describe the importance of high polymers and engineering materials*

Unit-I Water

Sources and impurities - hardness of water - expression and estimation by EDTA - Treatment of water for boilers - lime-soda, Zeolite and deionization processes - internal treatment of boiler water - domestic water treatment - coagulation, filtration and disinfection - reverse osmosis.

Unit-II Energy Sources

Classification of fuels - gross and net calorific values - proximate analysis of coal - manufacture of coke - refining of petroleum - cracking - thermal and catalytic - petrol knocking, octane number - unleaded petrol - diesel knocking, centane number - water gas, producer gas and biogas.

Unit-III Corrosion and its control

Corrosion - chemical and electrochemical - factors affecting electrochemical corrosion - sacrificial anode - impressed current cathodic protection - surface treatments and protective coatings - oil paint - emulsion paint - special paints - heat resistant, fire retardant and luminous.

Unit-IV Polymeric Materials

Polymers - Addition and condensation - thermoplastics and thermosetting plastics - preparation and uses of polythene, PVC, Teflon, Nylon, Terylene, and Backelite - compounding of plastics - natural rubber - vulcanization - synthetic rubbers - butyl, nitrile and styrene - butadiene rubber - adhesives - epoxides, urethanes and silicones.

Unit-V Pollution and its control

Causes of air and water pollution - primary and secondary pollutants - assessment of water pollution - definition and significance of DO, BOD and COD - primary and secondary treatment of sewage - air pollution - environmental impact - acid rain, greenhouse effect and global warming, ozone depletion - smog - pollution control by Cottrell precipitator, bag filter and absorption towers.

References

1. M. R. Balasubramanium, S. Krishnamoorthy and V. Murugesan, Engineering Chemistry, Allied Publisher Limited., Chennai, 1993.
2. M. Karunanidhi, N. Ayyaswami, T. Ramachandran and H. Venkatraman, Applied Chemistry, Anuradha Agencies, 1994.
3. P. C. Jain and Monika Jain, Engineering Chemistry, Dhanpat Raj and sons, Delhi, 2008.
4. C. Daniel Yesudian, Engineering Chemistry, Hi-tech publications, 1999.

15CHEUCE02 ENGINEERING CHEMISTRY LABORATORY

Objectives: *The objective of the practical course is to enhance knowledge in basic principles of titrimetry, to develop skill in titrimetric analysis, to gain practical knowledge in oil analysis and to develop skill in identification of water quality parameters.*

Specific learning outcomes: *After successful completion of the course, students will be able to*

- *Prepare standard solutions*
- *Estimate hardness and alkalinity of water*
- *Estimate iron, sodium in water by spectrophotometric and flame photometric method respectively*
- *Demonstrate potentiometric and conductometric titrations*

1. Preparation of Standard solutions.
2. Estimation of hardness of water by EDTA method.
3. Estimation of different types and amounts of alkalinity in water – Indicator method.
4. Determination of ' Dissolved Oxygen ' — Winkler's method.
5. Estimation of iron in water — Spectrophotometer method.
6. Estimation of sodium in water — Flame Photometer method.
7. Determination of molecular weight of polymers — Viscometric method.
8. Determination of total dissolved solids in water.
9. Corrosion experiments:
   - Corrosion rate measurements.
   - Inhibition efficiency.
10. Electrochemistry experiments:
    - Determination of emf.
    - Single electrode potential.
    - Potentiometric and conductometric titration.

References

1. V. Venkateshwaran, R. Veeraswamy, A. R. Kulandaivelu, Basic Principles of Practical Chemistry, 2nd Edition, Sultan Chand & Sons, 1997.

15CHEUCE03 ENVIROMENTAL ENGINEERING LABORATORY

Objectives: *The objective of the practical course is to enhance practical knowledge in basic principles of environmental engineering, to develop skill in estimation of water quality parameters.*

Specific learning outcomes: *After successful completion of the course, students will be able to*

- *Determine total alkalinity and total hardness of water*
- *Detrmine the pH of water and sand*
- *Determine total dissolved solid and total suspended solids, BOD, COD in water*
- *Measure electrical conductivity of water*

1. Determination of total alkalinity of water.
2. Detarmination of (i) pH of water (ii) pH of sand
3. Determination of (i) Total solids (ii) Total Dissolved solids (iii) Total Suspended solids.
4. Determination of Electrical conductivity of water
5. Estimation of total hardness of water.
6. Estimation of ferrous Iron.
7. Estimation of Sulphate.
8. Estimation of available chlorine in bleaching powder.
9. Estimation of Chloride.
10. Determination of (i) BOD (ii) COD.

References

1. V. Venkateshwaran, R. Veeraswamy, A. R. Kulandaivelu, Basic Principles of Practical Chemistry, 2nd Edition, Sultan Chand & Sons, 1997.
2. B.Kotaiah, N. Kumaraswamy, Environmental Enginneering Laboratory Manual, Charotar Publishing House Pvt. Ltd., New Delhi 2007.