--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 VI

CHEM 3601: Physical Chemistry –II, (03 Credits, 48 Lectures)

Unit No.	Unit	No. of Lecture
1	Electrochemistry	14
2	Nuclear Chemistry	12
3	Surface Chemistry	08
4	Catalysis	06
5	Quantum Chemistry	08

Course Objectives:

1. To know the electrochemical cell, its notations to represent cell and measurement of EMF of the cell by Nernst equation.
2. To learn different types of electrode system as well as different types of electrochemical cells.
3. To aware radioactivity, types of radioactivity, characteristic of radioactive decay, and measurement of radioactivity.
4. To learn various applications radioactive isotopes as tracer in chemical investigations, age determination, medical field etc.
5. To familiar with surface chemistry and different type of adsorption isotherms.
6. To understand catalysis, their types, the criteria of catalysis reaction and application of catalysis in different field.
7. To aware the postulates of quantum theory, behavior of particle in 1 D, 2D, and 3D box.
8. To solve the numerical problems on relevant topics.

Course Outcomes:

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

1. Understand in details about electrochemistry, electromotive force of cell, cell notations and representation of cell.
2. Learn different types of electrode system and classification of electrochemical cell and applications of emf measurements.
3. Know the various terminology used in nuclear chemistry such as, radioactivity, types of radioactivity, characteristic of radioactive decay, and measurement of radioactivity.
4. Discuss the applications radioactive isotopes as tracer in chemical investigations, age determination, medical field etc.
5. Identify the different types of adsorption isotherm.
6. Understand the concepts in catalysis and application of catalysis in different field of chemistry.
7. Learn postulates of quantum theory and its use to understand behavior of matter at different condition.
8. Enhance the ability of students towards thinking, reasoning and solving the numerical based on related topics.

Unit 1: Electrochemistry (14 L)

Reversible and irreversible cells, EMF and its measurements, standard cells, cell reaction and EMF, single electrode potential and its calculation, calculation of cell EMF, thermodynamics of cell EMF, types of electrodes, classification of electrochemical cells with and without transference, Capacitors, Types of batteries, applications of EMF measurement, such as (a) Solubility product of sparingly soluble salt, (b) Determination of pH, (c) Potentiometric titration; Numericals.

Unit 2: Nuclear Chemistry (12 L)

The atom, nucleus and outer sphere, classification of nuclides, nuclear stability and binding energy. Discovery of radioactivity, types of radioactivity, general characteristics of radioactive decay and decay

kinetics, Measurements radioactivity, gaseous ion collection method, proportional and G.M. counter, Numericals.

Applications of radioactivity-

Radiochemical principles in the use of tracers, Typical applications of radioisotopes as a tracer- i) Chemical investigations- reaction mechanism, ii) Structure determination- phosphorus pentachloride and thiosulphate ion, iii) Age determination- by Carbon-14 dating and Uranium-Lead / Thorium-Lead Ratio, iv) Medical Applications-Assess the volume of blood in patient's body, Goitre

Unit 3: Surface Chemistry (08 L)

Adsorption phenomenon, Adsorption of gases by solids, Types of adsorption, Freundlich, Langmuir and Temkin isotherms, Adsorption of solute by solids, Types of adsorptions (Physical & Chemisorption). BET equation (no derivation), determination of surface area using Langmuir and BET equations, Numericals.

Unit 4: Catalysis (06 L)

Catalysis, types of catalysis, homogeneous and heterogeneous catalysis, Characteristics of catalytic reactions, promoters, catalytic poisoning, Autocatalysis, positive and negative catalysis, activation energy and catalysis, theories of catalysis, acid-base catalysis, enzyme catalysis and its mechanism.

Unit 5: Quantum Chemistry (08 L)

Postulates of quantum theory (wave function and its interpretation, well-behaved function, quantum mechanical operators, eigen values and eigen functions, expectation values) formulation of Schrodinger equation, particle in box (1D, 2D and 3D box, No derivations for 2D and 3D box), sketching of wave function and probability densities for 1D box, correspondence principle, degeneracy (lifting of degeneracy, Jahn-Teller distortion), applications to conjugated systems such as butadiene, hexatriene and β-carotene; harmonic oscillator, zero point energy and quantum tunnelling, Numericals.

Reference books

1. Principles of Physical Chemistry, S.H. Marron and C.F. Prutton, 4th edn
2. Essentials of Physical Chemistry, B. S. Bahl, G.D. Tuli and Arun Bahl, 2000 edn, S Chand.
3. Essentials of Physical Chemistry, Bahl, -Tuli- Revised multicolor edn 2009.
4. Quantum Chemistry, Manas Chandra, second edn.
5. Physical Chemistry- a molecular approach, Donald A. McQuarrie, John D. Simon.
6. Essentials of Nuclear Chemistry, Prof. H.J. Arnikar Fourth edn.
7. Nuclear and Radiochemistry, Friedlander and Kennedy.

Class: T.Y.B.Sc. (SEM VI) **Subject**: Chemistry
Course: Physical Chemistry **Course Code**: CHEM 3601
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	3	0	0	0	0	0	0	0	0
CO3	0	0	0	0	0	0	3	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	3	0	0	0	0
CO7	0	0	0	0	0	0	3	0	0

Justification of mapping

PO1: Disciplinary Knowledge

CO1. Understand in details about electrochemistry, electromotive force of cell, cell notations and representation of cell.

CO2. Learn different types of electrode system and classification of electrochemical cell and applications of emf measurements.

PO4: Research-related skills and Scientific Temper

CO4. Discuss the applications radioactive isotopes as tracer in chemical investigations, age determination, medical field etc.

PO5: Trans-disciplinary Knowledge

CO5. Identify the different types of adsorption isotherm.

CO6. Understand the concepts in catalysis and application of catalysis in different field of chemistry.

PO7: Effective Citizenship and Ethics

CO3. Know the various terminology used in nuclear chemistry such as, radioactivity, types of radioactivity, characteristic of radioactive decay, and measurement of radioactivity.

CO7. Learn postulates of quantum theory and its use to understand behavior of matter at different condition.

CHEM 3602 Inorganic Chemistry –II, (03 Credits, 48 Lectures)

Unit No.	Unit	No. of Lecture
1	Chemistry of f-block element	08
2	Metals Semiconductors and Superconductors	10
3	Ionic Solids	06
4	Homogeneous Catalysis	08
5	Heterogeneous Catalysis	10
6	Bioinorganic Chemistry	08

Course Objectives:

1. Students should know the chemistry of f block elements(Lanthanide ,Actinide)
2. Students able to understand about metals, semiconductors and superconductors.
3. Students should know the ionic solids, crystal structure (BCC, FCC, HCP).
4. Students able to find the ionic radius, crystal radii and lattice energy by using Born Haber cycle.
5. Students should know the homogeneous catalysis and different catalytic reaction (Wilkinson catalyst ,Zeigler- Natta catalyst).
6. Students able to know heterogeneous catalysis and essential properties of heterogeneous catalyst, catalytic reaction.
7. Students able to understand role of metals in Bioinorganic chemistry, non - enzyme processes and metalloproteins

Course Outcomes:

1. Understanding the chemistry of f block elements apply of metals in various reactions.
2. Know the properties of metals , semiconductors and superconductors using different fields
3. Know the crystal structure and applied it for different ionic solids.
4. Understanding to find the radius and lattice energy.
5. Understand homogeneous catalysis and applied in different catalytic reaction.
6. Know the heterogeneous catalysis for different catalytic reaction.
7. Know the bioinorganic chemistry and role of metal in different in different processes.

Unit 1: Chemistry of f- block elements (08 L)

Introduction of f-block elements- on the basis of electronic configurations, occurrence and reactivity, f-block elements as Lanthanide and Actinide series

A) Lanthanides

Position in periodic table, Name and electronic configuration of lanthanides, Oxidation States, Occurrence and separation (Group/ Individual) by modern methods (ion exchange and solvent extraction method), Lanthanide contraction & its effect on chemistry of Lanthanides and post lanthanide elements, applications of lanthanides

B) Actinides

Position in periodic table, Name and electronic Configuration of actinides, Oxidation States, Occurrence, and general methods of preparation of transuranic elements [viz., a) Neutron Bombardment, b) Accelerated projectile bombardment and c) Heavy ion bombardment], Nuclear Fuels-Nuclear Fusion fuels & nuclear fission fuels, IUPAC nomenclature system for super heavy elements with atomic no. (z) greater than100, Comparison between Lanthanides and Actinides.

Ref. 2 Pg. 859-863, 865-866, 874 – 875, 879-886, 891-893, 898-900

Unit 2: Metals, Semiconductors and Superconductors (10 L)

Introduction, Metallic bonding, Band theory in metals with respect to Na along with n € and N€ diagrams, Electrical conductivity of metals (Na, Mg, Al), Valence electrons and conductivity of metals, Effect of temperature and impurity on electrical conductivity of metals, Semiconductors – types of Semiconductors: I. Intrinsic II. Extrinsic, effect of temperature and impurity on semi conductivity, N type semiconductors ZnO and NiO, Super conductivity- Discovery, Property, Models structure and superconductivity, Applications of superconductors,

Ref. 6, Ref. 7 Pg. 209-221,

Unit 3: Ionic Solids (06 L)

Crystalline and amorphous solids, crystal structures simple cubic, body centred cubic and face entered cubic, Properties of ionic solids, packing arrangements of anions in an ionic solids, Voids in crystal structure-tetrahedral and octahedral, Ionic radius, Palings univalent and crystal radii, Conversion of univalent radii to crystal radii, problems based on conversion of radii, Radius ratio effect, Lattice energy, Born-Lande equation, Born Haber cycle and its applications, Schottky and Frenkel defect.

Ref. 2 Pg. 32-61, Ref. 5 Pg. 102-127, Ref. 7 Pg. 55-62

Unit 4: Homogeneous Catalysis (06 L)

Definition, types of homogeneous catalysts, Essential properties of homogeneous catalysts, Catalytic Reactions such as:

A. Wilkinson's Catalysis
B. Zeigler Natta Catalysis
C. Monsanto acetic acid synthesis

Ref. 3, Ref. 6, Ref. 13 Pg. 650 - 652 and 656 - 661

Unit 5: Heterogeneous Catalysis (10 L)

Definition, types of heterogeneous catalysts-metals, semiconductors, solid acid catalysts and supported catalysts, Essential properties of heterogeneous catalysts, Catalytic Reactions such as:

A. Oxidation-i. Synthesis of terephthalic acid from xylene using ZSM-5
   ii)Synthesis of benzoic acid from toluene using KMnO4
B. Reduction-i) Hydrogenation of alkene to alkane using Raney Ni- catalyst.
   ii)Synthesis of p-aminophenol from nitrobenzene using Pd /C catalyst.
C. Cyclization-i. Benzimidazole synthesis using o-phenenediamine and benzaldehydeby
   acidic support or clay-solid support, amber list or NH4Cl.
D. Biodiesel Synthesis- using heteropoly acid catalyst-
   Transesterification using phosphomolybdic or phosphotungstic acid.

Ref. 5, Ref. 11, Ref. 13

Unit 6: Bioinorganic Chemistry (08 L)

Introduction, Role of metals in bioinorganic chemistry-

a. Classification as enzymatic and non-enzymatic metals,

Enzymatic redox metals such as Cu (SOD) and enzymatic non redox metals such as Zn (Hydrolase).

b. Role of metal ions in non-enzymatic process- Na, K, Ca, Mg (one example of each and briefdiscussion).
c. Role of metals in enzymatic Processes-Transition metals- Catalase, peroxidase and nitrogenase (Redox active).
d. Metalloproteinase-Iron Proteins-Introduction of Fe-S proteins, Electron transfer proteins (Fe-S, Fe_2S_2, Fe_3S_4, Fe_4S_4). Transport protein (transferrin) and Storage protein (ferritin) III. Bioinorganic Chemistry of Fe: Hemoglobin and myoglobin, its structure and functions. IV. Bioinorganic Chemistry of Co: Vitamin-B12, its structure and function.

Ref. 3 Pg.782-806, Ref. 2 Pg.353, 775, 779, 796-797, Ref. 12 Pg. 1-13, 24, 285-290

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. Concepts and Model of Inorganic Chemistry by Douglas – Mc Daniels – 3rd edition.
6. Chemistry by Raymond Chang – 5th edition
7. New Guides to Modern Valence Theory by G.I. Brown – 3rd edition
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. Heterogeneous Catalysis by D.K Chakraborty and B. Vishwanathan, New Age Int. Publishers, 1st edition.
12. Principles of Bioinorganic Chemistry by S. J. Lippard and J. M. Berg, Panima Publishing Corporation, 1stEdn.
13. Inorganic Chemistry by J.E. Huhey, 4th edn, Pearson Education.

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Class: T.Y.B.Sc. (SEM VI) **Subject**: Chemistry
Course: Physical Chemistry **Course Code**: CHEM 3602
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	PO8	PO9
CO1	3	3	0	3	3	0	0	0	0
CO2	3	3	0	3	3	0	0	0	0
CO3	3	3	0	3	3	0	0	0	0
CO4	3	3	0	3	3	0	0	0	0
CO5	3	3	0	3	3	3	0	0	0
CO6	3	3	0	3	3	3	0	0	0
CO7	3	3	0	3	3	3	3	0	0

Justification of Mapping

PO1: Disciplinary Knowledge

CO1: Understanding the chemistry of f block elements apply of metals in various reactions.
CO2: Know the properties of metals, semiconductors and superconductors using different fields
CO3: Know the crystal structure and applied it for different ionic solids.
CO4: Understanding to find the radius and lattice energy.
CO5: Understand homogeneous catalysis and applied in different catalytic reaction.
CO6: Know the heterogeneous catalysis for different catalytic reaction.
CO7: Know the bioinorganic chemistry and role of metal in different in different processes.

PO2: Critical Thinking and Problem Solving

CO1: Understanding the chemistry of f block elements apply of metals in various reactions.
CO2: Know the properties of metals, semiconductors and superconductors using different fields
CO3: Know the crystal structure and applied it for different ionic solids.
CO4: Understanding to find the radius and lattice energy.
CO5: Understand homogeneous catalysis and applied in different catalytic reaction.
CO6: Know the heterogeneous catalysis for different catalytic reaction.
CO7: Know the bioinorganic chemistry and role of metal in different in different processes.

PO4: Research-related skills and Scientific temper

CO1: Understanding the chemistry of f block elements apply of metals in various reactions.
CO2: Know the properties of metals, semiconductors and superconductors using different fields
CO3: Know the crystal structure and applied it for different ionic solids.
CO4: Understanding to find the radius and lattice energy.
CO5: Understand homogeneous catalysis and applied in different catalytic reaction.
CO6: Know the heterogeneous catalysis for different catalytic reaction.
CO7: Know the bioinorganic chemistry and role of metal in different in different processes.

PO5: Trans-disciplinary knowledge

CO1: Understanding the chemistry of f block elements apply of metals in various reactions.
CO2: Know the properties of metals, semiconductors and superconductors using different fields
CO3: Know the crystal structure and applied it for different ionic solids.
CO4: Understanding to find the radius and lattice energy.
CO5: Understand homogeneous catalysis and applied in different catalytic reaction.
CO6: Know the heterogeneous catalysis for different catalytic reaction.
CO7: Know the bioinorganic chemistry and role of metal in different in different processes.

PO6: Personal and professional competence

CO5: Understand homogeneous catalysis and applied in different catalytic reaction.

CO6: Know the heterogeneous catalysis for different catalytic reaction.
CO7: Know the bioinorganic chemistry and role of metal in different in different processes.

PO7: Effective Citizenship and Ethics

CO7: Know the bioinorganic chemistry and role of metal in different in different processes.

CHEM 3603 Organic Chemistry – II, (03 Credits, 48 Lectures)

Unit No.	Unit	No. of Lecture
1	Reactions of unsaturated Hydrocarbons and Carbon –oxygen double bond	10
2	Retrosynthetic Analysis and Applications	04
3	Rearrangement Reactions	06
4	Spectroscopic Methods in Structure Determination of Organic Compounds	22
5	Natural Products	06

ORGANIC CHEMISTRY

Course Objectives:

1. Students will be able to remember the mechanism of addition reactions of unsaturated compounds.
2. Students will be able to understand the retrosynthetical analysis and their application.
3. Students will be able to remember the rearrangement reactions with their mechanism.
4. Students will be able to understand the concepts of spectroscopy.
5. Students will be able to analyze the spectral data.
6. Students will be able to apply the spectral data to solve the examples based on spectroscopy.
7. Students will be able to understand the natural products and their importance.

Course Outcomes:

1. Students should be able to get knowledge of mechanism of addition reaction.
2. Students should be able to know the retrosynthetical analysis. Apply it for to analysis of other compounds containing single functional group.
3. Students should be able to know rearrangement with their mechanism.
4. Students should be able to know the importance of various spectroscopies.
5. Student should be able to compare the spectral data to another standard for determining structure.
6. Students should be able to analyze the spectra to determine the structure of the molecule.
7. Students should able to know the importance of natural products.

Unit 1: Reactions of unsaturated Hydrocarbons and Carbon –oxygen double bond.

(10 L)

a) Reactions of Carbon-Carbon double bond:

Introduction, Mechanism of electrophilic addition to C=C bond, Orientation and reactivity, Rearrangement, Mechanism of addition of hydro halogen, Anti-markownikoff's addition, addition of halogen, addition of hypohalous acid, hydroxylation, hydroboration-oxidation, hydrogenation and ozonolysis.

Ref. 1: Pg. 317-323, 327-343, 346-355 and 357-360.

b) Reactions of Carbon-Carbon triple bond:

Mechanism of addition of hydrogen, Halogen acids, Water. Formation of metal acetylides and its applications.

Ref. 1: Pg. 431-433.

c) Reactions of Carbon-Oxygen double bond:

Introduction, Structure of carbonyl group, Reactivity of carbonyl group, Addition of hydrogen cyanide, alcohol, thiols, water and Reformatsky reactions with mechanism.

Ref. 1: Relevant pages.

Unit 2: Retrosynthetic Analysis and Applications. **(04 L)**

Introduction, Different term used – Disconnection, Synthon, Synthetic equivalent, FGI, TM. Retro synthesis and synthesis of target molecules- Acetophenone, Crotonaldehyde, Cyclohexene, Benzoyl benzoate and Benzyl diethyl malonate.

Ref. 2: Relevant pages. Ref. 3: Relevant pages.

Unit 3: Rearrangement Reactions. **(06 L)**

Introduction, Mechanism of rearrangement reaction involving Carbocation, nitrene and oxonium ion intermediate. Beckmann, Bayer-Villiger, Pinacol-Pinacolone, Curtius, Favorski and Claisen rearrangement.

Ref. 7 Pg. 86-90, 150, 112, 122, 158. Ref. 6: Relevant pages.

Unit 4: Spectroscopic Methods in Structure Determination of Organic Compounds. (22 L)

A) Introduction:

Meaning of spectroscopy, Nature of electromagnetic radiation, Wavelength, Frequency, Energy, Amplitude, Wave number and their relationship, Different units of measurement of wavelength, Frequency, different regions of electromagnetic radiations. Interactions of radiations with matter, excitations of molecules with different energy levels- rotational, vibrational and electronic level.

Ref. 4: Pg.-1,3,7,11, Ref. 9 and 10: Relevant pages.

B) Ultra-Violet Spectroscopy:

Introduction, Spectrophotometer, Beer-Lambert's law, Electronic excitations, Terms used in UV spectroscopy, Effect of Conjugation on position of UV bands, Calculations of λ_{max} by Woodward and Fieser rule, Color and visible spectrum and Applications of UV spectroscopy.

Ref. 4: Pg.-13-15, 18-38.

C) Infra-Red Spectroscopy:

Introduction, Principle of IR spectroscopy, Types of molecular vibrations, Conditions of absorption of IR region, Interpretation of IR spectrum, Characteristics of IR absorption of some functional groups, Factors affecting IR frequencies, Applications of IR spectroscopy.

Ref. 4: Pg.- 46-51, 53, 54, 72-81, 86.

D) PMR spectroscopy:

Introduction, principles of PMR spectroscopy, magnetic and non-magnetic nuclei, processional motion of nuclei, nuclear resonance, chemical shift, shielding and deshielding, chemical shift, spin-spin coupling, coupling constant, Application of PMR spectroscopy.

Ref. 4: Pg.-95-98, 106-108.

E) Problems:

Spectral problems based on UV, IR and PMR data.

Ref. 1, 8 and 9**.**

Unit 5: Natural Products: **(06 L)**

(A) Terpenoids: Introduction, isolation, classification, Citral-structure (Chemical and Spectral methods) and Synthesis- Barbier and Boveault.

(B) Alkaloids: Introduction, Extraction, purification, Ephedrine-structure (Chemical and Spectral methods) and Synthesis-Nagi.

Ref. 5: Pg. -1437-1440, Ref. 6: Relevant pages

References books

1. Organic Chemistry by Morrison and Boyd 6th Edn.
2. Designing of organic synthesis by Stuart Warren 1983.
3. Organic Chemistry by Cram and Hammond.
4. Absorption spectroscopy of organic molecules by V. M. Parikh.
5. Organic chemistry by Claden, Greeves, Warren and Wothers.
6. Organic chemistry by I. L. Finar, Vol (II), 5thEdn.
7. Reaction, rearrangement and reagents by S. N. Sanyal.
8. Introduction to spectroscopy by Pavia.
9. Spectroscopic identification of organic molecules by Silver Stein.

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

Course: Practical course **CourseCode**: CHEM- 3603

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

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	3	0	0	0	0	0	0	0	0
CO4	0	3	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

Justification of Mapping

- **PO1: Disciplinary Knowledge:**

  CO1: Students should beable to get knowledge of mechanism of addition reaction.
  CO2: Students should be able to know the retro synthetical analysis. Apply it for to analysis of other compounds containing single functional group.
  CO3: Students should be able to know rearrangement with their mechanism.

- **PO2: Critical Thinking and Problem Solving:**

  CO4: Students should be able to know the importance of various spectroscopies.
  CO5: Student should be able to compare the spectral data to another standard for determining structure.
  CO6: Students should be able to analyse the spectra to determine the structure of the molecule.

- **PO7: Effective Citizenship and Ethics:**

  CO7**:** Understanding the importance of natural products (Strong Relation: 3)

CHEM 3604 Analytical Chemistry – II, (03 Credits, 48 Lectures)

Unit No.	Unit	No. of Lecture
1	Solvent Extraction	08
2	Chromatography	10
3	Gas Chromatography	09
4	High Performance Liquid Chromatography	09
5	Electrophoresis	06
6	Nephelometry and Turbidimetry	06

Course Objectives:

1. Students should know the different terms in Solvent extraction (Partitioncoefficient, Distribution ratio, % extraction etc.)
2. Students able to understand the chromatographic process with different types and its principls.
3. Students should know principle of GLC and GSC and its instrumentation/working.
4. Students able to understand the HPLC and its application.
5. Students able to understand the electrophoresis and its applications
6. Students able to understand the Nephelometry and turbidimetry and its applications
7. Students should know all above separation methods and its applications.

Course Outcomes:

1. Understanding the terms involved in solvent extraction and applied for separation method.
2. Know the chromatographic process applied indifferent separation processes.
3. Understanding the instrumentation and principle of GLC and GSC used for analysis.
4. Understanding the instrumentation and principle HPLC used for analysis.
5. Understanding the instrumentation and principle of electrophoresis used for analysis.
6. Understanding the Nephelometry and turbidimetry applied for analysis
7. Know all the methods apply to different chemical analysis.

Unit 1: Solvent Extraction(08 L)

Introduction, Principle of solvent extraction, Distribution coefficient, distribution ratio, Relation between Distribution coefficient and distribution ratio, factors affecting solvent extraction, percentage extracted, solvent extraction method, separation factor, batch extraction, counter current extraction, application of solvent extraction, numerical problems.

.

Ref: 3, 4, 7, 9 relevant pages**.**

Unit 2: Chromatography (10L)

Introduction and classification of chromatographic methods, Principle of chromatographic analysis with match box model, Theoretical plates and column efficiency, Theory, Principle, technique and applications of-Column Chromatography, Ion exchange Chromatography, Thin layer Chromatography, Paper Chromatography, Numerical Problems

Ref. 1- 8 Relevant pages

Unit 3: Gas Chromatography (09 L)

Introduction, Theory, Principle, GSC and GLC, Separation mechanism involved in GSC and GLC, Instrumentation of Gas chromatography, Working of gas chromatography, Gas chromatogram and Qualitative-quantitative analysis, Applications of gas chromatography

Ref. 1.Pg. 167-174, Ref. 4.Pg. 454-464, Ref. 5 Pg. 624-640

Unit 4: High Performance Liquid Chromatography (09 L)

Introduction, need of liquid chromatography, Separation mechanism involved in adsorption and partition HPLC, Instrumentation and working of HPLC, Applications of HPLC, and Introduction to super critical fluid chromatography (SFC)

Ref. 6. Pg. 529-545, Ref. 4. Pg. 178-183

Unit 5: Electrophoresis (06L)

Introduction, Principle and theory of electrophoresis, Different types of electrophoresis techniques, Moving Boundary Electrophoresis, Zone electrophoresis- Paper, Cellulose acetate and Gel electrophoresis, Applications of electrophoresis

Ref. 3 and Ref. 4 relevant pages

Unit 6: Nephelometry and Turbidimetry (06L)

Introduction, Principles and instrumentation of Nephelometric and Turbidimetric analysis, Difference between Nephelometric and Turbidimetric measurements, Choice between Nephelometry and Turbidimetry, Factors affecting Nephelometric and Turbidimetric measurements, Quantitative Applications, Numerical Problems

Ref.1. Pg.781-785, Ref.3. Pg.380-390

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 Besset Denney, Jaffrey, Mendham
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 VI) **Subject**: Chemistry
Course: Analytical Chemistry - II **Course Code**: CHEM 3604
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	PO8	PO9
CO1	3	3	0	3	3	0	0	0	0
CO2	3	3	0	3	3	0	0	0	0
CO3	3	3	0	3	3	0	0	0	0
CO4	3	3	0	3	3	0	0	0	0
CO5	3	3	0	3	3	0	0	0	0
CO6	3	3	0	3	3	0	0	0	0
CO7	3	3	3	3	3	3	3	0	0

Justification of Mapping

PO1: Disciplinary Knowledge

CO1: Understanding the terms involved in solvent extraction and applied for separation method.

CO2: Know the chromatographic process applied indifferent separation processes.

CO3: Understanding the instrumentation and principle of GLC and GSC used for analysis.

CO4: Understanding the instrumentation and principle HPLC used for analysis.

CO5: Understanding the instrumentation and principle of electrophoresis used for analysis.

CO6: Understanding the Nephelometry and turbidimetry applied for analysis

CO7: Know all the methods apply to different chemical analysis

PO2: Critical Thinking and Problem Solving

CO1: Understanding the terms involved in solvent extraction and applied for separation method.

CO2: Know the chromatographic process applied indifferent separation processes.

CO3: Understanding the instrumentation and principle of GLC and GSC used for analysis.

CO4: Understanding the instrumentation and principle HPLC used for analysis.

CO5: Understanding the instrumentation and principle of electrophoresis used for analysis.

CO6: Understanding the Nephelometry and turbidimetry applied for analysis

CO7: Know all the methods apply to different chemical analysis

PO3: Social competence

CO7: Know all the methods apply to different chemical analysis

PO4: Research-related skills and Scientific temper

CO1: Understanding the terms involved in solvent extraction and applied for separation method.

CO2: Know the chromatographic process applied indifferent separation processes.

CO3: Understanding the instrumentation and principle of GLC and GSC used for analysis.

CO4: Understanding the instrumentation and principle HPLC used for analysis.

CO5: Understanding the instrumentation and principle of electrophoresis used for analysis.

CO6: Understanding the Nephelometry and turbidimetry applied for analysis

CO7: Know all the methods apply to different chemical analysis

PO5: Trans-disciplinary knowledge

CO1: Understanding the terms involved in solvent extraction and applied for separation method.

CO2: Know the chromatographic process applied indifferent separation processes.

CO3: Understanding the instrumentation and principle of GLC and GSC used for analysis.

CO4: Understanding the instrumentation and principle HPLC used for analysis.

CO5: Understanding the instrumentation and principle of electrophoresis used for analysis.

CO6: Understanding the Nephelometry and turbidimetry applied for analysis

CO7: Know all the methods apply to different chemical analysis

PO6: Personal and professional competence

CO7: Know all the methods apply to different chemical analysis

PO7: Effective Citizenship and Ethics

CO7: Know all the methods apply to different chemical analysis

CHEM 3605 Industrial Chemistry – II, (03 Credits, 48 Lectures)

Unit No.	Unit	No. of Lecture
1	Polymer	09
2	Industrial Organic Synthesis	08
3	Soap and Detergents	08
4	Chemistry of pharmaceutical industries	08
5	Synthetic dyes industry	08
6	Pollution prevention and waste management	07

Course Objectives:

1. Students should know the expressions used in polymer industries.
2. Students able to understand the different steps in manufacturing of soaps and detergents.
3. Students should know the uses and application of dyes, polymers industries.
4. Students able to understand the different terminologies in pharmaceutical industries.
5. Student should understand aspects of small scale industries.
6. Students should know modern approach towards synthesis of Aspirin and chloroamphinicol etc.
7. Students should able to understand general terms in pollution prevention and waste management.

Course Outcomes:

1. Understanding the principles and concepts related to polymers, soaps and detergents, dyes, industrial organic synthesis, and pharmaceutical industries.
2. Gaining knowledge of the synthesis, properties, and applications of polymers, soaps and detergents, dyes, and pharmaceuticals.
3. Developing skills in laboratory techniques and experimental methods relevant to these fields.
4. Analyzing and evaluating the environmental, economic, and social impacts of these industries.
5. Applying theoretical knowledge to solve practical problems related to polymer synthesis, soap and detergent formulation, dyeing processes, and pharmaceutical production.
6. Developing critical thinking and problem-solving abilities in the context of these industries.
7. Understanding the regulatory and safety considerations associated with the production and use of polymers, soaps and detergents, dyes, and pharmaceuticals.
8. Enhancing communication skills through written reports, presentations, and discussions on topics related to these subjects.

Unit 1: Polymers(09 L)

Introduction, Classification, based on origin, based on the polymerization process, based on the molecularforces, based on the growth of polymerization, based on structure, based on the polymerization reaction, Methods of preparation and applications of Silicone polymers, Methods of preparation and applications of some polymers: Nylon-6,6, Terrylene, Polyethylene, polystyrene, polyvinyl chloride, Phenol-formaldehyderesin. Urea-formaldehyde resin, Melamine-formaldehyde resin.

Ref. 1 and 2

Unit 2: Industrial Organic Synthesis (08 L)

Manufacture of methanol from synthesis gas, Isopropanol from propylene, Glycerol from propylene via allyl chloride, Acetone by catalytic dehydrogenation of Isopropanol. (With flow sheet diagram), Unsaturated Hydrocarbon –preparation of Acetylene from Natural gas (with flow sheet), Aromatic hydrocarbon-Preparation of toluene (with flow sheet)

Ref.3: Chapter 11, Pg. 439 to 451 and Chapter 14, Pg. 493 to 522 (Relevant Points Only).

Unit 3: Soap and Detergents (08 L)

Soaps- Introduction, Importance of soap, Raw Materials used in Soap Manufacture, Manufacture of

Soaps(Continuous Process), Cleansing action of Soap and detergents, Classification of Soaps.

Detergents- Introduction, Advantages and disadvantages of Detergents, Surfactants and detergent, Emulsionand Emulsifying agents, Wetting and Non-wetting agents, Hydrophobic and Hydrophilic nature, Micelles, Types of surfactants, Detergent's builders and Additives, Manufacture of detergents, Comparison betweenSoap Detergent.

Ref.4

Unit 4: Chemistry of pharmaceutical industries (08 L)

Introduction - Importance, Qualities of good drugs, Classification of drugs, Functional and chemotherapeutic drugs, Meaning of the terms: Prescriptions, Doses, Analgesic, Antipyretics, Diuretics, Anaesthetics, Antibiotics, sulpha drugs, Anti-inflammatory, Tranquilizers, Anti-viral, Cardiovascular, Cough and Cold Preparations, Sedatives and Hypnotics, contraceptives, Anti-ulcer. Synthesis and uses of Paracetamol, Sulphanilamide, Benzocaine, Manufacture of Aspirin with flow sheet, Chloramphenicol, Penicillin-G, Diazepam.

Ref.3: Pg.762-775; Ref.5: Pg. 803-804, 818-822, Ref.6: Pg. .987-1011

Unit 5: Synthetic dyes (08 L)

Introduction - Importance, Qualities of good dye, colour and chemical constitution, Classification based onthe chemical constitution, Witt's theory.

Meaning of terms: chromospheres, auxochrome, bath chromic (red) and hypsochromic (blue) shifts.
Synthesis and uses of Methyl orange, Malachite green, phenolphthalein, Rosaniline, crystal violet, Florescence, Alizarin, Indigo. Pigments: Introduction, classification, and general physical properties.

Ref.3: Pg. 777-814; Ref.7: Pg. 863-915; Ref. 8. Ref. 9

Unit 6: Pollution prevention and waste management (07 L)

Introduction, importance of waste management, concept of atom economy, Terms involved in waste minimization: source reduction, recycling, product changes, source control, use and reuse, reclamation, assessment procedures, types of wastes, treatment, and disposal of industrial waste. Treatment of wastes or effluents with organic impurities. Treatment of wastes or effluents with inorganic impurities. The nature, effect and treatment of some important chemical wastes- (Pulp and paper industries, soap and detergent industries and food processing industries).

Ref. 3: Pg. 8-92; Ref.10: Pg. 15-30; Ref. www.wikipedia.org/atom economy

Reference books

1. Polymer materials C. C. Winding, and G.D. Hiatt Mc Grow Hill Book Co.
2. Polymer science by Gowarikar.
3. Polymer science, Bill Meyer, F.W. Jr. John Wiley and Sons.
4. Industrial Chemistry, B. K. Sharma, 16th Edition, Goal Publishing House, Meerut, (U.P.) 2011,India.
5. Perfumes Soaps Detergents & Cosmetics (Soaps & Detergents) (Volume 1) 1st Edition, CBSPublisher.
6. Shreve's chemical process industries 5th Edition, G.T. Oustin, McGraw Hill
7. Riegel`s handbook of Industrial chemistry, 9th Edition, James A. Kent.
8. Industrial chemistry –R.K. Das, 2nd Edition, 1976.
9. Dyes & Paints: A Hands-On Guide to Coloring Fabric, by Elin Noble.
10. Emergency Medicine: Chapter 146 Insecticides, Herbicides & Rodenticides, by James Adams.

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Class:T.Y.B.Sc. (SEM V) **Subject:** Chemistry
Course: Industrial Chemistry-II **Course Code:**CHEM 3605
Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

Mapping of Course Outcomes

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

PO1: Disciplinary Knowledge:

CO1: Understanding principles related to polymers, soaps, detergents, dyes, and pharmaceutical industries (Strong Relation: 3)

PO2: Practical Skills:

CO2: Gaining knowledge about synthesis, properties, and applications of various industrial products (Strong Relation: 3)

PO3: Critical Thinking:

CO3: Developing laboratory techniques and experimental methods in relevant fields (Strong Relation: 3)

PO4: Problem Solving:

CO4: Analyzing environmental, economic, and social impacts of industries (Strong Relation: 3)

PO5: Ethical Practice:

CO5: Applying theoretical knowledge to solve practical problems in industrial processes (Strong Relation: 3)

PO6: Practical Skills:

CO6: Enhancing critical thinking and problem-solving abilities in industrial contexts (Strong Relation: 3)

PO7: Research Skills:

CO7: Understanding regulatory and safety considerations in industrial production (Strong Relation: 3)

PO8: Communication Skills:

OPTIONAL THEORY PAPER- Select ANY ONE of the following

CHEM 3606(A) Nuclear Chemistry – II, (03 Credits, 48 Lectures)

Unit No.	Unit	No. of Lecture
1	Nuclear Fission	10
2	Nuclear Reactors	08
3	Nuclear Accelerators	08
4	Detection and measurement of nuclear radiations	08
5	Applications of Radioactivity	10
6	Radiation Safety precautions	04

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 discovery and process of nuclear fission, energy distribution among the fission fragments.
2. Student will be aware with compound nucleus theory along with mass distribution.
3. Student will able to understand the set-up, functioning and energy production from nuclear reactor. They also aware with nuclear energy program of India.
4. Student will able to learn the types Nuclear accelerators and their functioning.
5. Student will able to know different types of instruments used for detection and measurement of radioactivity such as Scintillation Counters, Semiconductor detectors, Neutron detectors
6. Student will able to learn the details of preparation and applications of radioisotopes in the different fields.
7. Student will be aware with Safety standards, safe working methods, biological effects of radiations, nuclear waste and its management.

Unit 1. Nuclear Fission **(10L)**

Introduction, Discovery of nuclear fission, The process of nuclear fission, Fission fragmentsand their mass distribution, Fission energy,Fission cross section and thresholds, Fission neutrons,Theory of nuclear fission**.**

Ref.1:Pg. 209to225

Unit 2. Nuclear Reactors **(08L)**

The fission energy, The natural uranium reactor, The four factor formula, The classification ofreactors. Reactor power, Critical size of a thermal reactor, Breeder reactor, The fast breeder testreactoratKalpakkam,India'snucleare nergy programme.

Ref.1:Pg. 232to249

Unit 3. Nuclear Accelerators **(08L)**

ElectrostaticAccelerators,Thecockcroft-waltonAccelerator, TheVande-GraftAccelerator,CyclicAccelerator,LinearAccelerator**.**

Ref:2Pg.290to305,325to330

Unit 4. Detection and measurement of nuclear radiations (08L)

Scintillation Counters, Semiconductor detectors, Neutron detectors.

Ref.2Pg.211to222.

Unit 5. Applications of Radioactivity (10L)

Probing by isotopes, Typical reactions involved in the preparation of radioisotopes, Szilard-Chalmer reaction, Cow and milk system, Use of charged plates in the collection of radioisotopes,Radiochemical principles in the use of tracers,Analytical applications: Isotope dilution analysis, Neutronactiv at ion analysis,Radiometrictitrations, Numericals,medicalapplications a)thyroidisis(Goiter), b) radioimmunoassay.

Ref.1Pg. 309to328,338to345

Unit 6. Radiation Safety precautions (04L)

Safetystandards, safe working methods, biological effects of radiations, nuclear waste and its management.

Ref.3Pg.322to328

Reference books

1. EssentialsofNuclearChemistrybyH.J.Arnikar,4th RevisedEdition,NewAge,
2. SourcebookofAtomicenergybySamuelGlasstone,3rdedition,East-Westpress.
3. NuclearPhysicsbyIrvingKaplan,2ndedition.
4. Introduction to Nuclear physics and Chemistry by B.G.Harvey.
5. FundamentalsofRadiochemistrybyD.D.Sood,A.V.R.ReddyandN.Ramamurthy.

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Class:T.Y.B.Sc. (SEM VI) **Subject:** Chemistry
Course: Nuclear Chemistry – II **Course Code:** CHEM 3606 (A)
Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

Mapping of Course Outcomes

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

PO1: Disciplinary Knowledge:

CO1: Learning about nuclear fission and energy distribution among fragments

PO2: Practical Skills:

CO2: Understanding compound nucleus theory and mass distribution

PO3: Critical Thinking:

CO3: Knowledge about nuclear reactor setup, functioning, and energy production, including India's nuclear energy program

PO4: Problem Solving:

CO4: Learning types of nuclear accelerators and their functioning

PO5: Ethical Practice:

CO5: Understanding instruments used for radioactivity detection and measurement

PO6: Practical Skills:

CO6: Learning about the preparation and applications of radioisotopes in various fields

PO7: Research Skills:

CO7: Awareness of safety standards, biological effects of radiations, nuclear waste management

CHEM 3606 (B) Polymer Chemistry – II, (03 Credits, 48 Lectures)

Unit No.	Unit	No. of Lecture
1	Polymer Degradation	03
2	Chemical and Geometrical structures of Polymer Molecules	04
3	Glass Transition Temperature and Heat Distortion Temperature(Softening Point)	05
4	Crystallinity in polymers	04
5	Some Important Polymers	08
6	Analysis and testing of polymers	06
7	Some Special Polymers	06
8	Polymer Processing	12

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 details about Degradation of polymers and their degradation types like, Thermal degradation, Mechanical degradation. Photodegradation.
2. Student will able to know the organic & inorganic polymers, homo chain & hetero chain polymers, Homopolymers &Copolymers
3. Students should able to know the terms – Microstructures based on geometrical structures and Optical and Geometric Isomerism
4. Student will able to understand physical properties and crystallinity in polymers
5. Students will able to understand the preparation, properties and uses of some important polymers like Polystyrene, Polymethylmethacrylate, Polyester, Polycarbonates, Polyamides, Polyvinyl alcohol(PVA), Polyvinylchloride(PVC), Polytetrafluoroethylene(Teflon) & polyvinyl fluoride, lyisoprene, Polyimide, Phenol formaldehyde resin (Novella), Urea formaldehyde resin, Epoxy polymers.
6. Student will able know the analysis and testing of some selected polymers.
7. Student will able to explain, physical and chemical processing of selected Polymers.

Unit 1. PolymerDegradation (03L)

Introduction,TypesofDegradation,Thermaldegradation,Mechanicaldegradation.Photodegradation.

Ref.1:Pg.262–277, Ref.3:Pg.151-160, Ref.4:RelevantPages, Ref.11:Pg.60-65

Unit 2. Chemical and Geometrical structures of Polymer Molecules (04L)

Microstructures based on chemical structures-Organic & Inorganic polymers ,Homochain & Hetero chainpolymers,Homopolymers &Copolymers, Microstructures based on geometrical structures - Interpenetrating coils, folded chain, Helical chain,Linear, Branched, Random,Alternating,Graft and Blockpolymers.

Stereo-regularpolymers -OpticalandGeometricIsomerism.

Ref1:Pg.136-149, Ref4:RelevantPages

Unit 3. Glass Transition Temperature (GTT) and Heat DistortionTemperature (SofteningPoint)

(05L)

Definition, Factors influencing the Glass transition temperature, Glass transition temperatureand molecularweight,Glasstransition
peratureandplasticizers,GlassTransitionTemperatureandCrystallinemeltingpoint(Tm),ImportanceofGlasstra

nsitionte mperature.

Ref1:Pg.150,163-169,171-172,219, Ref4, Ref9:Pg.113-116, Ref10:Pg.47-58

Unit 4. Crystallinityinpolymers(04L)

Introduction, Degree of Crystallinity, Crystallisability, crystallites, Factors affectingCrystallisability, Effectofcrystallinityonthepropertiesofpolymers.

Ref.1:Pg.173-177,180-183,189-191, Ref.5:Pg.69-74, Ref.9:Pg.103-112

Unit 5. Some Important Polymers(08L)

Polystyrene,Polymethylmethacrylate,Polyester,Polycarbonates,Polyamides,Polyvinylalcohol(PVA),Poly vinylchloride(PVC),Polytetrafluoroethylene(Teflon)&polyvinylfluoride,lyisoprene,Polyimide,Phenolfor maldehyderesin(Novolac),Ureaformaldehyderesin,Epoxypolymers.

Ref.1:Pg.213-254, Ref.3:RelevantPages, Ref.4:RelevantPages, Ref.8:RelevantPages

Unit 6. Analysis and testing of polymers (06L)

SpectroscopicMethods:IR,NMR,Thermalanalysis:DifferentialScanningCalorimeter(DSC), ThermoGravimetricAnalysis(TGA),Physicaltesting:Mechanicalproperties,Thermalproperties, Optical properties, Electrical properties, Chemical properties.

Ref2:Pg.229-237,242-252, Ref4:Pg.121-139

Unit 7. Some Special Polymers (06L)

Polymerblends,Bio-medicalpolymers, Biodegradable polymers ,Liquid Crystalline polymers(LC's), Conducting polymers, thermallystable polymers,Optical fibers,

Ref.4:RelevantPages, Ref.6:Pg.179,185,197, Ref.7:Pg.262-299, Ref.9:Pg.130-162

Unit 8. Polymer Processing (12L)

PlasticTechnology (04 L)

1.Molding2. Extrusion3. Otherprocessingmethods:Calendaring,FilmCasting,Coating,Foaming,Forming,Laminating&Lowpressure molding,Compounding.

Ref.2:Pg.457-469,474-475., Ref.1,4,6,7,9: Relevantpages

FiberTechnology (04 L)

1.Introduction,Textile&Fabricproperties,2.FiberSpinning:i)Meltspinningii)Dryspinning iii)Wetspinningand3.Fiberaftertreatments:Scouring,Lubrications,Sizing,Dyeing,Finishing,Textureyarns, Nonwovenfabrics.

Ref2:Pg.486-501, Ref.1,4,6,7,9: Relevantpages

ElastomerTechnology (04 L)

1.Introduction,Vulcanization(Sulphur&nonSulphurvulcanization),2.Reinforcement,ElastomerCompoundin

Reference Books

1. Polymer SciencebyV.R.Gowarikar,N. V. Vishwanathan,Jaydev ShreedharNewAge
2. TextbookofPolymerSciencebyFredBillmeyer,3rdEdn.JohnWiley &Sons(Reprint2008)
3. IntroductoryPolymerChemistrybyG. S. MisraNewAgeInternational(P)Ltd.Publisher1996.
4. PolymerChemistrybyCharlesE.Carraher(Jr.),6thEdn,(FirstIndianPrint2005),
5. InorganicPolymersbyG. R. ChatwalHimalayaPublishingHouse1stEdn.1996
6. PolymerScience–ATextBookbyV.K.Ahluwalia,AnuradhaMishra.
7. PrincipleofPolymerSciencebyP.Bahadur,N.V.Sastry,2ndEdn,NarosaPublishingHouse.
8. PolymerChemistrybyAyodhyaSingh,2008,CampusBookInternational,NewDelhi.
9. OrganicPolymerChemistrybyJagdambaSingh,R.C.Dubey,4thEdn,2012.
10. AdvancedPolymerChemistrybyV.K.Selvaraj,1stEdn,2008,CampusInternational,NewDelhi.
11. OrganicPolymerChemistrybyV.Jain,IVYPublishingHouse,NewDelhi.
12. PrinciplesofPolymerizationbyGeorgeOdian3rdEdn.JohnWiley&SonsNewYork.

Class:T.Y.B.Sc. (SEM VI) **Subject:** Chemistry
Course: Polymer Chemistry II **Course Code:** CHEM 3606 (**B**)
Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

Mapping of Course Outcomes

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

PO1: Disciplinary Knowledge:
CO1: Understanding polymer degradation types

PO2: Practical Skills:
CO2: Knowledge about organic, inorganic polymers, and copolymers

PO3: Critical Thinking:
CO3: Understanding microstructures, optical and geometric isomerism in polymers

PO4: Problem Solving:
CO4: Understanding physical properties and crystallinity in polymers

PO5: Ethical Practice:
CO5: Knowledge about preparation, properties, and uses of various important polymers

PO6: Practical Skills:
CO6: Understanding the analysis and testing of selected polymers

PO7: Research Skills:
CO7: Understanding the physical and chemical processing of selected polymers

CHEM 3606 (C): Introduction to Biochemistry&MolecularBiology– II(03 Credits, 48 Lectures)

Unit No.	Unit	No. of Lecture
1	Introduction to Metabolism	02
2	Carbohydrate metabolism	06
3	Lipid metabolism	04
4	Amino acid metabolism	04
5	Electron Transport Chain and Oxidative Phosphorylation	06
6	Nucleic acids	07
7	DNA replication	06
8	Transcription	05
9	Translation	04
10	Introduction to Genetic engineering	04

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 Introduction and types of Metabolism
2. Student will able to know the Carbohydrate metabolism and TC Acycle- enzymatic reactions and energetics.
3. Student will able to learn the details about, lipid metabolism and transportation of fatty acids,
4. Student will able to understand the details in decarboxylation reactions of amino acids. Urea cycle
5. Student will able to 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
6. Student will able to understand Basic concepts of genetic engineering
7. Student will be aware with the principle, working procedure and applications of genetic engineering

Unit 1. IntroductiontoMetabolism: (02L)

Definitionofcatabolismandanabolism,Typesofmetabolicreactions,Highenergycompounds,Significanceof ATP.

Ref:3,Chapter12,Pg. 247-249andChapter11 P g . 227-230.

Unit 2. CarbohydratemetabolismandTCAcycle (06L)

Aerobicandanaerobicglycolysis-structuresofintermediates,variousenzymesinvolvedandenergetics. Fate of Pyruvate, Pyruvate dehydrogenase complex. TCA cycle- enzymatic reactions andenergetics.

Ref:2,Chapter17:Pg. 136-144andChapter16:Pg. 130-135

Unit 3. Lipidmetabolism (04L)

Transportation of fatty acids with the help of carnitine, β-oxidation ofpalmiticacid inmitochondriaanditsenergetics. Triacylglycerolsynthesis,ketogenesis.

Ref :2,Chapter22,Pg. 180-189.

Unit 4. Aminoacidmetabolism: (04L)

Significanceoftransamination,deamination,decarboxylationreactionsofaminoacids. Ureacycle.

Ref:2,Chapter29, Pg. 242-248

Unit 5. ElectronTransportChainandOxidativePhosphorylation: (06L)

Location of Electron carriers, Electron transport chain, Proton gradient, Oxidative phosphorylation-Chemiosmotichypothesis,Inhibitorsand Uncouplers of Electron transport chain and Oxidative phosphorylation.

Ref:3,Chapter11,Pg. 230-239.

Unit 6. Nucleicacids: (07L)

StructuresofPurinesandPyrimidines,Nucleosides,Nucleotides,Polynucleotides. Differencebetween DNAand RNA. Watsonand Crick model of DNA. DNAas geneticmaterial (Macleod andMcCarty,HersheyandChaseexperiments) RNAanditstypes. Centraldogmaofmolecularbiology.

Ref:3,Chapter5,Pg. 73-83.

Unit 7. DNAreplication: (06L)

Semiconservative model of replication (Meselson and Stahl experiment). Brief account of initiation (features of Ori C), elongation and termination of DNA replication in prokaryotes. Okazaki fragments,Leading and Lagging strands, Distinguishing features of DNA polymerase I, II and III. Klenow fragmentofDNA polymeraseI.

Ref:1,Chapter25,Pg. 950-984

Unit 8. Transcription: (04L)

Briefaccountofinitiation-Promotersequences,elongationandterminationoftranscriptioninprokaryotes.RNApolymerase.Examplesofinhibitorsoftranscription.Chapter26:996-1027

Ref:1,Chapter26, Pg. 948–1033.

Unit 9. Translation: (05L)

Genetic code and its features. Brief account of initiation, elongation and termination of translation inprokaryotes. Examplesofinhibitorsoftranslation. Regulationofgeneexpression-Lacoperon.

Ref:1,Chapter27,Pg. 1034-1075.

Unit 10. Introductiontogeneticengineering: (04L)

Basicconceptsofgeneticengineering-RestrictionEnzymes-Typesandfeatures,Vectors(Plasmids PhagesandCosmids)RecombinantorChimericvector.PrincipleandStepsinvolvedingenecloningwithinsulinasexample.Applicationsofgeneticengineeringinvariousfields.

Ref:1,Chapter9,Pg. 307-310,311-313,Chapter2,Pg. 15.

ReferenceBooks

1. Lehninger's,PrinciplesofBiochemistry,byNelsonandCoxMacmillanPublisher4th edn.
2. Harper'sIllustratedBiochemistry,26thEdition.
3. BiochemistrybyU.Satya Narayana
4. Biotechnology,B. D. Singh,3rdedition.
5. Cellbiology,Genetics,MolecularBiology,EvolutionandEcology,byVermaandAgarwal,14thedition.
6. PrincipletechniquesofBiochemistryandMolecularBiologybyKeithWilsonandJohnWalker,6thedition.
7. BiophysicaltechniquesbyUpadhyayandNath,3rdrevisededition.

Class:T.Y.B.Sc. (SEM VI) **Subject:** Chemistry
Course: Introduction to Biochemistry & Molecular Biology - II **Course Code:**CHEM 3606 (**C**)
Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

Mapping of Course Outcomes

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

PO1: Disciplinary Knowledge:
CO1: Understanding metabolism and its types (Strong Relation: 3)

PO2: Practical Skills:
CO2: Knowledge about carbohydrate metabolism, enzymatic reactions, and energetics (Strong Relation: 3)

PO3: Critical Thinking:
CO3: Learning about lipid metabolism and fatty acid transportation (Strong Relation: 3)

PO4: Problem Solving:
CO4: Understanding decarboxylation reactions of amino acids and the urea cycle (Strong Relation: 3)

PO5: Ethical Practice:
CO5: Knowledge about nucleic acids, DNA, RNA, replication, and molecular biology's central dogma (Strong Relation: 3)

PO6: Practical Skills:
CO6: Understanding basic concepts of genetic engineering (Strong Relation: 3)

PO7: Research Skills:
CO7: Awareness of genetic engineering principles, procedures, and applications (Strong Relation: 3)

CHEM 3606 (D): EnvironmentalandGreenChemistry– II, (03 Credits, 48 Lectures)

Unit No.	Unit	No. of Lecture
1	Water treatment and effluent management	08
2	Soil and solid waste management	04
3	Instrumental methods in environmental analysis	08
4	Green House Effect and Global Warming	04
5	Water the ultimate Green solvent	12
6	Energy Relations	12

Course Objectives:

1. Students should know the water treatment and effluent management for domestic water and waste water.
2. Students able to understand soil and soil waste management with respect to soil composition, types and exchange capacity.
3. Students should know the different types of instruments, its principle and operation system for environmental trace pollutant analysis.
4. Students able to understand greenhouse gases, green house effect, global warming and climate change.
5. Students should know the green solvent, water as a solvent, its properties and the interaction of water with different phases as well as reaction.
6. Students able to understand the different energy sources and it's inter relationship.
7. Students should know overall pollutant effect on environment.

Course Outcomes:

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

Unit 1:Water treatment and effluent management (08 L)

Domesticsewage, wastewatertreatment:primary,secondaryandtertiarytreatments,

aerobic,anaerobicandup flowanaerobic sludgebedtreatmentprocesses

Industrialwastewatertreatmenti)filtrationmethodii)ion-exchangemethod

iii)membranetechniques:ultrafiltration, reverseosmosisandelectro dialysis

Treatmentofdrinkingwater

Ref.1,Ref.2,Ref.3

Unit 2: Soil and solid waste management (04 L)

Compositionofsoilandtypesofsoil., Organicandinorganiccomponentsofsoil

Acidbaseandionexchangereactionsinsoilandp Hofsoil

Chemistryofdisposalofsolidwastei)sanitarylandfillsii)incineratorsiii)pyrolysis

Ref.1,Ref.2,Ref.3

Unit 3:Instrumentalmethodsinenvironmentalanalysis(08 L)

Atomicabsorptionspectroscopy:determinationofHg,As,Zn,Ag,Pb,Mn,Fe,Cu,Cr,Cd

Gaschromatography:detectionanddeterminationofCO,HCandpesticides

HPLC:determinationofpesticides,PAHasmetabolites

Spectrophotometry:determinationofNOx,SO_2,NH_3,CN,PO_4,Cd,Pb,Hg

Chemiluminescence:determinationofNOxandO_3.

NonDispersiveIRspectrometryofdeterminationofCO

Ionselectiveelectrodes:determinationofNO_3anddissolvedoxygen(D.O.)

Ref.1,Ref.2

Unit 4:GreenHouseEffectandGlobalWarming(04 L)

Introduction, Greenhousegases, Radiativeforcing, SourcesandsinksofCO_2

Causesoffluctuationsinglobaltemperature, Globalwarmingandclimatechanges

Implicationsofclimatechanges

Ref.5

Unit 5.WatertheultimateGreensolvent(12 L)

H_2O:Simpleformulaandcomplexmolecule, Importantpropertiesofwater

Thehydrologiccycle, Bodiesofwaterandlifeinwater, Chemicalprocessinwater

Fizzywaterfromunderground, Oxygeninwater, Weakacidfromsky

Whynaturalwatercontainsalkalinityandcalcium, Metalsinwater,

Waterinteractionswithotherphases

Ref:GreenChemistrybyStanley EManahan,ChemcharResearchInc.(2006)- 2nd EdnChapter7:Pg. 161-173

Unit 6. EnergyRelations:

(12 L)

Energy, RadiantEnergyfromtheSun, Storageandreleaseofenergybychemicals

Energysources, Conversionsbetweenformsofenergy, Greenengineeringandenergyconversion

Efficiency, Conversionofchemicalenergy, Renewableenergysources

Ref:GreenChemistrybyStanleyEManahan,ChemcharResearchInc.(2006)- 2ndEdnChapter6:Pg. 135-157

ReferenceBooks

1:EnvironmentalChemistry–A.K.De,5thEdition(Newageinternationalpublishers)

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

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

4:AnalyticalChemistry–G.D.Christian4thEdition(JohnWileyandSons)

5:EnvironmentalChemistry–H.Kaur2ndEdition2007,Pragati Prakashan,Meerut,India

6.EnvironmentalChemistrywithGreenChemistryA.KDas,BooksandAllied(P)Ltd,

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

Course: Environmental and Green Chemistry – II **Course Code:**CHEM 3606 (**D**)

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

Mapping of Course Outcomes and ProgramOutcomes

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

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.

PO3: Critical Thinking:

CO3: Understanding instruments used for trace pollutant analysis

PO4: Problem Solving:

CO4: Knowledge about greenhouse gases, global warming, climate change, and remedial solutions

PO5: Ethical Practice:

CO5: Understanding the use of green solvents instead of hazardous solvents

PO6: Practical Skills:

CO6: Understanding energy sources and their applications

PO7: Research Skills:

CO7: Understanding environmental pollutants, remedies, and pollution minimization

CHEM 3606 (E): Dairy Chemistry, (03 Credits, 48 Lectures)

Unit No.	Unit	No. of Lecture
1	Market Milk	08
2	Common Dairy Processes	06
3	Special Milks	08
4	Milk proteins, Carbohydrates and Vitamins	08
5	Preservatives & Adulterant sin Milk	06
6	Milk Products	08
7	Dried Milk Products	04

Course objective ;

1. Student should able to know the definition, constituents of milk, physical and chemical properties of milk.
2. Student should able to know details about Milk Products like Cream, Butter, Cheese and Ice-Cream.
3. Student will aware with Milk proteins, Carbohydrates and Vitamins

Course Outcomes:

1. Student will able to understand the definition, constituents of milk, physical and chemical properties of milk.
2. Student will able to understand the Basic principles in Common Dairy Processe
3. Student will able to know the details about Special Milks, their types and properties of some Vitaminised/irradiated milk, Standardized milk
4. Student will able aware with Milk proteins, Carbohydrates and Vitamins.
5. Student will able to learn about Preservatives & Adulterants in Milk
6. Student will able to know details about Milk Products like Cream, Butter, Cheese and Ice-Cream.
7. Student will able to understand the details about Dried Milk Products like buttermilk powder, whey powder, cream powder ,infect milk powder, Shrikand powder, Ice-cream mix powder, cheese powder

Unit 1. Market Milk **(08L)**

Introduction, Definition, constituents ofmilk of different species suchas cow, buffalo, goat,etc.,ChemicalcompositionofmilkofIndianbreedandforeignbreedsofcow,factoraffectin gcomposition of milk, characteristics of milk of different mammals, physicochemical properties of milk, acidity, pH, density, specificgravity, color and flavor of milk, food and nutritive value of milk. Microbiology of milk, growth of microorganism, stages of growth, product of microbial growth, destruction of microorganism's growth.

Ref1, Ch.1relevantpages,Ref2Pg. 9-26,Ref6relevantpages.

Unit 2. Common Dairy Processes(Manufacture,storageandpackaging) **(06L)**

Cream separation- Basic principles, gravity creaming water dilution and centrifugalcreamingmethod, construction of centrifugal separator, factors affecting percentage of fat, speed of machine,temp. of milk, rate of inflow amount of flushing water formation ofseparator slime Pasteurization

ofmilk,flowsheetdiagram,processreceivingmilk,preheatingfiltration,clarification,coolinga ndstoragerawmilk,standardization,pasteurization,homogenization,packingandstorage,uses ofmilk.

Ref1.-Relevantpages.

Unit 3. Specia lMilks (08L)

Sterilizedmilk-Definition,methodofmanufactureindetail,Advantagesanddisadvantages. Homogenized milk, - Definition, merits and demerits factor influencing homogenization,Process ofmanufacture. Soft curd milk- Definition, characteristics, method of preparationsoftcurdmilk. Flavoredmilk-Definition,types,methodofmanufactureflowsheetdiagram.Vitaminised/irradiatedmilk--Definition,methodofmanufacture.FermentedMilk-Definition,methodofmanufacture.Standardizedmilk-Definition,methodofmanufacture.

Ref1Ch. 2relevantpages**.**

Unit 4. Milkproteins,CarbohydratesandVitamins (08L)

Milkproteins-importanceofproteinsfoundinthemilk-casein,albuminandglobulin,composition,nomenclature,propertiesanduses.2.Carbohydrates -importanceoflactose,classification,properties,nutritivevalueoflactoseuseoflactose.3.Vitamins-importance,definition, propertiesnutritivevalueofvitamins,Vit-A,Vit-B,B2,B6,B12,Vit-C(Ascorbicacid)&Vitamin-D.4.Food andnutritive valueofmilk,milk&public health.

Ref - 2Pg.11,12,33to38,42to49,51to53

Unit 5. Preservatives&AdulterantsinMilk (06L)

Preservationofmilk-Introduction,Commonpreservativesareused..

Adulterants-Introduction, Modes of Adulteration and their detection such as skimming, addition of separated milk,skimmilk,Water,Starchandcanesugar.

Ref-2Pg.78-81

Unit 6. MilkProducts(Cream,Butter,CheeseandIce-Cream.)**(08L)**

1. Cream- Definition, Classification, Composition, Food & Nutritive value, Physicochemical properties,Manufacture andusesofcream.

Ref-1 Pg.117,118,121 &142

2. Butter- Definition, Classification, Composition, Food & nutritive value,

Physicochemical properties,ManufactureandusesofButterselectionofmilk/cream.Preheatingofmilk,separatingofmilk,neutralization of cream, Pasteurization of cream, Cooking & ageing, repenting of cream, salting ofbutter, washingofbutter,packaging& Storage,use ofbutter.

Ref-1Pg.143,144,145to158&173

3. Cheese- Definition,Classification,Food&nutritivevalue,properties,Manufactureandusesofc

Ref-1Pg.224,227,229to242&267

4. Ice-cream- Definition, Classification, Composition, Food & Nutritive value,Manufacture, packing,hardening & Storage,usesofIce-cream.

Ref-1Pg.182,183,184,193,223

Unit 7. DriedMilkProducts (04L)

Introduction,buttermilkpowder,wheypowder,creampowder,infectmilkpowder,Shrikand powder,Ice-creammix powder, cheese powder.

Ref-1Pg. 357to 377

Reference books

1. OutlineofDairyTechnology-OxfordUniversityPressBy-SukumarDe.(Edition-1983)
2.DairyChemistryandAnimalNutrition-M.M.Rai,Kalyani,Publishers,3rdEdition,1980
3.FundamentalsofDairyChemistry-B.H.Webb,A.H.Hooson,J.A.Alford,CBBPublishers
4.MilkandMilkProducts-C.H.Eckles,H.Macy,TataMcGrawHikePublishing CompanyLtd.
5. ChemistryandTestingofDairyProducts-H.V.Atherton,J.A.New Lander,CBS,PublishersandDistributors.
6. DairyMicrobiology,Dr.K.C.Mahanta OmsonsPublicationNewDelhi.

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

Course: Dairy Chemistry **Course Code:**CHEM 3606 (**E**)

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	1	0	0	0	0	0	0	0	0
CO2	1	1	0	0	0	0	0	0	0
CO3	1	1	0	1	0	0	0	0	0
CO4	1	1	1	0	0	1	0	0	0
CO5	0	1	1	0	0	0	0	1	0
CO6	0	1	0	0	1	1	0	0	0
CO7	0	0	0	0	1	0	1	0	0

Explanation:

PO1: Disciplinary Knowledge:

CO1: Understanding the definition, constituents, physical, and chemical properties of milk.

CO2: Understanding basic principles in common dairy processes.

CO3: Knowing details about special milks, their types, and properties.

PO2: Critical Thinking and Problem Solving:

CO2: Understanding basic principles in common dairy processes.

CO3: Knowing details about special milks, their types, and properties.

CO4: Being aware of milk proteins, carbohydrates, and vitamins.

CO5: Learning about preservatives and adulterants in milk.

CO6: Knowing details about various milk products.

PO3: Social Competence:

CO3: Knowing details about special milks, their types, and properties.

CO5: Learning about preservatives and adulterants in milk.

CO6: Knowing details about various milk products.

CO7: Understanding the details about dried milk products.

PO4: Research-Related Skills and Scientific Temper:

CO4: Being aware of milk proteins, carbohydrates, and vitamins

CHEM 3606 (F): Environmental Nano technology and Applications

(03 Credits, 48 Lectures)

Unit No.	Unit	No. of Lecture
1	Water Pollution	12
2	Air pollution	12
3	Nano materials forsensing toxic gases	12
4	Meso porous materials for Environmental Applications	12

Course objectives :

1. Student should able to know about Toxicity due to air-borne nonmaterial, engineered nonmaterial's in the environment
2. Students will be aware with the Nanomaterials for sensing toxic gases.
3. Students should able to know the Air pollution, methods for the measurement of air pollution and its control, pollution in the atmosphere.
4. Students should able to know about Water Pollution, physicochemical properties of waste water, water and waste water treatment,

Course Outcomes:

1. Student will able to learn and understand details about Water Pollution, physicochemical properties of waste water, water and waste water treatment,
2. Student will able to learn and understand details about Ground water pollution, Sources, effect control, consequences of ground water pollution, nanotechnologies used in water treatments, effluent treatment.
3. Student will able to understand the Air pollution, methods for the measurement of air pollution and its control, pollution in the atmosphere.
4. Student will able to learn and understand details about Toxicity due toair-borne nonmaterial, engineered nonmaterial's in the environment
5. Student will able aware with the health effects of nanoparticles through air absorption, pulmonary deposition of nanoparticles, elimination of dust deposited in the lungs, nanoparticles.
6. Student will able aware with the Nanomaterials for sensing toxic gases
7. Student will able to know the details about Mesoporous materials for Environmental Applications.

Unit1: Water Pollution: (12L)

Water Pollution, sources and management of Water Pollution, need for water management, waste water collection, physicochemical properties of waste water, water and wastewater treatment, physical, chemical and biological treatment process, activated sludge,oxidation ditches, trickling filter, rotating discs, rotating drums,oxidationponds,Anaerobicdigestions,anaerobicfilters,upflowanaerobicsludgeblanketreactor,tret ments chemes for water of dairy, distillery, sugar and antibiotic industries.Groundwaterpollution,Sources,effectcontrol,consequencesofgroundwaterpollution. Drinking water, domestic and industrial waste water, nanotechnologies used in water treatments, effluent treatment. Environment (Protection) act-1986, the water (prevention and control of pollution) act-1974

Unit2: Air pollution: (12 L)

Air pollution, methods for the measurement of air pollution and its control, pollution in the atmosphere.

Toxicity due to air-borne nanomaterials,engineere dnanomaterialsin the environment

And healt heffects of nanoparticles through air,absorption,pulmonary depositionof nanoparticles,elimination of dustdeposited in the lungs, nanoparticles.

Absorption in th eair, effect of ultrafinedust

The air (prevention and control of pollution) act-1981,clean air act and nanotechnology.

Unit3: Nanomaterialsforsensingtoxicgases: (12L)

Gas sensing materials and devices, Techniques used for gas sensing (resistance, capacitanceandelectrochemical),Sensorproperties,advantagesofnanomaterials, synthesisandcharacterizationofNano-metaloxides(tinoxide,zinc oxide,indium oxide), mixed oxides, nanoscale materials for sensors (quantum dots, CNTs, nanotubes, wiresandbelts), colloidal silver and gold,magneticnanoparticles, application of nanomaterialsin sensors,CNT-basedsensors,Graphene-basedsensors,activedevicesbasedonNanostructures.

Unit4: MesoporousmaterialsforEnvironmentalApplications:(12L)

Why mesoporous materials? Hierarchy of solid structure and adsorption, mesoporous silicaanditsapplicationtotheabsorptionoftoxicanions,importantcharacteristicsforEnvironmental applications, nanocomposites for environmental applications, CeO_2catalystsand CO catalytic oxidation, metal loaded CeO_2/ ZrO_2catalysts, application of mesoporousTiO_2inPhoto catalysis,mesoporous materialsasAdsorbents.

ReferenceBooks

1. EnvironmentalapplicationsofNanomaterials:Synthesis,sorbentsandsens ors (2nd Edition)Editors:GlenE. FryxellandGuozhongCao,ImperialCollegePress
2. MetalOxideNanostructuresasGasSensingDevices,G.Eranna,CRC Press, ATaylorandFrancisBook,
3. EnvironmentalChemistry,A.K.De,WileyWesternLtd,NewDelhi,2003
4. Waste waterEngineering-Treatment, Disposal andReuse, Metcalf andEddy, Inc.,TatMcGrawHill,1999
5. StandardmethodbyAmericanpublichealthassociation(APHA),2005
6. Waterandwaste wateranalysis (Handbookofmethods inenvironmentalstudies,byS.K.Maiti, ABDPublication,Delhi,ISBN-978-81-8577- 34-07

Class: T.Y.B.Sc. (SEM VI) **Subject**: Chemistry
Course: Environmental Nanotechnology and Applications **Course Code**: CHEM 3606(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	3	0
CO2	3	0	0	0	0	0	0	3	0
CO3	0	0	0	0	0	0	3	0	0
CO4	0	0	0	2	0	0	3	0	0
CO5	0	0	0	3	0	0	3	0	0
CO6	0	0	0	3	0	0	3	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 Water Pollution, physicochemical properties of waste water, water and waste water treatment,

CO 2: Student will able to learn and understand details about Ground water pollution, Sources, effect control, consequences of ground water pollution, nanotechnologies used in water treatments, effluent treatment

PO4: Research-related skills and Scientific Temper

CO 4: Student will able to learn and understand details about Toxicity due toair-borne nanomaterials, engineered nanomaterials in the environment

CO 5: Student will able aware with the health effects of nanoparticles through air absorption, pulmonary deposition of nanoparticles, elimination of dust deposited in the lungs, nanoparticles.

CO 6: Student will able aware with the Nanomaterials for sensing toxic gases

PO7: Effective Citizenship and Ethics

CO 3: Student will able to understand the Air pollution, methods for the measurement of air pollution and its control, pollution in the atmosphere.

CO 4: Student will able to learn and understand details about Toxicity due to air-borne nanomaterials, engineered nanomaterials in the environment

CO 5: Student will able aware with the health effects of nanoparticles through air absorption, pulmonary deposition of nanoparticles, elimination of dust deposited in the lungs, nanoparticles.

CO 6: Student will able aware with the Nanomaterials for sensing toxic gases

CO 7: Student will able to know the details about Mesoporous materials for Environmental Applications.

PO8: Environment and Sustainability

CO 1: Student will able to learn and understand details about Water Pollution, physicochemical properties of waste water, water and waste water treatment,

CO 2: Student will able to learn and understand details about Ground water pollution, Sources, effect control, consequences of ground water pollution, nanotechnologies used in water treatments, effluent treatment

CHEM 3607: Physical Chemistry Practical – II, (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 inwritten and oral formats.
7. To understand and analyze current event and issues regarding routine laboratory practices.

Course Outcomes:

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

Group – A: Non Instrumental Experiments (ANY FIVE)

1. To investigate the adsorption of oxalic acid /acetic acid by activated charcoal and testthe validity of Freundlich / Langmuir isotherm.
2. To study the effect of change in concentration of sodium thiosulphate on the rate of reaction between sodium thiosulphate and hydrochloric acid.
3. To determine the energy of activation of the reaction between potassium iodide and potassium persulphate for an unequal concentrations of the reactants.
4. To determine the first order velocity constant of the decomposition of hydrogen peroxide by volume determination of oxygen.
5. To study the kinetics of iodination of acetone.
6. Interpretation of Spectra: Rotational spectra of diatomic molecules CO/ HCl/ DCl or triatomic molecules CO_2 / HCN.
7. Interpretation of Spectra: Infrared spectra of ethanol/allyl alcohol.
8. Report on Industrial Visit: To prepare a report on the study physical properties observed in industry.

Group – B: Instrumental Experiments (ANY FIVE)

1. To investigate the Conduct metric titration of mixture of strong and weak acid againststrong base.
2. To determine the amount of dibasic acid (Oxalic acid) by Conductometric titration against strong base.
3. To determine the dissociation constant of oxalic acid by pH-metric titration with strong base.
4. To determine pH of various mixtures of sodium acetate and acetic acid in aqueous solution and hence to find the dissociation of acetic acid.
5. To determine the formal redox potential of Fe^{2+}/ Fe^{3+} system potentriometrically.
6. To determine the amount of NaCl in the given solution by potentiometric titration against silver nitrate.
7. To titrate Cu^{2+} ions with EDTA photo metrically.
8. To determine the indicator constant of methyl red indicator.
9. To determine plateau voltage of the given G M counter.
10. To determine the resolving time of GM counter.

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
7. Senior Practical Physical Chemistry, Khosla, B. D.; Garg, V. C. & Gulati, A. R. Chand & Co.: New Delhi (2011).
8. Experiments in Physical Chemistry, Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. 8th ed.; McGraw-Hill: New York (2003).
9. Halpern, A. M. & McBane, G. C. Experimental Physical Chemistry 3rd ed.; W.H.Freeman & Co.: New York (2003).
10. Athawale V. D. and Mathur P. Experimental Physical Chemistry, New Age International (2001)

Class: T.Y.B.Sc. (SEM VI) **Subject**: Chemistry
Course: Physical Chemistry Practical – II **Course Code**: CHEM 3607
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	3	0
CO2	3	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	0	0
CO7	0	0	0	0	0	0	0	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.

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

PO8: Environment and Sustainability

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

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

CHEM 3608: INORGANIC CHEMISTRY PRACTICAL- II, (02 Credits, 10 Practicals)

Course Objectives:

1. Students able to understand safe working methods, standard requires in handling laboratory chemicals.
2. Students should know proper way for separation of cations in qualitative analysis.
3. Students able to understand the removal method of interfering radicals.
4. To develop the skills required in volumetric analysis.
5. Students able to understand for prepare the proper solutions required for analysis.
6. Students able to understand the separation method of binary cations by chromatography.
7. To familiar the recent development in inorganic chemistry.

Course Outcomes:

1. Know the methods and handling chemicals applied during the experiments.
2. Understanding the way for separation of cations used in experimental work.
3. Know the proper method for removal method of interfering radicals.
4. Know the proper method for removal method of interfering radicals.
5. Understanding skill and applied during work.
6. Know the separation method and apply during the work.
7. Know the recent development and applied during the experimental work.

A) Qualitative Analysis: (Minimum **FOUR** mixtures including Borates and Phosphates)

B) Volumetric Estimations (Any **THREE** of the following)

1. Mn by Volhard's method
2. Estimation of NO_2 - by using $KMnO_4$.
3. Estimation of titanium
4. Analysis of Brass-Estimation of copper by Iodometry
5. Fertilizer analysis (PO_4)

C) Separation of binary mixture of cations by Column Chromatography (THREE mixtures**)**

(One mixture should be colorless, Zn + Al, Zn + Mg)

D) Visit to a chemical industry and report writing is compulsory.

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 – II **Course Code**: CHEM 3608

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	PO8	PO9
CO1	3	0	0	0	0	0	0	0	0
CO2	3	0	0	0	0	0	0	0	0
CO3	0	3	0	0	0	0	3	0	0
CO4	0	0	0	0	0	0	0	0	0
CO5	0	0	0	3	3	0	0	0	0
CO6	0	0	0	0	3	0	0	0	0
CO7	0	0	0	0	0	3	3	0	0

Justification of mapping

PO1: Disciplinary Knowledge

CO1: Know the methods and handling chemicals applied during the experiments.

CO2: Understanding the way for separation of cations used in experimental work.

PO2: Critical Thinking and Problem Solving

CO3: Know the proper method for removal method of interfering radicals.

PO4: Research-related skills and Scientific temper

CO5: Understanding skill and applied during work.

PO5: Trans-disciplinary knowledge

CO5:Understanding skill and applied during work.

CO6: Know the separation method and apply during the work.

PO6: Personal and professional competence

CO7: Know the recent development and applied during the experimental work.

PO7: Effective Citizenship and Ethics

CO3: Know the proper method for removal method of interfering radicals.

CO7: Know the recent development and applied during the experimental work.

CHEM 3609: Organic Chemistry Practical – II, (02 Credits, 10 Practicals)

A. Course Objective:

1. Perform the quantitative chemical analysis of binary mixture.
2. Understand principle of Thin Layer Chromatography techniques.
3. Separate, purify and analyze binary water insoluble mixture and water-soluble mixture.
4. Understand the techniques involving drying and recrystallization by various method.
5. Familiarize the test involving identification of special elements.
6. Learn the confirmatory test for various functional groups.
7. To perform the determination of physical constant: Melting point, Boiling point. Different Separation techniques

B. Course Outcome :

1. Organic Estimations using volumetric analysis
2. Learnt t he basic principles of green and sustainable chemistry.
3. Perform organic synthesis and is able to follow the progress of the chemical reaction by suitable method (color change, ppt. formation, TLC).
4. Purification of organic compounds
5. Preparations and mechanism of reactions involved analysis of commercial products
6. Synthesis of various organic compounds through greener approach.
7. Students are able to understand the mechanism of various performed 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.

B)Organic Estimations (ANY **TWO**)

1. Estimation of Ethyl benzoate.
2. Determination of Molecular weight of dibasic acids by volumetric Methods.
3. Estimation of glycine.

C) Organic Preparations (ANY **FOUR)**

- Benzoic acid from Ethyl benzoate (Ester hydrolysis).
- p-Bromacetanilide from Acetanilide (Bromination).
- p-Acetomol from p-Hydroxyaniline (Acetylating).
- Ethyl benzene from Acetophenone (Wolff -Kishner reduction).
- Multicomponent reaction - Preparation of Dihydropyrimidone.
- Base catalyzed Aldol condensation- Preparation of Dibenzal propanone.
- Diels Alder reaction- Reaction between Furan and Maleic acid.

The preparation should be carried out on small scale. The starting compound should not be

given more than 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 should be 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 VI) **Subject**: Chemistry **Course**: Organic Chemistry Practical **Course Code**: CHEM 3609

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.