Tuljaram Chaturchand College of Arts, Science and Commerce, Baramati, Dist. Pune.
(Autonomous)
Affiliated to Savitribai Phule Pune University, Pune.
Department of Chemistry
T.Y. B. Sc. Chemistry Syllabus
To be implemented from Academic Year 2021-2022 (June 2021)

Semester	Course Code and Title of the paper	Number of Credits	Max. Marks (Int.+Ext.= Total)
V	**THEORY PAPERS**		
	CHEM -3501:Physical Chemistry- I	**03**	**40 + 60 = 100**
	CHEM -3502: Inorganic Chemistry-I	**03**	**40 + 60 = 100**
	CHEM -3503: Organic Chemistry-I	**03**	**40 + 60 = 100**
	CHEM -3504: Analytical Chemistry-I	**03**	**40 + 60 = 100**
	CHEM -3505: Industrial Chemistry-I	**03**	**40 + 60 = 100**
	OPTIONALTHEORY PAPER (Select *ANY ONE* of the following)		
	CHEM- 3506 (A)Nuclear Chemistry- I	**03**	**40 + 60 = 100**
	CHEM- 3506 (B)Polymer Chemistry-I		
	CHEM- 3506 (C)Introduction to Biochemistry and Molecular Biology-I		
	CHEM- 3506 (D)Environmental and Green Chemistry-I		
	CHEM- 3506 (E) Agriculture Chemistry		
	CHEM- 3506 (F) Synthesis of Nanomaterials and Nanotoxicology		
	PRACTICAL PAPERS		
	CHEM- 3507 :Physical Chemistry Practical-I	**03**	**40 + 60 = 100**
	CHEM- 3508 :Inorganic Chemistry Practical- I	**03**	**40 + 60 = 100**
	CHEM- 3509 :Organic Chemistry Practical - I	**03**	**40 + 60 = 100**
VI	**THEORY PAPERS**		
	CHEM -3601:Physical Chemistry- II	**03**	**40 + 60 = 100**
	CHEM -3602: Inorganic Chemistry-II	**03**	**40 + 60 = 100**
	CHEM -3603: Organic Chemistry-II	**03**	**40 + 60 = 100**
	CHEM -3604: Analytical Chemistry-II	**03**	**40 + 60 = 100**
	CHEM -3605: Industrial Chemistry-II	**03**	**40 + 60 = 100**
	OPTIONALTHEORY PAPER (Select *ANY ONE* of the following)		
	CHEM- 3606 (A)Nuclear Chemistry-II	**03**	**40 + 60 = 100**
	CHEM- 3606 (B)Polymer Chemistry-II		
	CHEM- 3606 (C)Introduction to Biochemistry and Molecular Biology-II		
	CHEM- 3606 (D)Environmental and Green Chemistry-II		
	CHEM- 3606 (E) Dairy Chemistry		
	CHEM- 3606 (F) Environmental Nanotechnology and Applications		
	PRACTICAL PAPERS		
	CHEM- 3607: Physical Chemistry Practical-II **OR** CHEM- 3607 (P): Project work Physical Chemistry	**03**	**40 + 60 = 100**
	CHEM- 3608: Inorganic Chemistry Practical-II **OR** CHEM- 3608 (P): Project work Inorganic Chemistry	**03**	**40 + 60 = 100**
	CHEM- 3609: Organic Chemistry Practical – II **OR** CHEM- 3609 (P): Project work Organic Chemistry.	**03**	**40 + 60 = 100**

Note: In semester VI, it is mandatory for every student to select two practical papers and remaining one project paper.

Semester V

CHEM 3501: Physical Chemistry – I, (03 Credits, 48 Lectures)

Unit No.	Unit	No. of Lecture
1	Investigation of Molecular Structure	16
2	Electrolytic conductance	14
3	Photochemistry	12
4	Colloids	06

Course Objectives:

1. To know the structure related properties of molecules such as molar refraction, molar polarization, dipole moment etc.
2. To learn molecular spectroscopy for determination of structural parameters.
3. To aware the Ohm's law and electrical units such as coulomb, Ampere, Ohm and Volt; Meaning of specific resistance, specific conductance, cell constant and their units.
4. To determine theoretically and experimentally cell constant, specific resistance, specific conductance etc. and to become familiar to preparation of conductivity water.
5. To learn Arrhenius theory, Debye-Huckel-Onsager Interionic Attraction theory, Asymmetry /Relaxation effect, Electrophoresis effect, Fugacity and activity concept etc.
6. To know thermal and photochemical processes, different laws of photochemistry, Jablonski diagram, radioactive and non-radioactive processes, quantum yield etc.
7. To understand colloidal system, their different classification and properties, and its applications.
8. The students are expected to solve the numerical problems on relevant topics.

Course Outcomes:

1. Understand in details about molar refraction, polarization of molecule, dipole moment and its experimental determination.
2. Learn different types of spectroscopy techniques, their principles, their limitations and applications.
3. Know the various terminology used in electrolytic conductance as well as applications of measurement of conductance.
4. Discuss the different theories of conductance and develop the skill to determine concentration of electrolytes.
5. Identify the thermal and photochemical process and able to discuss the difference between them. Apply the different laws of photochemistry.
6. Understand the meaning of colloidal system, types of colloids,Tyndall effect, Brownian movement, surfactants, emulsions, gels, importance and applications of colloids.
7. Enhance the ability of students towards thinking, reasoning and solving the numerical based topics

Unit 1: Investigation of Molecular Structure (16 L)

Molar refraction, Electrical polarization of molecules, Permanent dipole moment, Determination of dipole moment, Rotational spectra of diatomic molecules, intensities of spectral lines, vibrational spectra of diatomic molecule, rotational vibrational spectra of diatomic molecule, selection rule. Born- Oppenheimer approximation, quantum and classical theory of Raman spectra, Raman effect, pure rotational Raman spectra, Numericals.

Unit 2: Electrolytic Conductance (14 L)

Recapitulation of Electrolytic conductance, Specific and equivalent conductance, Variation of equivalent conductance with concentration, Kohlrausch's law and its applications to determine Equivalent conductanceat infinite dilution of a weak electrolyte, The ionic product of water, Solubility of sparingly soluble salts, Migration of ions and ionic mobilities, absolute velocity of ions, Transport number determination by Hittorf's method and moving boundary method, Relation between ionic mobility, ionic conductance andtransport number, Ionic theory of conductance, Debye-Hückel-Onsager equation and its validity, Activity insolution, fugacity and activity coefficient of strong electrolyte, Conductometric titrations, Numericals.

Unit 3: Photochemistry (12 L)

Interaction of radiation with matter, difference between thermal and photochemical processes, Laws of photochemistry: Grotthuss – Draper law, Stark – Einstein law, Jablonski diagram depicting various processes occurring in the excited state, qualitative description of fluorescence, phosphorescence, non- radiative processes (internal conversion, intersystem crossing), quantum yield, photosensitized reactions – energy transfer processes (simple examples), Kinetics of Photo chemical reaction, Numerical.

Unit 4: Colloids (06 L)

Types of colloidal system, classification of colloids, lyophobic and lyophilic sols, preparation of colloidal solution, Tyndall effect, Brownian movement, Determination of size of colloidal particles, surfactants, emulsions, gels, importance and applications of colloids.

Reference books

1. Principles of Physical Chemistry, S.H. Marron and C.F. Prutton, 4 th edn
2. Essentials of Physical Chemistry, B. S. Bahl, G.D Tuli- Revised multicolor edn 2009.S Chand
3. Physical Chemistry- a molecular approach, Donald A. McQuarrie, John D. Simon.
4. Physical Chemistry, G. M. Barrow, Fifth edn.

Class: T.Y.B.Sc. (SEM V) **Subject**: Chemistry
Course: Physical Chemistry **Course Code**: CHEM 3501
Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

Mapping of Course Outcomes with Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	0	0	0	0	0	0	0	0
CO2	0	0	3	0	0	0	0	0	0
CO3	0	0	3	0	0	0	0	0	0
CO4	0	0	0	3	0	0	0	0	0
CO5	0	0	0	0	3	0	0	0	0
CO6	0	0	0	0	0	3	0	0	0
CO7	0	3	0	0	0	0	3	0	0

Justification of Mapping

PO1: Disciplinary Knowledge:

CO1: Understanding molar refraction, polarization of molecules, dipole moments, and their experimental determination (Strong Relation: 3)

PO2: Critical Thinking and Problem Solving:

CO7: Enhancing students' ability to think, reason, and solve numerical problems (Strong Relation: 3)

PO3: Social Competence:

CO2: Learn different types of spectroscopy techniques, their principles, their limitations and applications.

CO3: Know the various terminology used in electrolytic conductance as well as applications of measurement of conductance.

PO4: Research-related Skills and Scientific Temper:

CO4: Discussing different theories of conductance and determining the concentration of electrolytes (Strong Relation: 3)

PO5: Trans-Disciplinary Knowledge:

CO5: Identifying thermal and photochemical processes, applying different laws of photochemistry (Strong Relation: 3)

PO6: Personal and Professional Competence:

CO6: Understanding colloidal systems, types of colloids, their effects, importance, and applications (Strong Relation: 3)

CHEM 3502: Inorganic Chemistry – I, (03 Credits, 48 Lectures)

Unit No.	Unit	No. of Lecture
1	Werner's theory of Coordination Compounds	04
2	Isomerism in Coordination Complexes	06
3	Sidgwick Theory	06
4	Pauling's Valence Bond Theory	08
5	Crystal Field Theory	10
6	Molecular Orbital Theory of Coordination Complex	08
7	Concept and Scope of Ligand Field Theory	06

Course Objectives:

1. Students should know meaning of various term involved in coordination chemistry
2. Students able to understand different theories of complex formation and the geometries, isomerism of various types of complexes.
3. Students should know geometry of complexes with CN 4 and 6 as well as find out the stability of complexes with EAN rule.
4. Students able to understand merit and demerits of Sidgwick theory.
5. Students able to explain structure and magnetic behavior of complexes.
6. Students should know the assumptions and limitations of VBT and CFT.
7. Students able to compare the different approaches to bonding in coordination compounds.

Course Outcomes:

1. Know the various terms involved in coordination chemistry apply to coordination compounds.
2. Understanding the different theories of complex and various types of isomerism .
3. Use of EAN rule to calculate value of complexes and its stability.
4. Know the Sidgwick theory and formation square planner, tetrahedral octahedral complexes.
5. Know the structure and magnetic behavior of complexes.
6. Know the various assumption and limitations of VBT and CFT.
7. Know the different approaches to bonding in coordination compounds.

Coordination Chemistry

Unit 1: Werner's theory of Coordination Compounds (04 L)

Assumptions of Werner's coordination theory, Werner's formulation of Coordination compounds, Physical and chemical test to support his formulation of ionisable and non-ionisable complexes, Stereoisomerism in complexes with C.N.4 and C.N. 6 to identify the correct geometrical arrangement of the complexes.

Unit 2: Isomerism in Coordination Complexes (06 L)

Definition of isomerism in Complexes-Structural Isomerism and stereoisomerism,

Structural isomerism (ionization, hydrate, linkage, ligand, coordination position and polymerization isomers)

Stereoisomerism and its Types-Geometrical isomerism and optical isomerism.

Unit 3: Sidgwick Theory (06 L)

Concept of Sidgwick's model, Scheme of arrow indication for M-L bond suggested by Sidgwick's, Effective Atomic Number rule (EAN), Calculations of EAN value for different complexes and stability of complexes, Advantages and Drawbacks of Sidgwick's theory.

Unit 4: Pauling's Valence Bond Theory (08 L)

Introduction of Valence Bond Theory (VBT), Need of concept of hybridization, Aspects of VBT, Assumptions, VB representation of tetrahedral, square planer, trigonal Bi-pyramidal and octahedral complexes with examples, Inner and outer orbital complexes, Electro neutrality principle, Multiple bonding(dπ-pπ and dπ-dπ), Limitations of VBT.

Unit 5: Crystal Field Theory (10 L)

Introduction and need of Crystal Field Theory(CFT), Assumptions, Shapes and degeneracy of d orbital, Splitting of d-orbitals, Application of CFT to octahedral complexes, pairing energy(P) and distribution of electrons in e_g and t_{2g} level, calculation of magnetic moment using spin-only formula, Crystal Field Stabilization Energy (CFSE), calculation of CFSE in weak oh field and strong oh field complexes, Evidence for CFSE, Interpretation of spectra of complexes, calculation of 10 Dq and factors affecting magnitude of 10Dq, d-d transitions and colour of the complexes, Jahn-Teller distortion theorem for octahedral complexes and its illustration, CFT of tetrahedral and square planar complexes, calculations of CFSE, Spectrochemical series, Nephelauxatic effect and Nephelauxatic series, Limitations of CFT, modified CFT (LFT), Problems related to calculation of 10 Dq, CFSE and spin only magnetic moment for octahedral, tetrahedral & square planar complexes. (i.e. for high spin & low spin complexes)

Unit 6: Molecular Orbital Theory of Coordination Complex (08 L)

Introduction, Assumptions, MO treatment to octahedral complexes with sigma bonding, Formation of MO'sfrom metal orbitals and Composite Ligand Orbitals (CLO), MO correlation diagram for octahedral complexes with sigma bonding, effect of π bonding, Charge transfer spectra, Comparison f VBT, CFT, and MOT.

Unit 7: Concept and Scope of Ligand Field Theory (06 L)

Free ion configuration, Term and states, Energy levels of transition metals, free ion term, Term wave function, Spin orbit coupling,

Reference Books

1. Introduction to Electrochemistry by Glasstone – 2nd edition.
2. Concise Inorganic Chemistry by J.D. Lee – 5th edition.
3. Inorganic Chemistry, - D.F. Shiver & P.W. Atkins- C. H. Longford ELBS - 2nd edition.
4. Basic Inorganic Chemistry, - F.A. Cotton and G. Wilkinson, Wiley Eastern
Ltd 1992.5.Concept and Model of Inorganic Chemistry by Douglas – Mc
Daniels – 3rd edition.
6. Chemistry by Raymond Chang – 5th edition
7. New Guide to Modern Valence Theory by G.I. Brown – 3rdedition
8. Co-ordination Compounds by Baselo and Pearson.
9. Theoretical Inorganic Chemistry by Day and Selbin.
10. Inorganic Chemistry by A. G. Sharpe – 3rd Edition.
11. Coordination Chemistry by A. K. De.

Class: T.Y.B.Sc. (SEM V) **Subject**: Chemistry
Course: Inorganic Chemistry **Course Code**: CHEM 3502
Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

Mapping of Course Outcomes with Program Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	3	0	0	0	0	0	0	0	0
CO2	3	0	0	0	0	0	0	0	0
CO3	0	0	3	0	0	0	0	0	0
CO4	0	0	0	3	0	0	0	0	0
CO5	0	0	0	3	0	0	0	0	0
CO6	0	0	0	0	0	3	0	0	0
CO7	0	0	0	0	0	3	0	0	0

Justification of Mapping

PO1: Disciplinary Knowledge:
CO1: Know the various terms involved in coordination chemistry apply to coordination compounds.
CO2: Understanding the different theories of complex and various types of isomerism.

PO3: Social Competence:
CO3: Applying the EAN rule to calculate complex stability

PO4: Research-related Skills and Scientific Temper:
CO4: Know the Sidgwick theory and formation square planner, tetrahedral octahedral complexes.
CO5: Know the structure and magnetic behaviour of complexes.

PO6: Personal and Professional Competence:
CO6: Know the various assumption and limitations of VBT and CFT.

CO7: Know the different approaches to bonding in coordination compounds

CHEM 3503: Organic Chemistry – I, (03 Credits, 48 Lectures)

Unit No.	Unit	No. of Lecture
1	Strength of organic acids and bases	07
2	Stereochemistry of di-substituted cyclohexane	06
3	Nucleophilic Substitution at Aliphatic Carbon	08
4	Elimination Reaction	06
5	Aromatic Electrophilic and Nucleophilic substitution reactions	10
6	Carbanion and Their Reactions	06
7	Green Chemistry	05

Course objectives:

1. Students will be able to remember the strength of acids and bases
2. Students will be able to understand the stereochemistry of substituted cyclohexane.
3. Students will be able to remember the nucleophiles and their substitution at aliphatic carbon with mechanism.
4. Students will be able to understand the concept of elimination reaction.
5. Students will be able to understand the carbanion and their reactions.
6. Students will be able to use the concept of electrophilic substitution for aromatic compounds.
7. Students will be able to understand the principles of green chemistry.

Course Outcomes:

1. Students should be able to get knowledge of strength of acids and bases.
2. Students should be able to know the stereochemistry of substituted cyclohexane. Apply it for to make the models to study their stability.
3. Students should be able to know mechanism of substitution reactions.
4. Students should be able to compare the Saytzeff's and Hofmann elimination reactions.
5. Students should be able to compare the mechanism of electrophilic and nucleophilic substitution reactions.
6. Students should be able to know the reactions of carbanions.
7. Students should be able to know the importance principles of green chemistry.

Unit 1. Strength of organic acids and bases. (07 L)

Introduction, pK_a, Origin of acidity, Influence of solvent, Simple aliphatic saturated and unsaturated acids, Substituted aliphatic acid, Phenols, Aromatic carboxylic acids, pK_a and emperature, pK_b, Aliphatic and aromatic bases, acid and bases catalysis.

Ref. 5: Pg. -53-75, Ref. 4: Relevant pages.

Unit 2. Stereochemistry of di-substituted cyclohexane.

(06 L)

Introduction, 1,1-alkyl substituted cyclohexane, 1,2; 1,3; 1,4-di methyl cyclohexane- geometrical isomerism, optical isomerism, Stability of conformation, Energy calculation.

Ref. 1: Relevant pages, Ref. 3: Pg. 204-214.

Unit 3. Nucleophilic Substitution at Aliphatic Carbon

(08 L)

Introduction, Nucleophiles and leaving groups, Mechanism of nucleophilic substitution, The S_N1 reaction: Kinetic, mechanism and stereochemistry, stability of carbocation, The S_N2 reaction: Kinetic, mechanism and stereochemistry. How to know whether a given reaction will follow S_N1 or S_N2 mechanism, S_Ni reaction and mechanism.

Ref. 1: Pg. 172-203, 208-201, Ref. 5: Relevant pages.

Unit 4. Elimination Reaction. (06 L)

Introduction, 1,1; 1,2-elimination, E1, E2 and E1cB mechanism with evidences, Hoffmann and Saytzeff'selimination, Reactivity, Effect of structure, Attacking and leaving groups.

Ref. 1: Pg. -53-75, Ref. 2: Relevant pages.

Unit 5. Aromatic Electrophilic and Nucleophilic substitution reactions (10 L)

Introduction, Arenium ion mechanism, Effect of substituent groups (orientation, o/p directing and meta directing groups), Classification of substituent groups (activating and deactivating group). Mechanism of nitration, sulphonation, halogenation, Friedel-Craft reactions, diazo-coupling reactions, Ipso substitution. Addition elimination (S_NAr), S_N1, Elimination- addition (benzyne) S_NR1 reactions, reactivity.

Ref. 1: Pg.- 517-544, 666-667, Ref. 4 and 5: Relevant pages.

Unit 6. Carbanion and Their Reactions (06 L)

Introduction, Formation and stability of carbanion, Reaction involving carbanions and their mechanism-Aldol, Claisen, Dieckman and Perkin condensation; Synthesis and synthetic applications of –Wittig reagent.Ref. 5: Pg.-270-299.

Unit 7. Green Chemistry: **(05 L)**

Introduction, twelve principles of green chemistry, Green solvents, Atom economy, lesshazardous chemical synthesis, Designing safer chemicals, Safer solvents and auxiliaries.

Ref. 6: Relevant pages.

Reference books

1. Organic Chemistry by Morrison and Boyd 6thEdn.
2. Organic Chemistry by Cram and Hammond.
3. Stereochemistry of Organic compounds by Eliel, Tata MC Grow Hill 1989.
4. Organic Chemistry by Clayden, Greeves, Warren and Wothers (Oxford press)
5. A guide book of reaction mechanism by Peter Sykes 5thEdn.
6. New Trends in Green Chemistry- V.K. Ahluwalia, M. Kidwai
7. Introduction, Formation and stability of carbanion, Reaction involving carbanions and their mechanism-Aldol, Claisen, Dieckman and Perkin condensation; Synthesis and synthetic applications of –Wittig reagent.

Class: T.Y.B.Sc. (SEM V) **Subject** :Chemistry

Course: Organic Chemistry **CourseCode** : CHEM 3503

Weightage: 1=weak or low relation,2=moderate or partia relation,3=strong or direct relation

Mapping of Course Outcomes with Program Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	3	0	0	0	0	0	0	0	0
CO2	0	0	3	0	0	0	0	0	0
CO3	0	0	0	3	0	0	0	0	0
CO4	0	0	0	0	3	0	0	0	0
CO5	0	0	0	0	0	3	0	0	0
CO6	0	0	0	0	0	3	0	0	0
CO7	0	0	0	0	0	0	3	0	0

Justification of Mapping

PO1: Disciplinary Knowledge:

CO1: Understanding the strength of acids and bases

PO3: Social Competence:

CO2: Understanding stereochemistry and its applications in stability studies

PO4: Research-related Skills and Scientific Temper:

CO3: Students should be able to know mechanism of substitution reactions.

CO4: Students should be able to compare the Saytzeff's and Hofmann elimination reactions.

PO5: Trans-Disciplinary Knowledge:

CO5: Students should be able to compare the mechanism of electrophilic and Nucleophilic substitution reactions.

CO6: Students should be able to know the reactions of carbanions.

PO7: Effective Citizenship and Ethics:

CO7: Grasping principles of green chemistry

CHEM 3504: Analytical Chemistry – I, (03 Credits, 48 Lectures)

Unit No.	Unit	No. of Lecture
1	Gravimetric Analysis	12
2	Thermal methods of analysis	06
3	Spectrophotometer	10
4	Polarography	08
5	Flame Emission Spectroscopy	06
6	Atomic Absorption Spectroscopy	06

Course Objectives:-

1. Students should know the basic things in gravimetric analysis (Principle, apparatus, steps etc.)
2. Students able to know different types of thermal analysis by using TGA, DTA, DSC etc techniques.
3. Students should know the principle of spectrophotometry, different terms like absorption, transmittance etc. and laws of spectrophometer as well as instrumentation.
4. Students able to know different instrumentation like voltammetry, polarography as an analytical tool.
5. Students should know the FES, its principle and instrumentation.
6. Students should know the AAS, its principle and instrumentation.
7. Student aware to all analytical techniques.

COURSE OUTCOMES:-

1. Understanding the basic thing applied for in gravimetric analysis.
2. Know the different thermal methods applied in analysis.
3. Understanding the spectroscopic method used in analysis.
4. Understanding the instrumentation in different analysis.
5. Know the FES used in experimental analysis.
6. Know the AAS used in experimental analysis.
7. Understanding different techniques applied for various analysis.

Unit 1. Gravimetric Analysis (12 L)

Common ion effect and solubility product principles, Conditions for good precipitation, Factors affecting precipitation like acid, temperature, nature of solvent, super saturation and precipitation formation, Precipitation from homogeneous solution and examples, Co-precipitation, post precipitation and remedies for their minimization, washing of precipitate and ignition of precipitate, Brief idea about method of filtration and drying of precipitate,

Introduction to electrogravimetry: principle, applications, electrolytic separations of Cu and Ni, Numericalproblems only on gravimetric analysis.

Ref. 1.Pg. 22-28, 30-33, 95, 107-114, 169-171, 403-404, 407-415, Ref. 3.Pg. 527-532

Unit 2. Thermal methods of analysis (06L)

Principle of thermal analysis, classification of thermal techniques, Principle, instrumentation and applications of TGA and DTA, factors affecting the thermal analysis, numerical problem.

Ref. 1.Pg. 515-527,531-537, Ref. 6 Pg. 732-737

Unit 3. Spectrophotometry (10 L)

Introduction, Electromagnetic spectrum, Interaction of electromagnetic radiations with the matter, Mathematical Statement and derivation of Lambert's Law and Beer's Law, Terminology involved inspectrophotometry analysis, Instrumentation of single beam colorimeter, Instrumentation of single and double beam spectrophotometer, Principle of additivity of absorbance and simultaneous determination, Spectrophotometric Titrations, Experimental Applications-Structure of organic compounds, Structure of complexes, Numerical Problems

Ref. 1 Pg. 693-705, Ref. 3 Pg. 144-153, 157-160, 170-174

Unit 4. Polarography (08 L)

Introduction to voltammetric methods of analysis, Principles of polarographic analysis, Dropping Mercury Electrode, Instrument and working of polarographic apparatus, Ilkovic equation and quantitative analysis, Polarogram and chemical analysis, Analysis of mixture of cations, Factors affecting Polarographic wave, Quantitative Applications, Numerical Problems

Ref.6. Pg.691-734

Unit 5. Flame Emission Spectroscopy (06 L)

Introduction and theory of atomic emission spectroscopy, Instrumentation of single beam flame emission spectrophotometer, Measurement of emission of atomic species, Interferences in emission spectroscopy, Methods of analysis- calibration curve method, Standard addition method, and internal, standard method, Qualitative and Quantitative Applications of FES, Numerical Problems.

Ref. 3.Pg. 321-322, 336-341, 364-370, 372-376

Unit 6. Atomic Absorption Spectroscopy (06 L)

Introduction and theory of atomic absorption spectroscopy, Instrumentation of single beam atomic absorption Spectrophotometer, Measurement of absorbance of atomic species by AAS, Spectral and Chemical Interferences, Qualitative and Quantitative Applications of AAS. Numerical Problems.

Ref. 3.Pg. 321-342

Reference books

1. Textbook of Quantitative Chemical Analysis- 3rd Edition, A. I. Vogel
2. Principles of Physical Chemistry 4th edition – Prutton and Marron
3. Instrumental Methods of Chemical Analysis- Chatwal and Anand
4. Basic Concept of Analytical Chemistry-2nd edition S.M. Khopkar
5. Vogel's textbook of Quantitative Inorganic Analysis-4th edition
6. Instrumental Methods of Chemical Analysis- 6th edition Willard, Merritt, Dean and Settle
7. Analytical Chemistry by Skoog
8. Introduction to Instrumental Analysis- R.D. Braun
9. Instrumental methods of Chemical Analysis-Willard, Dean & Merrit-6th Edition

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Class: T.Y.B.Sc. (SEM V) **Subject**: Chemistry
Course: Analytical Chemistry-I **Course Code**: CHEM 3504
Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

Mapping of Course Outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	0	0	0	0	0	0	0	0
CO2	0	3	0	0	0	0	0	0	0
CO3	0	3	3	0	0	0	0	0	0
CO4	0	0	3	0	0	0	0	0	0
CO5	0	0	3	0	0	0	0	0	0
CO6	0	0	3	0	0	0	0	0	0
CO7	0	0	0	0	0	0	3	0	0

Explanation of Mapping:

PO1: Disciplinary Knowledge:

CO1: Understanding basic principles of gravimetric analysis

PO2: Critical Thinking and Problem Solving:

CO2: Know the different thermal methods applied in analysis.

CO3: Understanding the spectroscopic method used in analysis.

PO3: Social Competence:

CO4: Understanding the instrumentation in different analysis.

CO5: Know the FES used in experimental analysis.

CO6: Know the AAS used in experimental analysis.

PO7: Effective Citizenship and Ethics:

CO7: Understanding various techniques applied for different types of analysis

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CHEM 3505: Industrial Chemistry – I, (03 Credits, 48 Lectures)

Unit No.	Unit	No. of Lecture
1	Modern Approach to Chemical Industry	08
2	Manufacture of Heavy Chemicals	08
3	Fertilizers	08
4	Sugar Industry and Fermentation Industry	08
5	Cement and Glass Industry	08
6	Small Scale Industries	08

COURSE OBJECTIVES:-

1. Students should know the terminology used industries.
2. Students able to understand the different steps in manufacturing of heavy chemical
3. Students should know the uses and application of cement, sugar and glass industries.
4. Students able to understand the different constituents and synthesis in fertilizers.
5. Student should understand aspects of small scale industries.
6. Students should know modern approach towards chemical industry.
7. Students should able to understand general terms like patent, copyright, trademarks.

COURSE OUTCOMES:-

1. Understanding the production processes and technologies used in the sugar, cement, fertilizer, and glass industries.
2. Analyzing the economic, environmental, and social impacts of these industries.
3. Identifying the key factors influencing the growth and development of these industries.
4. Evaluating the challenges and opportunities faced by the sugar, cement, fertilizer, and glass industries.
5. Applying relevant theories and concepts to solve problems and make informed decisions in these industries.
6. Developing effective communication and teamwork skills necessary for working in these industries.
7. Exploring sustainable practices and innovations in the sugar, cement, fertilizer, and glass industries.

Unit 1. Modern Approach to Chemical Industry (08 L)

Introduction, basic requirements of chemical industries, chemical production, raw materials, unit process and unit operations, Quality control, quality assurance, process control, research and development, pollution control, human resource, safety measures, classification of chemical reactions, batch and continuous process, Conversion, selectivity, and yield, copy right act, patent act, trademarks

Ref.1: Chapter 2 Pg. 26, 27, 31 to 36, Ref.4: Chapter 1 and 2, Ref.6: Chapter 1, 2 and 3

Ref: Websites and Web Pages www.wikipedia.org/wiki/patentact, www.wikipedia.org/wiki/trademarks, www.wikipedia.org/wiki/copyright_act_of1976

Unit 2. Manufacture of Heavy Chemicals (08 L)

Introduction, Manufacture of Ammonia (NH_3) i. Physico-chemical principles ii. Manufacture by Haber's process. Its uses.

Manufacture of Sulphuric acid (H_2SO_4) i. Physico-chemical principles ii. Manufacture by Contact process. Its uses.

Manufacture of Nitric acid (HNO_3) i. Physico-chemical principles ii. Manufacture by Ostwald's (Ammonia oxidation process). Its uses. Ref. 7: Pg. 571 to 588, 618 to 664

Unit 3. Fertilizers (08 L)

Introduction, Plant Nutrients, important of fertilizers, Nutrient functions, Fertilizer types, organic manure, Need for fertilizers, Essential requirements, Classification of fertilizers, inorganic fertilizers, Artificial- fertilizers- Nitrogenous fertilizers Ammonium sulphate, Urea (Manufacture of Urea & Ammonium Sulphate), Action of Ammonium Sulphate & Urea as Fertilizer, Phosphatic Fertilizers- Triple Super Phosphate (Manufacturing Process Only), Potassium fertilizer, Manufacture of mixed fertilizers.

Ref. 5: - Chapter 26

Unit 4. Sugar Industry and Fermentation Industry: (08 L)

Introduction, Important of sugar industry, Manufacture of cane sugar from sugarcane in India:

Extraction of juice, Clarification, Concentration, crystallization, centrifugation, and other details of industrial process. Utilization of by-products of sugar industries. Testing and estimation of Analysis sugar by-I-Calorimetry II- Fehling solution.

Ref. 3: Chapter 38 Pg.1208 to 1218

Fermentation Industry: Introduction, importance, Basic requirements of fermentation process, Factors favoring fermentation, Fermentation operations. Manufacture of industrial alcohol from molasses, fruits, food grains, & ethylene, importance Power alcohol.

Ref.2: Pg. 578-596. Ref.3: Chapter 36, Pg. 1175-1190

Unit 5. Cement and Glass industry (08 L)

Cement industry: - Introduction, Definition and classification of cement, Importance, composition of Portland cement, Raw materials, proportioning of raw materials, Manufacture of Portland cement by usingmodern vertical shaft kiln/Rotary kiln, Uses of cement

Ref.7: Pg. 313-333 Ref. 8: Pg. 173-176, Ref. 10: Pg. 188-192

Glass industry Introduction, importance, Composition and structure of glass, physical and chemical properties of glass, chemical reaction, classification of glass, Outline of manufacture of Glass.

Ref.7: Pg.160-171; Ref. 8: Pg.247-265; Ref. 9: Pg. 197-212

Unit 6. Small Scale Industries (08 L)

Introduction and Aspects of Small-Scale Industries, Safety Matches, Agartbatties, Naphthalene balls, Wax Candles, Shoe Polishes, Gum Paste, Writing and fountain Pain ink, Plaster of Paris, Silicon Carbide Crucibles, how to Remove Stains and Liquid Phenyl Manufacturing.

Reference books

1. Principles of Industrial Chemistry, Chris A Clausen III and Guy Mattson, John Wiley and Sons, Inc.Somerset, 1978, New York.
2. Shreve's Chemical Process Industries, George T. Austin, 5 th Edition, The McGraw-Hill,
3. Industrial Chemistry by B. K. Sharma, 16th Edition, 2011
4. Comprehensive Industrial Chemistry, P.G. More, 1st Edition, Pragati Prakashan, Meerut,

5. Industrial Chemistry by B. K. Sharma, 16th Edition, 2011

6. Handbook of Industrial Chemistry Organic Chemicals, Mohammad Farhat Ali, Bassam M. El Ali, James

G. Speight, The McGraw-Hill Companies, 2005, ISBN 0-07-141037-6

7. Industrial Chemistry-B.K. Sharma, Goyal publishing house, Meerut,

8. Shreve's chemical process industries 5th Edition, G.T. Oustin, McGraw Hill

9. Rigel's handbook of Industrial chemistry, 9th Edition, Jems A. Kent

10. Industrial chemistry –R.K. Das, 2nd Edition, 1976.

Class : T.Y.B.Sc. (SEM V) **Subject:** Chemistry
Course : Industrial Chemistry – I **Course Code :** CHEM 3505
Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

Mapping of Course Outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	0	0	0	0	0	0	0	0
CO2	0	3	3	0	0	0	0	0	0
CO3	3	0	0	0	0	0	0	0	0
CO4	3	0	0	0	0	0	0	0	0
CO5	0	3	0	0	0	0	0	0	0
CO6	0	0	0	0	0	3	0	0	0
CO7	0	0	3	0	0	0	0	0	0

Justification of Mapping

PO1: Disciplinary Knowledge:

CO1: Understanding the production processes and technologies used in the sugar, cement, fertilizer, and glass industries.

CO3: Identifying the key factors influencing the growth and development of these industries.

CO4: Evaluating the challenges and opportunities faced by the sugar, cement, fertilizer, and glass industries.

PO2: Critical Thinking and Problem Solving:

CO2: Analyzing the economic, environmental, and social impacts of these industries.

CO5: Applying relevant theories and concepts to solve problems and make informed decisions in these industries.

PO3: Social Competence:

CO2: Analyzing the economic, environmental, and social impacts of these industries.

CO7: Exploring sustainable practices and innovations in the sugar, cement, fertilizer, and glass industries.

PO6: Personal and Professional Competence:

CO6: Developing communication and teamwork skills

OPTIONAL THEORY PAPER- Select ANY ONE of the following

CHEM 3506 (A): Nuclear Chemistry – I, (03 Credits, 48 Lectures)

Unit No.	Unit	No. of Lecture
1	The Atomic Nucleus, Properties of Nucleons and Nuclei	08
2	Nuclear Models	12
3	Radioactivity	16
4	Nuclear Reactions	12

Course Objectives:

1. To aware radioactivity, types of radioactivity, characteristic of radioactive decay, and measurement of radioactivity.
2. To learn various applications radioactive isotopes as tracer in chemical investigations, age determination, medical field etc.
3. To familiar with surface chemistry and different type of adsorption isotherms.
4. To understand catalysis, their types, the criteria of catalysis reaction and application of catalysis in different field.

Course Outcomes:

1. Student will able to learn and know details about the atom, elementary particles, sub-nucleons and the quarks,
2. Student will be aware with classification of nuclides, isotopes, isobars, isotones and isomers, factors affecting nuclear stability and quantum numbers
3. Student will able to understand the Shell model, the liquid drop model and semi-empirical mass equation.
4. Student will able to learn the types of radioactive decay, nuclear isomerism, isomeric transitions, internal conversion, Auger effect and their examples with numerical.
5. Student will able to know the principles of decay kinetics, the mathematical derivations and their general characteristics,
6. Student will able to solve the problems related to decay constant, half-life and mean life.
7. Student will able to know the concepts with Bethe's notation, types of nuclear reactions, conservation in nuclear reaction, compound nucleus theory.
8. Students are expected to understand the different types of nuclear transformations along with various examples.

Unit 1. The Atomic Nucleus ,Properties of Nucleons and Nuclei (08L)

The atom ,Elementary particles, Subnucleons,quarks,thenucleusandoutersphere,Classificationofnuclides,Nuclearstability,Evenoddnature,N/Zratio,TheNuclearpotential,Bindingenergy,Bindingenergy calculations.Thenucleus,itssize,shapeandradius,Mechanicaleffectsduetoorbitingandspinningofnucleons,Magneticquantum numbers, principal and radial quantum number.

Ref.1:Pg.1to13and 19to25.

Unit 2. Nuclear Models (12L)

Historical, the shell model, Periodicity in nuclear properties: the magic numbers. The salient features ofshell model. The sequence of filling the orbit, Rectangular well potential model, Harmonic oscillator potential model, Spin-orbit coupling model, Nuclear configuration of lighter nuclides(<20),Merits of the shell model,Theliquiddropmodel,Thesemi-empiricalmassequation,Meritsofthe liquid drop model, Limitations of liquid drop model.

Ref.1Pg. 64to69,72to84and91to92., Ref.2Pg. 464to469

Unit 3. Radioactivity(16L)

Discovery, Types of radioactivedecay, Decay schemes, General characteristicsof radioactive decays, decay kinetics ,units of radioactivity, problem solving on decay kinetics.

Alpha decay: Alpha active nuclides, The alpha energy spectrum, Geiger-Nuttals law, The theory of alpha decay.

Beta decay: Types of beta decay, absorption and range through matter, Fermi theory of beta decay.(Mathematical details are not expected)

Gammadecay: Nuclearisomerismandisomerictransitions,internalconversion,Augereffect.

Ref.1Pg.100to106,120to135,138to142,and150to154.

Unit 4. Nuclear Reactions(12L)

Bethe's notation, Types of nuclear reactions, Conservation of nuclear reactions(Conservationofprotonsandneutrons,Conservationmomentumandenergy),Reactioncrossection,Thecompoundnucleustheory,Calculationsofexcitationenergyofcompoundnucleus,Photonuclearre actions, Thermo nuclear reactions.

Ref.1pages160to174and192to196.

References books

1. EssentialsofNuclearChemistrybyH.J.Arnikar,4th RevisedEdition,N
ewAge International Publishers.

SourcebookofAtomicenergybySamuelGlasstone,3rd edition,East-Westpress

Class : T.Y.B.Sc. (SEM V) **Subject:** Chemistry
Course : Nuclear Chemistry – I **Course Code:** CHEM 3506(A)
Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

Mapping of Course Outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	0	0	0	0	0	0	0	0
CO2	3	0	0	0	0	0	0	0	0
CO3	3	0	0	0	0	0	0	0	0
CO4	3	0	0	0	0	0	0	0	0
CO5	0	3	0	0	0	0	0	0	0
CO6	0	3	0	0	0	0	0	0	0
CO7	0	0	0	0	0	0	3	0	0
CO8	0	0	0	0	0	0	3	0	0

Justification of Mapping

PO1: Disciplinary Knowledge:

CO 1: Student will able to learn and know details about the atom, elementary particles, sub-nucleons and the quarks

CO 2: Student will be aware with classification of nuclides, isotopes, isobars, isotones and isomers, factors affecting nuclear stability and quantum numbers

CO 3: Student will able to understand the Shell model, the liquid drop model and semi-empirical mass equation.

CO 4: Student will able to learn the types of radioactive decay, nuclear isomerism, isomeric transitions, internal conversion, Auger effect and their examples with numerical.

PO2: Critical Thinking and Problem Solving:

CO5: Student will able to know the principles of decay kinetics, the mathematical derivations and their general characteristics,

CO 6:Student will able to solve the problems related to decay constant, half-life and mean life.

PO7: Effective Citizenship and Ethics:

CO 7: Student will able to know the concepts with Bethe's notation, types of nuclear reactions, conservation in nuclear reaction, compound nucleus theory.

CO 8: Students are expected to understand the different types of nuclear transformations along with various examples.

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CHEM 3506 (B): Polymer Chemistry – I, (03 Credits, 48 Lectures)

Unit No.	Unit	No. of Lecture
1	Introduction to Polymer Chemistry	04
2	Mechanism and Nomenclature of Polymers	04
3	Chemistry of Polymerization	10
4	Polymerization Techniques	08
5	Polymer Additives	06
6	Molecular Weights of Polymers	05
7	Silicone and Cellulose Polymers	04
8	Polymer Reactions	07

Course Objectives:

1. Students should know the expressions used in polymer industries.
2. Students should know the uses and application of dyes, polymers industries.
3. Student should understand aspects of small scale industries

Course Outcomes:

1. Student will able to understand history, names and various methods of nomenclature of polymers,
2. Student will able to aware about difference between (a) simple compound and polymer, (b) natural and synthetic polymers (c) organic and inorganic polymers.
3. Student should able to know the terms -monomer, polymer, polymerization, degree of polymerization, functionality, number average, weight average molecular weight,
4. Student will able to understand mechanisms of polymerization, polymerization techniques, importance of silicone polymers.
5. Students will able to understand the cellulose polymers – derivatives and applications, Ingredients and fillers
6. Student will able know Polymer reactions, their types and applications in manufacturing.
7. Student will able to explain, physical and chemical properties of Polymer. Advantages of polymer reactions to change their properties.

unit 1. Introduction to Polymer Chemistry (04L)

Brief History, Polymer definition, Preparation, Classification, Structures, Chemical bonding and Molecular forces in Polymers.

Ref.1:Pg.1-14, Ref.2:Pg.1-16, Ref.3:Pg.1-12, Ref.4:Pg.1-17Ref.7:RelevantPagesRef.9:Pg.1-8

Unit 2. Mechanism and Nomenclature of Polymers **(04L)**

Polymerization Mechanism,b)NomenclatureofPolymers-i)Common/Trivialnamesii)Source-Based names, iii) Structure-Based names (Non IUPAC), iv) IUPAC Structure-based and Linkage-based nomenclature system andv) Tradenames / Brandnames &Abbreviations

Unit 3. Chemistry of Polymerization **(10L)**

Introduction, b) Chain Polymerization: Free radical Polymerization, Ionic polymerization, Co-ordinationpolymerization-Ziegler-Nattacatalystc)StepPolymerization:Polycondensation, Polyaddition polymerization, and Ring Opening polymerization.

Ref.1:Pg.15-64, Ref.2:Pg.25-32,49-56,82-86,88-89,91-94, Ref. 3: Relevant Pages, Ref. 4: Relevant Pages Ref. 6:Relevant Pages, Ref. 9:Pg.22-63

Unit 4. Polymerization Techniques

Bulk polymerization ,Solution polymerization, Suspension polymerization ,Emulsion polymerization,MeltPolycondensation,SolutionPolycondensation,Interfacialcondensation, electrochemicalpolymerization,Salientfeaturesofdifferentpolymerizationtechniques

Ref.1:Pg.71-79,82-84, Ref.2:Pg.126-132, Ref.4:Pg.309-324, Ref.12:Pg.335-341,173-175

Unit 5. Polymer Additives **(06L)**

Fillers & Reinforcement, Plasticizers, Antioxidants & Thermal Stabilizers(Heat Stabilizers),Ultravioletstabilizers,Fireretardants,Colorants,Antistaticagents&Curin gagents.

Ref.3:Pg.170-176, Ref.4:Pg.502-512,528-538, Ref.10:RelevantPages

Unit 6. Molecular Weights of Polymers **(05L)**

(a) AverageMolecularweight,NumberAverage&WeightAverageMolecularweight,Molecular weight & degree of polymerization, Practical significance of polymer molecular weights,

(b) Molecular weight determination by End Group Analysis & Viscosity method and c) Problemsbased on Number Average & Weight Average Molecular weight

Ref.1:Pg.86-89,92,96-98,402-409, Ref.2 & 4:RelevantPages

Unit 7. Silicone and Cellulose Polymers **(04L)**

(a) Introduction, Synthesis ,Reactions ,Uses of Silicone polymers,

Cellulose & Derivatives of cellulose: Rayon ,CellophaneCellulose nitrate ,Cellulose acetate and the iruses.

Ref.1:Pg.255-261, Ref.5:Pg.143-155

Unit 8. Polymer Reactions **(07L)**

Introduction,Hydrolysis,Hydrogenation,AdditionandSubstitutionreactions,Cross-linking reactions,Curereactions,Reactionsofvariousaliphaticandaromaticpendentgroupsinpolymers.

Ref.1:Pg.291-297,306-308,311-321,Ref.3:RelevantPages,Ref.4: Pg. 545-555

Reference Books

1. Polymer Science by V.R.Gowarikar, N. V. Visvanathan, Jaydev Sridhar, New Age InternationalLtd.Publisher1996. (Reprint2012)
2. TextbookofPolymerSciencebyFredBillmeyer,3rdEdn.JohnWiley and SonsNewYork1984.(Reprint2008)
3. Introductory Polymer Chemistry byG. S. Misra New Age International(P)Ltd.Publisher1996.
4. Polymer Chemistry by Charles E.Carraher(Jr.),6thEdn,(FirstIndianPrint2005),New York- Basel.
5. Inorganic Polymers by G. R. Chatwal HimalayaPublishingHouse1stEdn.1996
6. Polymer Science–AText Book by V.K Ahluwalia, Anuradha Mishra.
7. PrincipleofPolymerSciencebyP.Bahadur,N.V.Sastry,2ndEdn,NarosaPublishingHouse.
8. PolymerChemistrybyAyodhyaSingh,2008,PublishedbyCampusBookInternationa l,New Delhi.
9. OrganicPolymerChemistrybyJagdambaSingh,R.C.Dubey,4thEdn,2012.
10. AdvancedPolymerChemistrybyV.K.Selvaraj,1stEdn,2008,PublishedbyCampu

Class: T.Y.B.Sc. (SEM V) **Subject:** Chemistry
Course: Nuclear Chemistry – I **Course Code:**CHEM 3506(B)
Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

Mapping of Course Outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	0	0	0	0	0	0	0	0
CO2	3	0	0	0	0	0	0	0	0
CO3	3	0	3	0	0	0	0	0	0
CO4	3	0	0	3	0	0	0	0	0
CO5	0	0	0	0	0	0	0	0	0
CO6	0	0	0	3	0	0	0	0	0
CO7	0	0	0	3	0	0	0	0	0

Justification of Mapping

- **PO1: Disciplinary Knowledge:**

  CO1: Student will able to understand history, names and various methods of nomenclature of polymers,
  CO 2: Student will able to aware about difference between (a) simple compound and polymer, (b) natural and synthetic polymers (c) organic and inorganic polymers.
  CO 3: Student should able to know the terms -monomer, polymer, polymerization, degree of polymerization, functionality, number average, weight average molecular weight.
  CO 4: Student will able to understand mechanisms of polymerization, polymerization techniques, importance of silicone polymers.
- **PO3: Problem-Solving Skills:**

  CO3: Understanding terms related to polymerization and molecular weight
- **PO4: Practical Skills:**

  CO4: Student will able to understand mechanisms of polymerization, polymerization techniques, importance of silicone polymers.
  CO6: Student will able know Polymer reactions, their types and applications in manufacturing.
  CO7: Student will able to explain, physical and chemical properties of Polymer. Advantages of polymer reactions to change their properties.

CHEM 3506 (C): Introduction to Biochemistry &MolecularBiology– I(03 Credits, 48 Lectures)

Unit No.	Unit	No. of Lecture
1	Amino acids and Proteins	11
2	Carbohydrates	06
3	Lipids	06
4	Hormones	03
5	Enzymes	07
6	Vitamins and Coenzymes	04
7	Cell Biochemistry	05
8	Biochemical techniques	06

Course Objectives :

1. Students should understand the Introduction and types of Metabolism.

2. Students should the know the details of Nucleic acids, Difference between DNA and RNA. Watson and Crick model of DNA, replication of DNA, RNA and its types. Central dogma of molecular biology

3. Students should know the Basic concepts of genetic engineering .

Course Outcomes :

1. Student will able to understand the cell types- bacterial cell., plant cell and animal cell. Biological composition and organization of cell membrane, Singer and Nicholson model. Biomolecules and macromolecules.

2. Student will able to know the carbohydrates and their biochemical significance, structure, properties and reactions of carbohydrates with glucose as example.

3. Student will able to learn the details about, lipids, amino acids, proteins, enzymes and vitamins.

4. Student will able to understand the details in biochemical studies, basic concepts of Endocrinology. Endocrine glands and their hormones.
5. Student will able to know the details in biochemical studies, basic concepts of Endocrinology. Endocrine glands and their hormones

6. Student will be aware with the principle, working procedure and applications of various techniques used in biochemical studies.

7. Student will able to understand basic concepts of endocrinology, types of Endocrine glands and their hormones, biochemical nature of hormones and second messengers in hormone action.

Unit 1. Amino acid sand proteins:(11L)

Introduction, biologicalfunctions,classification-basedonstructure,functionandcomposition.Structural organization of proteins-primary, secondary, tertiary and quaternary structures (general over view).Factors that stabilize protein structure. Denaturation of Proteins.Ref:3,Chapter4, (Pg.45-71) Folding and misfoldings of proteins by stepwise process 2)Diseases caused by misfoldings of proteins for ex. Alzheimer, Prions

Unit 2. Carbohydrates:(06L)

Introduction of carbohydrates, Introduction and biological significance of proteoglycans, Glycoproteins,Glyco lipids, Lectin Carbohydrates-Interaction (Sugar code).Analysis of carbohydrates.

Ref.1:Pg. 255to268, Ref.2:Pg.648to653.

Unit 3 Lipids : (06L)

Introduction,Biologicalsignificance,Classificationsimple,compound,steroidsandderivedlipids.Structureofs aturatedandunsaturatedfattyacids,structure of phospholipids (Phosphatidic acid, Lecithin, Cephalic, Lipositol), structure of Sphingomyelin and Cholesterol.Amphipath lipids and their behavior in water. Saponification number, Acid number, Iodine number rand their significance.
Rancidity of lipids. Types of Lipoproteins and their significance, Lipids in membrane glycerophopholi pids, Sulphalipids, Galactolipids,glycosphingo lipids

Ref.1:Pg. 343to360, Ref:3,Ch.3,Lipids,Pg.29-42.

Unit 4. Hormones:(03L)

Definition, classification based on biochemical nature, location and mechanism of action. Concept of second messengers-c. AMP and Calciuminositide system.

Ref:2,Ch.42and43,Pg.434,462and464.

Unit 5. Enzymes:(07L)

Classification-Six major classes of enzymes, Conjugated enzymes-Apo enzyme, Holoenzyme, prosthetic group (coenzymes and of factors).Features of active site. enzyme specificity, Factors affecting enzyme activity- substrate concentration, pH, temperature, and enzyme concentration, product concentration. MM equation,LB equation (derivation not required) and significance of Km. Enzyme inhibition-competitive, noncompetitive and uncompetitive with suitable examples. Allosteric enzymes and clinical significance of Iso enzymes.

Ref: 3,Ch.6,Enzymes,Pg. 85–112.

Unit 6. Vitamins and Coenzymes:(04L)

Classification-Fat soluble and water soluble vitamins(source, biological functions and deficiency disorders), coenzyme forms of vitamin B complex. (Structure not required).

Ref:2,Ch.45:Pg. 481-496

Unit 7. Cell Biochemistry:(05L)

Introduction to Cell, Unicellular and Multicellular organisms, Distinguishing features of Prokaryotic and Eukaryotic cell. Structure and function of Cell membrane, Mitochondria, Endoplasmic reticulum, Golgicomplex, Lissome, Peroxisomes, Plant cell wall and Chloroplast. Concepts of Bimolecular andtypes of bonds in biomolecules.

Ref:5,Ch.3,Pg. 32-68, Ch.10, Pg. 191-219,Ch.6,Pg. 154-165,Ch.7,Pg. 166- 174,Ch.8,Pg. 175-

Unit 8. Biochemical techniques.(06L)

Principle, working and applications of dialysis, Paper chromatography, Thin layerchromatograp

Ref:6,Ch.11,Pg. 524-546.Ch.10,Pg. 449-473.2,Ch.3,Pg. 89-97,Pg. 344-421,

ReferenceBooks

1. Lehninger's, Principles of Biochemistry,byNelsonandCoxMacmillanPublisher4th edn.
2. Harper's Illustrated Biochemistry,26thEdition.
3. Biochemistry by U.Satya Narayana
4. Biotechnology. D. Singh,3rdedition.
5. Cellbiology,Genetics,MolecularBiology,EvolutionandEcology,byVermaandAgarwa l,14the dition.
6. PrincipletechniquesofBiochemistryandMolecularBiologybyKeithWilsonandJohnWalk er,6t h edition.
7. BiophysicaltechniquesbyUpadhyayandNath,3rdrevisededition.

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Class: T.Y.B.Sc. (SEM V) **Subject**: Chemistry

Course: Introduction to Biochemistry &Molecular Biology– I **Course Code**: CHEM 3506 (C)

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

Mapping of Course Outcomes with Program Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	0	0	0	0	0	0	0	0
CO2	0	3	0	0	0	0	0	0	0
CO3	0	0	3	0	0	0	0	0	0
CO4	0	0	0	3	3	0	0	0	0
C05	0	0	0	0	3	0	0	0	0
CO6	0	0	0	0	0	3	0	0	0
CO7	0	0	0	0	0	0	0	0	0

Justification of Mapping

PO1: Disciplinary Knowledge

CO 1: Student will able to understand the cell types- bacterial cell., plant cell and animal cell. Biological composition and organization of cell membrane, Singer and Nicholson model. Biomolecules and macro molecules.

PO2: Critical Thinking and Problem Solving

CO 2: Student will able to know the carbohydrates and their biochemical significance, structure, properties and reactions of carbohydrates with glucose as example.

PO3: Social competence

CO 3: Student will able to learn the details about, lipids, amino acids, proteins, enzymes and vitamins.

PO4: Research-related skills and Scientific temper

CO 4: Student will able to understand the details in biochemical studies, basic concepts of Endocrinology. Endocrine glands and their hormones.

PO5: Trans-disciplinary Knowledge

CO 4: Student will able to understand the details in biochemical studies, basic concepts of Endocrinology. Endocrine glands and their hormones.

CO 5: Student will able to know the details in biochemical studies, basic concepts of Endocrinology. Endocrine glands and their hormones

PO6: Personal and professional competence

CO 6: Student will be aware with the principle, working procedure and applications of various techniques used in biochemical studies.

PO7: Effective Citizenship and Ethics

CO 7: Student will able to understand basic concepts of endocrinology, types of Endocrine glands and their hormones, biochemical nature of hormones and second messengers in hormone action.

CHEM 3506 (D): Environmental and Green Chemistry– I, (03 Credits, 48 Lectures)

Unit No.	Unit	No. of Lecture
1	Concepts and scope of Environmental Chemistry	02
2	Atmosphere and Air Pollution	14
3	Hydrosphere and water pollution	08
4	Introduction to Green Chemistry	10
5	Green Chemistry and Technology for sustainable development	10
6	Green Chemistry and Hazardous Organic Solvents	04

COURSE OBJECTIVES:-

1. Students should know the terminology used in environmental chemistry.
2. Students able to understand the different atmospheric pollution and its adverse effect.
3. Students should know the different water resources and water pollution.
4. Students able to understand the green chemistry and green synthesis.
5. To adequate the student about green technology and the principles of green chemistry.
6. Students should know green solvent and alternative techniques for synthesis.
7. Students able to understand hazardous organic solvents

COURSE OUTCOMES:-

1. Know the different terms in environmental chemistry used in study.
2. Understanding the atmospheric pollution and its effect, helpful control the pollution.
3. Understanding the water resources and its conservation.
4. Know the green chemistry and green synthesis applied in daily life.
5. Understanding all the green principles and used in laboratory for different synthesis.
6. Use the alternative techniques for synthesis using green solvent.
7. know the hazardous solvent banned to for use and only green solvents are used.

Unit 1:Concepts and Scope of Environmental Chemistry (02 L)

Introduction, Terminologies, Units of concentration, Segments of Environment

Unit 2: Atmosphere and Air Pollution (14L)

Composition and structure of atmosphere, Chemical and photochemical reactions in atmosphere ChemistryofO$_3$, SOx,NOx and chlorides in atmosphere, Primary air pollutants, Sampling of air Particulate matter: inorganic and organic, Smog: reducing and photochemical, Mechanism of ozone Depletion, Stability and reactions of CFCs, Harmful effects of CFCs, CFCs substitutesBhopal gas tragedy

Ref.1, Ref.3, Ref.5

Unit 3:HydrosphereandWaterpollution (08 L)

Water resources, Physical chemistry of sea water : composition, equilibrium, pH, pE Microbially mediated aquatic reactions, nitrogen cycle ,iron and manganese bacteria Classification of water pollutants, Organic and Inorganic pollutants: Pesticides, Detergents, Eutrophication, Marine, Oil, Acidmine drainage, remedial measures and sediments, thermal pollution, Sampling and monitoring water quality parameters: pH, D.O.(WinklerMethod), COD,TOC,Total hardness,freechlorine.

Ref.1, 2,3, and 5

Unit 4.Introduction to Green Chemistry (10 L)

Chemistry is good, The environment and the five environmental spheres What is environmental Chemistry? Environmental Pollution, what is green Chemistry? Green Chemistry and synthetic chemistry, Reduction of risk :Hazard and exposure The risk and no risks, Waste prevention, Basic principles of green chemistry Examples based on green technology.

[Ref: Green Chemistry by Stanley E Manahan ,ChemcharResearchInc.(2006)-2nd Edn. Ch.1, Pg. 1-17andRef.6Relevantpages.]

Unit 5.Green Chemistry and Technology for sustainable development(10 L)

Green Chemistry from theory to practice, The twelve principles of green chemistry Green Chemistry and sustainable Development, Designing Products under the holistic approach"

Cradle-to Cradle", Scientific are as for practical applications of green chemistry Use of alternative basic chemicals as feeds to chemical industry and research. Green Chemistry and Reduction of solvent Toxicity(Alternative Solvents or replacement) ApplicationsofNewMethodologiesinthesynthesisofchemicalcompounds-catalysisandgreen chemistry.

[Ref: Green Chemistry–Green engineering by Athanasius Valavanidis and Thomas Vlachogianni (March 2012);Ch.2Pg. 17-37 and Ref.6 Relevant pages]

Unit 6.Green Chemistry and Hazardous Organic Solvents (Green solvents, replacement and alternative techniques). (04 L)

Introduction to Green Chemistry and Toxic organic solvents Green solvents and Alternative methods Green Chemistry ,Green solvents–Alternative techniques inorganic synthesis

[Ref:GreenChemistry–Greenengineering,Chapter5,Pg. 81-91,Ref.6Relevantpages]

Reference Books

1:Environmental Chemistry–A.K.De,5thEdition(New age international publishers)

2:EnvironmentalChemistry–J.W.MooreandE.A.Moore(AcademicPress,NewYork)

3:EnvironmentalChemistry–A.K.BhagiandC.R.Chatwal(HimalayaPublishingHouse)

4:AnalyticalChemistry–G.D.Christian4thEdition(John Wiley and Sons) 5:EnvironmentalChemistry–H.Kaur2ndEdition2007,Pragati Prakashan Meerut, India

Class: T.Y.B.Sc. (SEM V) **Subject**: Chemistry
Course: Physical Chemistry **Course Code**: CHEM 3506 (D)
Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

Mapping of Course Outcomes with Program Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO6	PO7
CO1	3	2	0	0	0	0	0	0	0
CO2	3	3	0	0	0	0	0	0	0
CO3	3	0	2	0	0	0	0	0	0
CO4	3	3	0	2	0	0	0	0	0
CO5	3	3	0	3	0	0	0	0	0
CO6	3	3	3	3	3	3	0	0	0
CO7	3	3	0	3	0	3	3	0	0

justification of mapping

PO1: Disciplinary Knowledge

CO1: Know the water treatment and effluent management apply for waste water purification.
CO2: Understanding the soil structure, composition, types and exchange capacity for applying in a waste management.
CO3: Understanding the instruments used for the different trace pollutant analysis.
CO4: Know the greenhouse gases, greenhouse effect, and global warming, climate change
CO5: and find the remedial solution for it.
CO5: Know the solvent properties use such type of green solvent instead of hazardous solvents for carry out the chemical reactions.
CO6: Understanding the energy sources and its relation apply for different purposes.
CO7: Know the environmental pollutants, find remedies on it and minimizes the pollution.

PO2: Critical Thinking and Problem Solving

CO1: Know the water treatment and effluent management apply for waste water purification.
CO2: Understanding the soil structure, composition, types and exchange capacity for applying in a waste management.
CO4: Know the greenhouse gases, greenhouse effect, and global warming, climate change
CO5: and find the remedial solution for it.
CO5: Know the solvent properties use such type of green solvent instead of hazardous solvents for carry out the chemical reactions.
CO6: Understanding the energy sources and its relation apply for different purposes.
CO7: Know the environmental pollutants, find remedies on it and minimizes the pollution.

PO3: Social competence

CO3: Understanding the instruments used for the different trace pollutant analysis.
CO6: Understanding the energy sources and its relation apply for different purposes.

PO4: Research-related skills and Scientific temper

CO4: Know the greenhouse gases, greenhouse effect, and global warming, climate change
CO5: and find the remedial solution for it.

CO5: Know the solvent properties use such type of green solvent instead of hazardous solvents for carry out the chemical reactions.
CO6: Understanding the energy sources and its relation apply for different purposes.
CO7: Know the environmental pollutants, find remedies on it and minimizes the pollution.

PO5: Trans-disciplinary knowledge

CO6: Understanding the energy sources and its relation apply for different purposes.

PO6: Personal and professional competence

CO6: Understanding the energy sources and its relation apply for different purposes.
CO7: Know the environmental pollutants, find remedies on it and minimizes the pollution.

PO7: Effective Citizenship and Ethics

CO7: Know the environmental pollutants, find remedies on it and minimizes the pollution.

CHEM 3506 (E): Agriculture Chemistry, (03 Credits, 48 Lectures)

Unit No.	Unit	No. of Lecture
1	1.SoilChemistry	10
2	2.ProblematicSoilandSoiltesting	10
3	3.QualityofIrrigationWater	08
4	4.PlantNutrients	08
5	5.FertilizersandManures	06
6	6.ProtectionofPlants	06

Course Objectives :

1. Student should know the role of agriculture chemistry and its potential, basic concept, properties & classification of soil on the basis of pH
2. Student should understand the chemical methods for analysis of soil samples
3. Students should aware with excess use of chemical fertilizers and its effect on soil quality.
4. Students should learn about pesticides, insecticides, fungicides and herbicides, problematic soil and reclamation.

Course Outcomes:

1. Student will able to understand the role of agriculture chemistry and its potential, basic concept, properties & classification of soil on the basis of pH
2. Student will able to understand the chemical methods for analysis of soil samples
3. Student will able to know the details of plant nutrients, importance of manures, green manuring, various techniques to protect the plants.
4. Student will able aware with excess use of chemical fertilizers and its effect on soil quality.
5. Student will able to learn about pesticides, insecticides, fungicides and herbicides, problematic soil and reclamation.
6. Student will able to know details about irrigation water, water quality standards and analysis methods of water for the dissolved major and minor constituent s and their function,.
7. Student will able to understand the details about related problems public health, environment and agriculture,
8. Student will able to learn about toxicological properties of nanoparticles onbiological systems and the environment.

Unit 1. Soil Chemistry (10L)

Role of agriculture chemistry, Scope and importance of agricultural chemistry, Agricultural chemistry and other science, Definition of soil, Soil components-mineral component, organic matter or humus, soil atmosphere ,soil water ,soil microorganism, Physical properties of soil-soil texture, soil structure, soil color, soil temp, Soil density, porosity o fossil, Surface soil and sub-soil, Chemical properties of soil, soil reactions and solutions, Factor controlling soil reaction, bufferingcapacity,importanceofbufferactioninagriculture,ionexchange

Ref1-Pg.8-12,92-94,98-113,116-146, Ref3-Pg.28-50

Unit 2.ProblematicSoilandSoiltesting (10L)

Acid soil – formation of acid soil, effect of soil acidity, reclamation of it.
Alkali Soil-formation of alkali soil, reclamation of alkali soil, Classification of alkali soil- saline oil,saline alkali soil, non-saline alkali soil, Calcareous soils Introduction to soil testing, Objectives of Soil testing Phasesofsoiltesting-collectionofsoilsample,analysisinthelaboratoryand fertilizer applications.

Ref1, Pg. 345-370,Ref3, Pg. 301-312,Ref4, Pg. 135-147and150-159

Unit 3. Quality of Irrigation Water(08L)

SourcesofWater-Atmosphericwater,SurfaceWater,StoredWater,GroundWater ImpuritiesinWater,Waterquality,relatedproblemsinpublichealth,environment and agriculture, Analysis of irrigation water(ppm, meq /lit.epm), Dissolved constituents and t heir function, Majorconstituents-Ca,Mg,Na,K,Carbonate,bicarbonate,sulfate,Chlorideandnitrate Minor constituents-,nitrite, Sulfide andfluoride,Waterqualitystandardtotalsolublesalt(TSS),sodiumadsorptionratio(SAR),Exchangeablesodiumpercentage(ESP),Residualsodium carbonate, salinity classes for irrigation water

Ref8-Pg. 293-309

Unit 4. Plant Nutrients (08L)

Needofplantnutrients,formsofnutrientsupdates,nutrientabsorptionbyplants Classification of essential nutrients Primary nutrients(N,P,K),its role and deficiency symptoms in plantsSecondarynutrients,(Ca,Mg,S),itsroleanddeficiencysymptomsinplants
Micronutrients,Generalfunctionsofmicronutrients(Zn,Fe,Mn,Cu,B,Mo,Cl) Effect of environmental condition, nutrient uptake

Ref3-Pg. 207-241,Ref4-Pg. 176-195,Ref7-Pg. 287-300

Unit5.Fertilizers and Manures (06L)

Introduction, Classification & application of fertilizers, Time and methods of fertilizers Factors affecting efficiency of fertilizers, Vermi compost preparation,effect of vermin compost on soil fertility
Synthetic fertilizers definition, comparison of synthetic fertilizers with organic fertilizers, Environmental effect of synthetic fertilizers
Introduction, Definition and classification of manures, Effect of bulk Organic manures on soil, farmyard manures(FYM),Factors affecting on FYM, method of preparation, losses during handling and storage, Biogasplant.Humanwaste,sewageandsludge,typesofsludge,carbonnitrogenratio, sewage irrigation and uses, Green manuring,types of green manuring,characteristics,advantages and disadvantages of green manuring, Biofertlizers:definition,classification,role&advantages

Ref2-Pg.205-213,Ref3- Pg. 90-112,137-149

Unit 6. Protection of Plants **(06L)**

Pesticide Classification and mode of action
Insecticide-Definition, Classification,chemicalproperties,elementalcomposition,modeofactionof syntheticandplantoriginatedcompoundsorganophosphates,malathion,parathion, carbonates
Fungicides-Definition, Classification, Chemical properties, mode of action of S &Cu fungicides Herbicides-
Definition,Classification,composition,modeofactionofSelectiveandnon-selective

ReferenceBooks

1. A text book of soil science (RevisedEdn)J.A.Daji, Revised byJ.R.Adam, N.D.Patil,Media promoters and publishers,Mumbai, 1996
2. Textbookofsoilscience,T.D.Biswas,S.K.Mukherjee,TataMcGrawHil l Publishingcompany,NewDelhi
3. IntroductiontoAgronomyandsoil,watermanagement,V.G.Vaidya,K.R . Sahashtra Buddhe(Continental Prakashan)
4. Principalsofsoilscience,M.M.Rai,MilliancomplexofIndia,Bombay,1977
5. Manuresandfertilizers(sixthedn),K.S.Yawalkar,J.P.AgarwalandBokde, Agrihorticulture publishing house,Nagpur,India
6. Chemistryofinsecticidesandfungicides,U.S.Sreeramula(2ndEd),oxford andIBHPublishing company,NewDelhi
7. Fundamentalsofsoilsciences,C.E.MillarandL.M.Turk,Bio-Tech-NewDelhi(1stEd2001)
8. Soil,Plant,Waterandfertilizeranalysis,P.K.Gupta,PublishedbyAgroBotanica
9. **Biofertlizers**andbio pesticides,Author:Deshmukh,A.M.

Class: T.Y.B.Sc. (SEM V) **Subject**: Chemistry
Course: Agriculture Chemistry **Course Code**: CHEM 3506 (E)
Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

Mapping of Course Outcomes with Program Outcomes

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	3	0	0	0	0	0	0	0	0
CO2	0	3	0	0	0	0	0	0	0
CO3	0	0	3	0	0	0	0	0	0
CO4	0	0	0	3	0	0	0	0	0
C05	0	0	0	0	3	0	0	0	0
CO6	0	0	0	0	0	3	0	0	0
CO7	0	0	0	0	0	0	3	0	0

Justification of mapping

PO1: Disciplinary Knowledge
CO 1: Student will able to understand the role of agriculture chemistry and its potential, basic concept, properties & classification of soil on the basis of pH

PO2: Critical Thinking and Problem Solving
CO 2:Student will able to understand the chemical methods for analysis of soil samples

PO3: Social competence
CO 3: Student will able to know the details of plant nutrients, importance of manures, green manuring, various techniques to protect the plants.

PO4: Research-related skills and Scientific temper
CO 4:Student will able aware with excess use of chemical fertilizers and its effect on soil quality.

PO5: Trans-disciplinary Knowledge
CO 5: Student will able to learn about pesticides, insecticides, fungicides and herbicides, problematic soil and reclamation.

PO6: Personal and professional competence
CO 6: Student will able to know details about irrigation water, water quality standards and analysis methods of water for the dissolved major and minor constituent sand their function,

PO7: Effective Citizenship and Ethics
CO 7: Student will able to understand the details about water quality, related problems in public health, environment and agriculture.

CHEM 3506 (F): Synthesis of nanomaterial and Nano toxicology(03 Credits, 48 Lectures)

Unit No.	Unit	No. of Lecture
1	Synthesis of nanomaterial (Chemical Methods)	09
2	Synthesis of nanomaterial (Chemical Methods)	09
3	Synthesis of nanomaterial (Chemical Methods)	09
4	Synthesis of nanomaterial (Biological Methods)	09
5	Introduction to Nanotoxicology	12

Course Objectives :

1. Students should know the details of production, use, safety and disposal of nano-structured materials like nanoparticles, nanomedicines.

2. Students should learn and understand details about the different chemical methods for synthesis of nanomaterials with detail mechanism

3. Students should aware with the advantages and disadvantages of chemical and biological methods for synthesis of nanomaterials

Course objectives:

1. Student will able to learn and understand details about the different chemical methods for synthesis of nanomaterials with detail mechanism.

2. Student will able to learn and understand details about the different biological methods for synthesis of nanomaterials with detail mechanism

3. Student will able to understand the use of microorganisms,plantextract,proteins,and DNA in biological synthesis of nanomaterials

4. Student will able aware with the advantages and disadvantages of chemical and biological methods for synthesis of nanomaterials.

5. Student will able to know the details of production, use, safety and disposal of nano-structured materials like nanoparticles, nanomedicines.

6. Student will become familiar with interactions of engineered nanomaterials with biological systems and the environment.

7. Student will able to learn about toxicological properties of nanoparticles onbiological systems and the environment.

Unit 1:Synthesis of nanomaterial (Chemical Methods) (09 L)

Colloids and colloids in solution, Nucleation and growth of nanoparticles, Synthesis of metal and semiconductor nanoparticles by colloidal routes,Langmuis-Blodgett(L-B) method,sol-gel method.

Unit 2:Synthesis of nanomaterial (Chemical Methods) (09 L)

Hydrothermal synthesis, Solvo thermal synthesis, Sono chemical Synthesis, Microwave synthesis, Synthesis using micro-reactor or Lab-or-chips pray pyrolysis, Successive ionic layer adsorption and reaction (SILAR),Electrode position,

Unit 3:Synthesis of nanomaterial (Chemical Methods) (09 L)

Chemical vapour deposition, Metal organic chemical vapor deposition (MOCVD),Plasma enhanced chemical vapour deposition (PECVD), Vapour-Liquid-Solid (ULS) method,Metal Oxide framework (MoF), Kirkindal effect and method.

Unit 4:Synthesis of nanomaterial (Biological Methods) (09 L)

Introduction, Synthes is using microorganisms,Synthesis using plant extract, Use of proteins, Templates like DNA,S-tayer synthesis of nano particles using DNA.

Unit5:Introduction to Nanotoxicology(12 L)

Physico chemical determinants: Size Shape,Surfacearea Surface chemistry Material composition,Redox cycling and catalytic chemistry, UV activation leading to radical formation, Surface coatings for protection, passivation, hydrophobicity,hydrophilicity, Effect of material synthesis methods, solvents etc. NPs Degradation.

Routes of Exposure:oralrespiratory tract,Skin,Gastro intestinal tract,injection Risks evaluation both *invitro* and *invivo* studies,*Invivo*abnormalbehavior,clinicalsigns,mortality Body weight changes, histological observation Histopathology, Immuno histo chemistry, SEM, TEM, AFM Spectroscopic techniques: AAS, X-ray fluorescence, SEM-EDS

ReferenceBooks

1. Nanotechnology: TechnologyRevolutionof21st CenturybyRakeshRathi,publishedbyS.Chand.
2. Introduction to Nano science,byStuartLindsay.
3. Introduction to Nanomaterials and nanotechnology by Vladimir Pokropivny,Rynno Lohmus,Irina Hussainova,Alex PokropivnyandSergeyVlassov
4. NanomaterialsbyA.K.Bandyopadhyay;NewAgeInternationalPublishers.
5. NanotechnologybyMarkRatnerandDanielRatner,PearsonEducation.
6. NanoEssentials-T. Pradeep / TMH
7. Bharat Bhusan, "Springer Handbook of Nanotechnology", Springer,New York,2007
8. Nanotechnology:Principles&Practices.Sulbha K. Kulkarni,Capital Pub(3rd Edition)
9. Nanostructures and Nanomaterials Synthesis, Properties and Applications, GuozhongCao,imperialscollegePress,London.
10. Nanomaterials: Synthesis, properties and Applications. Edited by A. S. Edelstein & R. C.Commutate, Instituteof Physics Publishing, Bristol&Philadelphia.
11. NanomaterialsbyA.K.Bandyopadhyay(2nd Edition),International Publishers.

Class: T.Y.B.Sc. (SEM V) **Subject**: Chemistry

Course: Synthesis of nano-material and Nano-toxicology **Course Code**: CHEM 3506 (F)

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

Mapping of Course Outcomes with Program Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	0	0	0	0	0	0	0	0
CO2	0	3	0	0	0	0	0	0	0
CO3	0	0	3	0	0	0	0	0	0
CO4	0	0	0	3	0	0	0	0	0
C05	0	0	0	0	3	0	0	0	0
CO6	0	0	0	0	0	3	0	0	0
CO7	0	0	0	0	0	0	3	0	0

Justification of Mapping

PO1: Disciplinary Knowledge

CO 1: Student will able to learn and understand details about the different chemical methods for synthesis of nanomaterials with detail mechanism.

PO2: Critical Thinking and Problem Solving

CO 2: Student will able to learn and understand details about the different biological methods for synthesis of nanomaterials with detail mechanism

PO3: Social competence

CO 3: Student will able to understand the use of microorganisms, plant extract, proteins, and DNA in biological synthesis of nanomaterials

PO4: Research-related skills and Scientific temper

CO 4: Student will able aware with the advantages and disadvantages of chemical and biological methods for synthesis of nanomaterials.

PO5: Trans-disciplinary Knowledge

CO 5: Student will able to know the details of production, use, safety and disposal of nano-structured materials like nanoparticles, nanomedicines.

PO6: Personal and professional competence

CO 6: Student will become familiar with interactions of engineered nanomaterials with biological systems and the environment.

PO7: Effective Citizenship and Ethics

CO 7: Student will able to learn about toxicological properties of nanoparticles on biological systems and the environment.

CHEM 3507: Physical Chemistry Practical – I, (02 Credits, 10 Practicals)

(Any **TEN Experiments** from the given List of Experiments)

Course Objectives:

1. To develop skills required in physical chemistry experiments such as the appropriate handling of apparatus, instruments and chemicals.
2. To aware the preparation stock / standard solutions.
3. To provide skills needed for operation and safe conduct of experiments based on instruments
4. To develop the knowledge required for interpretation of experimental data and method to report it.
5. To familiar the students with an adequate extent of experimental techniques with hands on training using modern instrumental methods of chemical analysis.
6. To obtain the ability to interpret and communicate scientific information effectively in written and oral formats.
7. To understand and analyze current event and issues regarding routine laboratory practices.

Course Outcomes:

By the end of the course, students will be able to:

1. Understand in details about general laboratory practices in terms of safely handling of chemicals and apparatus.
2. Learn the preparation and utilization of various laboratory solutions by considering environmentally friendly behavior of chemical.
3. Know the handling of instruments and generation of experimental data.
4. Develop the experimental and operational skill with hands on training using sophisticated instruments and practicing for mathematical and graphical interpretation.
5. . Apply theoretical concept learn in classroom to field work through performing practical.
6. . Develop problem solving skill through experiments and reporting data in proper way.
7. . Apply theory and practical knowledge to design new experiment

Group – A: Non Instrumental Experiments (ANY FIVE)

1. To study the effect of addition of salt on critical solution temperature of phenol- water System.
2. To determine the molecular weight of a high polymer by using solutions of different concentrations.
3. To determine the order of reaction between $K_2S_2O_8$ and KI by half-life method.
4. Determine the rate constant of reaction between potassium persulphate and potassium iodide for equal concentration of the reactants (a=b).

5. To compare the relative strength of HCl and H_2SO_4 by studying the kinetics of hydrolysis of an ester.
6. To compare the relative strength of HCl and H_2SO_4 by studying the kinetics of Inversion of canesugar using Polarimeter.
7. To compare the precipitation value of sodium chloride, barium chloride and aluminum chloride for arsenious sulphide sol.
8. To compare the effectiveness of a number of emulsifying agents in forming emulsions.

Group – B: Instrumental Experiments (ANY FIVE)

1. To determine the cell constant of the given cell using 0.01 M KCl solution and hence determinedissociation constant of a given monobasic weak acid by conductometry.
2. To estimate the amount of lead present in given solution of lead nitrate by Conductometric titration with sodium sulphate.
3. To determine the degree of hydrolysis of aniline hydrochloride by pH metry.
4. To determine pKa value of given weak acid by pH-metric titration with strong base.
5. To prepare standard 0.2 M Na_2HPO_4 and 0.1 M Citric acid solution, hence prepare four different buffer solutions using them. Determine the pKa value of thus prepared and unknown buffer solutions using potentiometry.
6. To determine the concentrations of strong acid and weak acid present in the mixture by titrating with strong base using potentiometry.
7. Determination of λmax and concentration of unknown solution of $KMnO_4$ in 2 N H_2SO_4.
8. Determination of λmax and concentration of unknown solution of $CuSO_4$.
9. To determine the molecular refractivity of the given liquids A, B, C and D.
10. To determine the molar refraction of homologues methyl, ethyl and propyl alcohol and show theconstancy in contribution to the molar refraction by - CH_2 group.

Reference books:

1. Practical Physical Chemistry, 3rd ed. A. M. James and F. E. Prichard, Longman publication.
2. Experiments in Physical Chemistry, R. C. Das and B. Behera, Tata McGraw Hill.
3. Advanced Practical Physical Chemistry, J. B. Yadav, Goal Publishing House.
4. Advanced Experimental Chemistry, Vol-I, J. N. Gurtu and R. Kapoor, S. Chand and Company.
5. Physical Chemistry Experiments, Raghvan and Vishwanathan.
6. Comprehensive experimental Chemistry, V. K. Ahluwalia and S. Raghav, New Age International Senior Practical Physical Chemistry, Khosla, B. D.; Garg, V. C. & Gulati, A. R. .
7. Experiments in Physical Chemistry, Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. 8th ed.;McGraw-Hill: New York (2003).
8. Experimental Physical Chemistry Halpern, A. M. & McBane, G. C. 3rd ed.; W.H. Freeman & Co.:New York (2003).
9. Experimental Physical Chemistry, Athawale V. D. and Mathur P., New Age International (2001)

Class: T.Y.B.Sc. (SEM V) **Subject**: Chemistry

Course: Physical Chemistry Practical – I **Course Code**: CHEM 3507

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

Mapping of Course Outcomes with Program Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	0	0	0	0	0	0	0	0
CO2	0	3	0	0	0	0	0	0	0
CO3	0	0	3	0	0	0	0	0	0
CO4	0	0	0	3	0	0	0	0	0
CO5	0	0	0	0	3	0	0	0	0
CO6	0	0	0	0	0	3	0	0	0
CO7	0	0	0	0	0	0	3	0	0

Justification of mapping

PO1: Disciplinary Knowledge

CO1. Understand in details about general laboratory practices in terms of safely handling of chemicals and apparatus.

PO2: Critical Thinking and Problem Solving

CO2. Learn the preparation and utilization of various laboratory solutions by considering environmentally friendly behaviour of chemical.

PO3: Social Competence

CO3. Know the handling of instruments and generation of experimental data.

PO4: Research-related skills and Scientific Temper

CO4. Develop the experimental and operational skill with hands on training using sophisticated instruments and practicing for mathematical and graphical interpretation.

PO5: Trans-disciplinary Knowledge

CO5. Apply theoretical concept learn in classroom to field work through performing practical.

PO6: Personal and Professional Competence

CO6. Develop problem solving skill through experiments and reporting data in proper way.

PO7: Effective Citizenship and Ethics

CO7. Apply theory and practical knowledge to design new experiment.

CHEM 3508: Inorganic Chemistry Practical – I, (02 Credits, 10 Practicals)

(Any **TEN Experiments** from the given list of Experiments)

COURSE OBJECTIVES:-

1. Students able to understand safe working methods, standard requires in handling laboratory chemicals.
2. To develop the skills required in gravimetric analysis with various steps.
3. Students able to understand the proper synthetic method for in inorganic complexes.
4. To learn the instrumental methods for quantitative analysis.
5. Students able to understand for preparing the proper solutions required for analysis.
6. To familiar the recent development in inorganic chemistry.
7. Students should know the details about all types of chemical analysis.

OURSE OUTCOMES:-

1. Know the methods and handling chemicals applied during the experiments.
2. Understanding the skill of gravimetric analysis used in experimental work.
3. Know the proper method for synthesis, synthesize different inorganic complexes.
4. Apply instrumental methods for quantitative analysis in laboratory and develop the skill.
5. Students are able to learn preparation of various laboratory solutions.
6. Know the recent development and applied during the experimental work.
7. Understanding all types of analysis.

A) Gravimetric estimations (ANY THREE)

1. Iron as Fe_2O_3
2. Nickel as Ni – DMG
3. Chromium as $PbCrO_4$
4. Barium as BaSO4 using homogeneous precipitation method.

B) Inorganic Preparation (ANY FOUR)

1. Preparation of Potassium Tri-oxalato ferrate (III), $K_3[Fe(C_2O_4)_3]$.
2. Preparation of tris (acetyl acetanato) Chromium(III) $[Cr(acac)_3]$.
3. Preparation of Tri-chlorotriammine cobalt (III) $[Co(NH_3)_3Cl_3]$
4. Preparation of tris (di-pyridyl) Manganese (III) chloride
5. Preparation of Tris(Thiourea) Copper (I) Chloride $[Cu\ (Thiourea)_3]$ Cl.
6. Preparation of Manganese (III) acetylacetonate $[Mn(acac)_3]$.

C) Colorimetric Estimations (ANY ONE)

1. Iron by 8 HQ method.
2. Titanium by H_2O_2.

3. Nephelometric estimation of Ca / Ag / Na / Ba by precipitation method KF Vs.$CaCl_2$ $AgNO_3$ Vs. $KBrNa_2SO_4$ Vs. $BaCl_2$ NaCl Vs $AgNO_3$

D) Flame Photometry

1. Estimation of Na by flame photometry by calibration curve method.
2. Estimation of K by flame photometry by calibration curve method.

Reference Books

1. General Chemistry Experiment – Anil J Elias (University press).
2. Vogel Textbook of Quantitative Chemical Analysis G.H. Jeffery, J. Basset.
3. Quantitative Chemical Analysis S. Sahay (S. Chand & Co.).
4. Quantitative Analysis R.A. Day, Underwood (Prentice Hall).
5. Practical Chemistry K.K. Sharma, D. S. Sharma (Vikas Publication).6.Vogel's Textbook of Quantitative Chemical Analysis.
7. Monograph on Green Chemistry Laboratory Experiments by Green Chemistry Task Force Committee,DST.
8. Experimental Methods in Inorganic Chemistry." Tanaka, J. and Squib, S.L., Prentice Hall, New Jersey, 1999.

Class:T.Y.B.Sc. (SEM VI) **Subject:** Chemistry

Course: Inorganic Chemistry Practical – I **Course Code:**CHEM 3508

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

Mapping of Course Outcomes and Program Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	3	3	3	3	3	3	3		
CO2		3							
CO3									
CO4			3						
CO5									
CO6						3			
CO7									

Justification of mapping

PO 1: Disciplinary Knowledge:

CO 1: Know the various terms involved in coordination chemistry apply to coordination compounds.

PO 2: Critical Thinking and Problem Solving

CO1: Students should know meaning of various term involved in coordination chemistry

CO 2: Students able to understand different theories of complex formation and the geometries, isomerism of various types of complexes.

PO 3: Social Competence

CO 1: Students should know meaning of various term involved in coordination chemistry

CO 4: Students able to understand merit and demerits of Sidgwick theory.

PO 4: Research-Related Skills and Scientific Temper

PO 1: Students should know meaning of various term involved in coordination chemistry

PO 5: Trance-disciplinary Knowledge

PO 1: Students should know meaning of various term involved in coordination chemistry

PO 6: Personal and Professional Competence

CO 1: Students should know meaning of various term involved in coordination chemistry

CO 6: Students should know the assumptions and limitations of VBT and CFT.

PO 7: Effective Citizenship and Ethics

CO 1: Students should know meaning of various term involved in coordination chemistry

CHEM 3509: Organic Chemistry Practical – I, (02 Credits, 10Practicals)

A. Course Objective:

1. To enable to perform the analysis of binary mixture in micro scale
2. To understand Separate, purify and analyze binary water insoluble and water-soluble mixture.
3. Students will familiar with the experimental technique and get hands on training on sophisticated instruments.
4. Understand the techniques involving drying and recrystallization by various method.
5. To perform the determination of molecular weight of organic compounds by volumetrically (Acids only).
6. To perform the estimations of organic compounds by volumetrically
7. Familiarize the preparation of organic compounds by using various methods.

B. Course Outcome:

1. To develop experimental skills.
2. Organic estimations using volumetric analysis
3. Practical knowledge of handling chemicals.
4. Achieve the practical skills required to estimations of acetamide, ethyl benzoate.
5. Synthesis and Purification of organic compounds
6. Systematic working skill in laboratory will be imparted in student.
7. Students are able to mechanism of organic reactions.

A)Separation of Binary Mixtures and Qualitative Analysis (ANY FOUR MIXTURES) Solid-Solid (2 Mixtures),Solid-Liquid (1 Mixture),Liquid-Liquid (1 Mixture). At least one mixture from each of the following should be given -(Acid-Base, Acid-Phenol, Acid-Neutral, Phenol-Base, Phenol-Neutral, Base-Neutral, Neutral-Neutral)Name and structure of the separated components of the binary mixture is not necessary. Students are expected to record the- Type, Separation of mixture, Preliminary tests, Physical constants, Elements and Functional groups only.
the purified samples of the separated components should be submitted.
Separation and qualitative analysis of the binary Mixtures should be carried out on micro scale using micro scale kits.

A) Organic Estimations (ANY TWO)

1. Estimation of acetamide.
2.Determination of Molecular weight of monobasic acids by volumetric methods.
2. Estimation of basicity (Number of -COOH groups) of acid.
3. Saponification value of oil.

B) Organic Preparations (ANY FOUR)

1. Adipic acid from cyclohexanone (Oxidation by Con. HNO_3).
2. Benzoquinone from Hydroquinone (Oxidation by $KBrO_3/K_2CrO_3$).
3. P-nitro acetanilide from Acetanilide (Nitration).
4. β-Naphthyl ether from β-naphthol (Methylation by DMS, NaOH).
5. Hippuric acid from Glycine (Benzoylation).
6. p-Iodo nitrobenzene from p-Nitro aniline (Sandmeyer Reaction).
7. Benzil- Benzilic acid rearrangement reaction.

The preparation should be carried out on small scale. The starting compound should not be given morethan one gm. Double burette method should be used for titration. Monitoring of the reaction and purification should be carried out by recrystallization and purity of the product in preparation shouldbe checked by physical constant (M.P/B.P.) determination and thin layer Chromatography (TLC) with proper selection of the solvent system.

Reference Books

1. Practical Organic Chemistry by – A.I. Vogel.
2. Practical Organic Chemistry by – O.P. Agarwal.

Class: T.Y.B.Sc. (SEM V) **Subject**: Chemistry

Course: Organic Chemistry Practical **Course Code:** CHEM 3509

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

Mapping of Course Outcomes with Program Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	0	0	0	0	0	0	0	0	0
CO2	0	0	0	0	0	0	0	3	0
CO3	0	0	0	0	0	0	0	0	0
CO4	0	0	0	0	0	0	0	0	0
CO5	0	0	0	0	0	0	0	0	0
CO6	0	0	0	0	0	0	0	3	0
CO7	0	0	0	0	0	0	0	0	0

justification of mapping

PO8: Environment and Sustainability

CO1. Organic Estimations using volumetric analysis

CO2. Learnt the basic principles of green and sustainable chemistry.