SACRED HEART COLLEGE (AUTONOMOUS)

Tirupattur – 635 601, Tamil Nadu, S.India

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Ready for Every Good Work

A Don Bosco Institution of Higher Education, Founded in 1951 * Affiliated to Thiruvalluvar University, Vellore * Autonomous since 1987

Accredited by NAAC (4th Cycle – under RAF) with CGPA of 3.31 / 4 at 'A+' Grade

SACRED HEART COLLEGE (AUTONOMOUS)
TIRUPATTUR – 635601, TIRUPATTUR DISTRICT
PROPOSED OBE FRAMEWORK

Department of Chemistry

B. Sc Chemistry - Scheme of papers (CBCS) - From 2021 – 22 onwards

Year / Semester	Part	Subject	Title of the Paper	Hrs / Week	Credits	Exam hours	Max Marks		
							CIA	Sem	Total
I Year / I Semester	I	Tamil	Tamil – I	5	3	3	50	50	100
	II	English	English – I	5	3	3	50	50	100
	II		Communicative English		1				
	III	Core	Analytical Chemistry - I	4	4	3	50	50	100
	III	Core	Organic Chemistry – I	3	3	3	50	50	100
	III	Core Practical	Volumetric Analysis	3	3				
	III	Allied	Allied Mathematics - I	6	4	3	50	50	100
	IV		FC	2	1				
	IV		Religion & Ethics – I	2	1	3	50	50	100
I Year / II Semester	I	Tamil	Tamil – II	5	3	3	50	50	100
	II	English	English – II	5	3	3	50	50	100
	II		Communicative English		1				
	III	Core	Inorganic Chemistry - I	3	3	3	50	50	100
	III	Core	Physical Chemistry - I	4	4	3	50	50	100
	III	Core Practical	Volumetric Analysis	3	3	3	50	50	100
	III	Allied	Allied mathematics - II	6	4	3	50	50	100
	IV		FC	2	1	3	50	50	100
	IV		Religion & Ethics – II	2	1	3	50	50	100
II Year / III Semester	I	Tamil	Tamil – III	5	3	3	50	50	100
	II	English	General English – III	5	3	3	50	50	100
	III	Core	Organic Chemistry - II	3	3	3	50	50	100
	III	Core	Inorganic Chemistry – II	4	4	3	50	50	100
	III	Core Practical	Qualitative Inorganic Analysis	3	3				
	III	Allied	Allied Physics – I	6	4	3	50	50	100
	IV		FC	2	1				
	IV		Human Rights	2	1	3	50	50	100
	V		DEEDS						
	V		SHELTERS						
			Certificate course – I		2*				
II Year /	I	Tamil	Tamil – IV	5	3	3	50	50	100

IV Semester	II	English	English – IV	5	3	3	50	50	100
	III	Core	Organic Chemistry - III	3	3	3	50	50	100
	III	Core	Physical Chemistry - II	4	4	3	50	50	100
	III	Core Practical	Qualitative Analysis	3	3	4.5	50	50	100
	III	Allied	Allied Physics – II	6	4	3	50	50	100
	IV		FC	2	1		50	50	100
	IV		Environmental Studies	2	1	3	50	50	100
	V		DEEDS		2				
	V		SHELTERS		2				

III Year / V Semester	III	Core	Organic Chemistry – IV	4	4	3	50	50	100
	III	Core	Inorganic Chemistry – III	4	4	3	50	50	100
	III	Core	Physical Chemistry – III	4	4	3	50	50	100
	III	Core	Analytical Chemistry –II	4	4	3	50	50	100
	III	Main Elective	Elective – I	3	2	3	50	50	100
	III	Main Elective	Elective – II	3	2	3	50	50	100
		SSP	Chemistry for Competitive Exam – I		1*				
	III	Core Practical	Gravimetric & Organic Analysis	3	3		50	50	100
	III	Core Practical	Physical Chemistry Practicals	3	3		50	50	100
		NME	Chemistry of Drugs and Disease	2	1		50	50	100
			Certificate Course - II		2*				
III Year / VI Semester	III	Core	Organic Chemistry – V	4	4	3	50	50	100
	III	Core	Inorganic Chemistry – IV	4	4	3	50	50	100
	III	Core	Physical Chemistry – IV	4	4	3	50	50	100
	III	Subject Skill (SS-I)	Paper – I	5	4	3	50	50	100
	III	Subject Skill (SS-II)	Paper – II	5	4	3	50	50	100
	IV	NME	Chemistry in Everyday Life	2	1	3	50	50	100
	III	SSP	Chemistry for Competitive Exam – II		1*				
	III	Core Practical	Gravimetric & Organic Analysis	3	3	6	50	50	100
	III	Core Practical	Physical Chemistry Practicals	3	3	3	50	50	100

			Internship/Iindusdrial Visit/ Case study/Project*		2*				
			Total	180	148 +2* +2* +2*				

*** Extra credits**

Note:

SSP/Project/Certificate course - optional

Abbreviations

FC	Foundation Course
Comm. Eng	Communicative English
ET	Ethics
RE	Religion
DEEDS	Dept. of extension and educational services.
HR	Human Rights
SSP	Self study paper
NME	Non-major Elective

List of Electives

Elective - I **3 Hours**

1. Pharmaceutical Chemistry
2. Forensic Chemistry
3. Bio-Inorganic Chemistry

Elective - II **3 Hours**

1. Applied Chemistry
2. Protein Chemistry
3. Cheminformatics

Subject Skill Papers **5 Hours**

1. Polymer Chemistry
2. Industrial and Environmental Chemistry
3. Green Chemistry
4. Materials Chemistry
5. Water Chemistry and Inorganic Materials of Industrial Importance
6. Chemistry of Drug Design

Certificate Courses **2 Hours**

1. Organic Farming
2. Industrial Safety

B.Sc Chemistry–2022-2023

The following details should be given before syllabus of each programme (UG)

Vision To educate and empower young students in the field of Chemistry and its allied subjects in order to create intellectuals with integrity, responsibility and vision towards the furtherance of knowledge and wisdom

Mission -

Name of the Programme Undergraduate Programme

B. Sc / M. Sc Chemistry B.Sc Chemistry

Programme Outcomes *Undergraduates will be able to*:

PO1 Discuss their new knowledge and understanding; apply new ideas in order to acquire employability/self-employment

PO2 Pursue higher learning programmes and become entrepreneurs

PO3 Recognize moral and ethical values and be socially responsible citizens in the society

PO4 Apply analytical, technical, problem solving, critical thinking skills, and decision-making skills in solving real life problems in one's life and in the society.

PO5 Direct their own self-learning through MOOC courses, co-curricular activities, industrial exposures and field trainings

PO6 Develop their own broad conceptual background in biological sciences, Computing sciences, Languages and culture, Management studies, Physical sciences, etc.

PO7 Demonstrate communication skills both oral and written in personal and academic pursuits

Programme Specific Outcomes *Undergraduates in Chemistry are supposed to*

PSO1 Describe the fundamentals and theories in different domains of chemistry which enables them for higher studies.

PSO2 Have basic knowledge in few fundamental concepts in mathematics and physics.

PSO3 Have capacity to understand and solve common problems and issues arise related to chemistry.

PSO4 Get adequate skills to devise methods to analyse chemicals both qualitatively and quantitatively.

PSO5 Have a thorough knowledge on the impact of chemicals on environmental pollution and develop methods to control them.

PSO6 Handle different kinds of Chemicals and instruments in laboratories and industries safely.

PSO7 Develop skills to synthesise organic molecules propose reaction mechanism, characterise, categorise common chemicals.

PSO8 Gain potential as entrepreneurs to plan a manufacturing unit and as a service provider.

PSO – PO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Mean Score**
PSO1	3	3	3	3	3	3	2	2.9
PSO2	3	3	3	3	3	3	3	3.0
PSO3	3	2	3	3	1	3	3	2.6
PSO4	3	3	3	3	3	3	3	3.0
PSO5	3	2	3	3	2	2	2	2.4
PSO6	3	3	3	3	2	3	2	2.7
PSO7	3	3	2	3	3	3	2	2.7
PSO8	3	3	3	3	3	3	2	2.9
Mean Overall Score								2.8
Result								High

High – (2.1 – 3), Medium – (1.1 – 2), Low – (0 – 1)

Course Code	Type	Total Hours: 45 h	Lecture: 40	Tutorial: 5	Practical: 0
CH116	Theory	Course Name: Organic Chemistry - I		Max Marks: 100	Credits: 3

Course Objectives:

- Understanding the fundamentals of acidity and basicity.
- Understanding the structure of organic compounds.
- Fathom the acidity and basicity of organic molecules.
- Provide the rudimentaries of stereochemistry.
- Conceptualize the correlation between structure, acidity and reactivity.
- Discern the reactivity of alkenes and alkynes.

Course Outcomes:

Sl. No.	Course Outcome Statements	Knowledge level
	On successful completion of this Course, students will be able to	
CO1	Network structure, hybridization, acidity, basicity and reactivity of organic molecules, identify the molecular structure.	**K1**
CO2	Categorize molecules on the basis of hybridization; predict the acidity and basicity of the molecules based on functional groups; predict products for organic reactions.	**K2**
CO3	Represent molecules dimensionally; infer the reactivity of molecules from their hybridization; Chart out the mechanism for organic reactions.	**K3**
CO4	Distinguish the stereochemistry of molecules; rationalize the reactivities of alkenes and alkynes.	**K4**
CO5	Evaluate and hypothesize the stability of molecular intermediates and alicyclic molecules.	**K5**
CO6	Collaboratively assess the reactivity of molecules based on structure, stereochemistry, hybridization, acidity and basicity; Build on understanding the reactivity and mechanism of molecules and reagents.	**K6**

Course Content:

Unit 1Electronic structure and bonding **9 Hours**

1.1 Ionic and covalent bonds, Polar covalent bonds and dipole moment. Introduction to molecular orbital theory, Single, double, and triple bond formation in organic compounds.

1.2 Bonds in methyl cation, radical and anion. Bonds in water, ammonia, ammonium ion and hydrogen halides. Hybridization, bond lengths, strengths, and angles.Fischer, Flying wedge, Newmann projection and Sawhorse representations .Rotation about carbon-carbon single bonds, conformational analysis of ethane, butane.

1.3 Baeyer strain theory-conformational analysis of cyclohexane

Unit 2Acidity and basicity of organic compounds 9 Hours

2.1 Acids and Bases, pKa and pH, organic acids and bases, Acid-base reaction and position of equilibrium, Effect of structure on the pKa of acids(electronegativity, hybridization, size).

2.2 Effect of substituent on the strength of an acid, delocalized electrons. Buffer solutions, Lewis acids and bases.

2.3 Effect of pH on the structure of organic compounds.

Unit 3Stereochemistry 1 9 Hours

3.1 Isomerism, constitutional, conformational isomers, stereoisomers, cis-trans isomers from restricted rotation, asymmetric centers and stereocenters.

3.2 Isomers with one and two asymmetric centers, configurational isomers, Cahn Ingold Prelog rules and assigning E, Z, R & S to molecules.

3.3 Optical activity, measurement of specific rotation, enantiomeric excess, meso compounds with an asymmetric center, reactions of compounds that contain an asymmetric center-Stereoselective, regioselective and stereospecific reactions.

Unit 4Chemistry of Alkenes 9 Hours

4.1 Stereochemistry of electrophilic addition reactions of alkenes. Addition reactions resulting in one and two asymmetric centers: addition reactions forming a cyclic bromonium ion intermediate.

4.2 Alkenes, addition of hydrogen halides, stability of carbocations, electrophilic addition reactions and regioselectivity.

4.3 Addition of water, alcohols, halogens, peroxy acid and hydrogenation of alkenes. Oxymercuration-reduction and hydroboration-oxidation with mechanism.

Unit 5Chemistry of Alkynes 9 Hours

5.1 Alkynes: Structure and reactivity of alkynes(with mechanism).

5.2 Addition of hydrogen halides, halogens, water, hydroboration-oxidation

5.3 Addition of hydrogen to an alkyne, acidity of hydrogen bonded to an ‘sp’ carbon, synthesis using

Reference Books:

Text Book

1. Paula YurkanisBruice, *Organic chemistry*, 6th Edition, Prentice Hall, Illinois, 2011.

Further reading

2. R.T. Morrison and R. N. Boyd, *Organic chemistry*, 6th Edition, Prentice-Hall of India, New Delhi, 2008.
3. Leroy. G. Wade, *Organic chemistry*, 6th Edition, Pearson, New York, 2005.
4. Clayden, J Greeves, N and Warren, S, *Organic Chemistry*, 2nd Edition,. Oxford University Press, New York, 2001.
5. Loudon, Marc G, *Organic Chemistry*, 6th Edition,. Oxford University Press, New York, 2016.

Outcomes

- Ability to draw the structure of molecules.
- Assess the acidic, basic and delocalization nature of molecules.

Mapping of CO with PO and PSO

CO	Programme Specific Outcomes (PSO)								Programme Outcomes (PO)							Mean Scores of COs
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PO1	PO2	PO3	PO4	PO5	PO6	PO7	
1	3	2	2	3	2	2	3	3	3	3	1	2	3	3	2	2.5
2	3	3	3	3	2	3	3	3	3	3	1	3	3	3	2	2.7
3	3	2	2	3	3	3	3	3	3	3	2	3	3	3	2	2.7
4	3	2	3	3	2	2	3	3	3	3	1	3	3	3	2	2.6
5	3	2	3	3	3	3	3	3	3	3	1	3	3	3	2	2.7
6	3	3	3	3	3	3	3	3	3	3	2	3	2	3	2	2.8
															Mean Overall Score	2.7
															Result	**High**

Assessment Pattern

Bloom's Category	CA Tests (Marks Allotment)		Term End Exam (100) Marks Allotment
	I CA (50)	II CA (50)	
Remember	10	10	20
Understand	10	10	30
Apply	10	10	20
Analyze	10	10	10
Evaluate	5	5	10
Create	5	5	10

Course Code	Type	Total Hours: 45 h	Lecture: 60	Tutorial: 4	Practical: 0
CH117	Theory	Course Name: ANALYTICAL CHEMISTRY-I		Max Marks: 100	Credits: 4

Course Objectives:

- To learn the safety practices and precaution in the laboratory while handling the chemicals and to maintain the laboratory hygiene and to learn the concepts of common waste chemical management.
- To learn the various separation techniques to analysing the chemicals.
- To develop the sound knowledge about the chromatographic techniques and its applications.
- To illustrate the various types of titration and applications of indicators in volumetric analysis.
- To learn the principle and applications of different types of thermal analysis and their significance in the analytical chemistry.
- To learn and prepare the solution with different units and find out the accuracy of the concentration.

Course Outcomes:

- On successful completion of this Course, students will be able to

S.NO.	COURSE OUTCOME	Knlowdge Level
CO1	Learn the safety practices in the laboratory while handling and disposal of the hazardous chemicals.	K1,K3
CO2	Identify the appropriate separation procedures and its description.	K4
CO3	Evaluate various chromatographic technique principles and analyse the chemical using the appropriate techniques.	K4, K5
CO4	Explain the different concepts of titrations and calculate the strength of solutions using various methodologies.	K2,K3
CO5	Outline the principle behind gravimetric analysis, thermal analysis and list out their applications.	K1,K2
CO6	Preparation of solutions of desired concentration and to modify them.	K6

Course Content.

Unit-1.Laboratory hygiene and Safety **12 Hours**

1.1. Storage and handling of corrosive, flammable, toxic, carcinogenic and poisonous chemicals. Disposal of solid, liquid and fume wastes.

1.2. Simple First Aid Procedures: Acids, alkalis, phenols, toxic substances like bromine, benzene, pyridine, glass cuts and poisons. Universal antitodes, tartaremetic and tincture of iodine.

1.3 Laboratory Glassware-Cleansing agents-interchangeable ground joints apparatus-description, advantages and precautions to be followed. Safety practices in the laboratory.

Unit - IISeparation Techniques **12 Hours**

2.1 Solvent Extraction-Principle-Extracting from solid-liquid phases-Soxhlet extractor Extraction by chemically active Solvents-Chromatography-types of chromatography.

2.2 Principle, techniques and applications of TLC, and Paper. Principle, techniques and applications of Column chromatography.

2.3 Gas-Liquid Chromatography-Principle, Instrumentation, and applications.

Unit-IIIVolumetric analysis **12 Hours**

3.1 Primary and secondary standards. Requirements of primary standards with examples-classifications of volumetric analysis. Acid-base titrations: Principle-theory of acid-base indicators- Methyl red and phenolphthalein.

3.2 Redox titrations: Theory of redox titrations-theory of redox Indicators-Diphenyl amine, Ferroin, and Starch.

3.3 Precipitation Titrations: Principle-Estimations of Chloride by Mohr's method and Volhard's Method. Complexometric Titrations: Principle-Estimation of Magnesium using EDTA-Theory of metal-ion indicators.

Unit - IVGravimetric Analysis and Thermal Analysis **12 Hours**

4.1 Gravimetric Analysis-Principle-Conditions of precipitation-choice of Precipitants. Inorganic and Organic Precipitants-specific and selective precipitants.

4.2 Masking Agents-Precipitation from homogeneous Medium-Post Precipitation-Co-Precipitation-Differences between post and Co-precipitation.

4.3 Principles of thermogravimetric analysis and Instrumentation-Derivative thermogravimetry-Factors influencing thermogram. DTA-Principle and Instrumentation-Applications: TGA-Calcium oxalate monohydrate-DTA-Calcium acetate monohydrate.

Unit - V Units of measurement and Error Analysis **12 Hours**

5.1 Units of measurement-normality, molality, and molarity, examples for this concept. Mole fraction-percentage solution

5.2 Significant Figures-Rules-Rounding off figures. Definition of terms in mean, median, and mode. Standard deviation, relative standard deviation.

5.3 Precision and Accuracy-absolute error, relative error. Types of error in experimental data, determinate (systematic), indeterminate (or random) and gross.

References

1. Gary D. Christian,;Purnendu K. Dasgupta,; Kevin A. Schug, *Analytical Chemistry*, 7thEdition;Wiley Global Education, 2013.
2. Douglas A. Skoog,; F. James Holler,; Stanley R. Crouch, *Principles of Instrumental Analysis*, 6thEdition;Cengage Learning, 2006.
3. John H Kennedy, *Analytical Chemistry: Principles*, 2ndEdition; Saunders College Pub, 1990.
4. Larry G. Hargis, *Analytical Chemistry: Principles and Techniques*, 1stEdition; Prentice Hall, 1988.
5. Reuben Alexander Day,; Arthur Louis Underwood, *Quantitative Analysis*, 6thEdition;Prentice Hall India Learning Private Limited, 1992.
6. S. M. Khopkar, *Basic Concepts of Analytical Chemistry*, 3rd Rev Edition; New Age Science Ltd, 2008.
7. Frank A. Settle, *Handbook of Instrumental Techniques for Analytical Chemistry*, 1stEdition; Prentice Hall, 1997.
8. R.Gopalan, P. S. Subramanian and K. Rengarajan, *Elements of analytical chemistry*, 3rdEdition, Sultan Chand, New Delhi, 2003
9. A. K. Srivatsava and P. C. Jain, *Chemical Analysis and Instrumental Approach*, 3rdEdition, S.Chand and Company Ltd., New Delhi, 2010.

Learning Outcomes

- Identify the suitable methods for separation; explain chemical analysis of compounds
- Outline the principle behind Volumetric, gravimetric analysis, mass spectrometry, Chromatography and list out their applications

Mapping of CO with PO and PSO

CO	Programme Outcomes (POs)							Programme Specific Outcomes (PSOs)								
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**Mean Scores of COs**
CO1	3	3	1	2	3	1	1	1	1	3	3	3	3	3	3	2.3
CO2	3	1	1	3	3	1	1	2	1	3	3	3	3	2	2	2.1
CO3	3	3	1	2	3	1	1	3	1	2	3	1	2	3	3	2.1
CO4	3	1	1	1	3	1	1	2	3	2	3	2	3	2	2	2.0
CO5	3	3	1	2	3	1	1	3	3	3	3	2	3	1	1	2.2
Mean Overall Score																2.14
Result																High

Assessment Pattern

Bloom's Category	CA Tests (Marks Allotment)		Term End Exam (100) Marks Allotment
	I CA (50)	II CA (50)	
Remember	10	10	20
Understand	10	10	30
Apply	10	10	20
Analyze	10	10	10
Evaluate	5	5	10
Create	5	5	10

Course Code	Type	Total Hours: 45 h	Lecture: 40	Tutorial: 5	Practical: 0
CH216	Theory	Course Name: Inorganic Chemistry - I		Max Marks: 100	Credits: 3

Course Objectives:

- To understand the basic atomic structure of elements their periodic properties and chemical bonding.
- To evaluate the nature of bonding by applying various fundamental theories.
- To learn the properties and applications of *s* and *p* block elements.
- To compare and contrast the relationship between groups.
- To understand the principles and theories of Acids and Bases.
- To apply fundamental theories of acids and bases and identify the progress of the chemical reaction.

Course Outcomes

At the end of this course, the students will be able to

Sl. No.	Course Outcome Statements	Knowledge level
	On successful completion of this Course, students will be able to	
CO1	Understand the behavior and properties of the elements in the periodic table and comprehend them	K1, K3
CO2	Comprehend the fundamentals of electronic configuration, oxidation states, and specific properties of the major group elements.	K1
CO3	Compare and contrast the properties of acids and bases and justify their applications	K2, K3
CO4	Predict atomic structure, chemical bonding, Hybridization, and molecular geometry.	K4
CO5	Analyze and understand the diagonal relationship between alkali and alkaline earth metals their properties and applications.	K1, K3
CO6	Evaluate the properties of elements based on their atomic structure, bonding nature, etc., and relate the uses and significance of the s and p block elements.	K3, K5
CO7	Devise and validate acid and base using the metal oxides and predict the feasibility of the reaction	K3, K5, K6

Course Content Unit-1Atomic Structure **9 Hours** 1.1

Electronic configurations of the elements, Aufbau principle, quantum numbers, and Pauli's

exclusion principle.Hund's multiplicity rule for filling electrons in various orbitals, Stability of half-filled and completely filled orbitals, effective nuclear charge.

1.2 Shapes of s, p, d orbitals - s, p, d and f block elements – classification and characteristic properties.

1.3 Periodicity of properties – Definition and periodicity of the following properties – Atomic radii – factors affecting atomic radii – ionic radii – factors affecting ionic radii. Ionisation potential – factors affecting ionisation potential – Electron affinity – factors affecting electron affinity – Electronegativity – factors affecting electronegativity – Pauling scale.

Unit-2Chemical Bonding 9 Hours

2.1. Ionic Bonding: General characteristics of ionic bonding. Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Landé equation for calculation of lattice energy, Born-Haber cycle and its applications.

2.2 Polarizing power and polarizability. Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character.

2.3. Covalent bonding: Lewis theory, Octet theory, VSEPR theory and applications – geometries of BCl_3, H_2O, ClF_3, PCl_5, IF_7 and XeF_6 molecules.

Unit-3 Alkali and alkaline earth metals 9 Hours

3.1 Alkali metals – Comparative study of elements – oxides, halides, hydroxides and carbonates – Exceptional property of Lithium – Diagonal relationship of Li with Mg.

3.2. Alkaline earth metals – comparative study of the elements with respect to oxides, hydroxides, halides, sulphates and carbonates – Exceptional property of Beryllium – Diagonal relationship of Be with Al

3.3. Comparison of alkaline earth metals with alkali metals – Magnesium acting as bridge element between IIA and IIB groups – Magnesium resembles zinc.Properties and uses of Alkaline earth metals. Biological role of Mg^{2+} and Ca^{2+}

Unit-4 p–block elements, Chemistry of group 13 9 Hours

4.1. Main group elements- introduction, general and special characteristics. Group 13: general properties, electronic configuration, oxidation states, inert pair effect, size of atoms and ions, electropositive nature and ionization energy.

4.2 Compounds of group 13: Structure and bonding in diborane. Preparation, properties and structure: Borazine, trihalides- Boron and Aluminium.

4.3 Compounds of Boron and Oxygen (structure and properties): Sesquioxides-Borates and Borax.

Unit-5Acids and Bases 9 Hours

5.1. Arrhenius concept. Lowry Bronsted concept-conjugate acid-base pairs, relative strengths of acid-base pairs.

5.2. Lux-flood concept. Lewis concept, limitations of lewis concept.

5.3. Pearson concept-HSAB principle.Estimation of TDS in water.

Learning Outcomes

- The student can explain the atomic structure and bonding nature present in a molecule along with the applications and importance of s and p block elements
- The students can understand the theories pertaining to the acids and bases.

References

1. R. D. Madan, *Modern Inorganic Chemistry*, Second edition, S. Chand publications, New Delhi, 2000.
2. B. R. Puri, L. R. Sharma and K. C. Kalia, *Principles of Inorganic Chemistry*, 33rd Edition, Vishal Publishing Co, Jalandar, 2004.

(Advanced Reading)

1. C. Chambers and A. K. Holliday, *Modern Inorganic Chemistry*, First edition, Butterworth and Co. , Sussex, 1975.
2. Gary L Miessler and Donald A Tarr, *Inorganic Chemistry*, Third edition, Pearson Prentice Hall.
3. B. Murphy, C. Murphy and B. J. Hathway, *Basic Principles ofInorganic Chemistry*, The Royal Society of Chemistry, Cambridge, 1998.

Mapping of CO with PO and PSO

CO	Programme Specific Outcomes (PSO)								Programme Outcomes (PO)							Mean Scores of COs
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PO1	PO2	PO3	PO4	PO5	PO6	PO7	
1	3	3	2	3	2	2	3	3	3	3	1	2	3	3	1	2.5
2	3	3	3	3	2	3	3	3	3	3	1	3	3	3	2	2.7
3	3	2	3	3	3	3	3	3	3	3	2	3	3	3	1	2.7
4	3	2	3	3	2	2	3	3	3	3	1	3	3	3	1	2.5
5	3	2	3	3	3	3	3	3	3	3	1	3	3	3	1	2.7
6	3	3	3	3	3	3	3	3	3	3	2	3	2	3	1	2.7
7	3	3	3	3	3	3	3	3	3	3	3	3	2	3	2	2.9
														Mean Overall Score		2.7
														Result		**High**

Assessment Pattern

Bloom's Category	CA Tests (Marks Allotment)		Term End Exam (100) Marks Allotment
	I CA (50)	II CA (50)	
Remember	10	10	20
Understand	10	10	30
Apply	10	10	20
Analyze	10	10	10
Evaluate	5	5	10
Create	5	5	10

CH217	**Theory**	**4**	**3**	**1**	**0**
		PHYSICAL CHEMISTRY -I		**100**	**4**

Course Objectives

- To understand the important behaviour of gases and liquids
- Realize the concept of thermodynamics and appreciate the different terminologies used to describe the same
- Appreciate the differences between real and ideal gases, the laws of thermodynamics and their applications
- Derive the gas laws based by the kinetic theory of gases and understand the collision theory of gaseous molecule
- Can describe the measurement of different properties of liquids
- Estimate the enthalpy changes of chemical processes based on thermodynamics parameters

Course Outcomes:

On successful completion of this Course, students will be able to

Sl. No.	Course Outcome Statements	Knowledge level
	On successful completion of this Course, students will be able to	
CO1	Define the fundamental concepts of thermodynamics, kinetic theory of gases, and the theory of liquid state.	**K1**
CO2	Discuss the nature of ideal and real gases, thermodynamic laws, the measurement of various properties in the liquid state, describe Joule-Thomson effect.	**K2**
CO3	Use kinetic theory of gases to derive gas laws, apply Hess's Law and Kirchoff'sequation; distinguish between different thermodynamic terms, real and ideal gases; apply Linde's and Claudes Process for liquification	**K3**
CO4	Calculate various enthalpy changes based on thermodynamic parameters.	**K4**
CO5	Formulate the collision theory of gas molecules, describe the measurement of properties of liquid, appraise the difference between Cv and Cp	**K5**
CO6	Inferendothermic and exothermic processes, evaluate properties related to collision of gas molecules and different bond enthalpies	**K6**

Unit –IGaseous State -I **12 Hours**

1.1. Kinetic theory of gases –derivation of kinetic gas equation–Gas laws from the kinetic gas equation.
1.2. Maxwell's distribution of-molecular velocities (no derivation)–Experimental verification of velocity distribution – Effect of temperature on velocity distribution.
1.3. Kinds of velocities – mean, rms, most probable velocities-Degrees of freedom of a gaseous molecule, equipartition of energy, heat capacity on molecular basis.
1.4. Collision diameter-Collision Number-Collision frequency-and mean free path

Unit - II Gaseous State -II **12 Hours**

2.1 Effect of Temperature and Pressure on mean free path and Collision frequency
2.2 ideal gas and real gas-Deviation of real gas from ideal behaviour-Compressibility factor-causes of deviation-Compressibility of various Gases (variation of Z with Pressure)
2.3 Derivation of van der Waals Equation for real gases-significance of van der Waals constants-Behaviour of real gas using van der Waals equation-Exceptional behaviou of H and He.
2.4 Liquification of gases-Linde'sProcess and Claudes Process

Unit -III Liquid State **12 Hours**

3.1 Differences between solids/liquids/gases in terms of structure-Intermolecular forces in liquids – Vapour pressure and Factors affecting them – Determination of Vapour pressure of a liquid -
3.2 Surface tension of a liquid-surface energy-liquid raises in a capillary tube-surface active agents Effect of temperature on surface tension-Determination of surface tension-
3.3 Capillary Rise and Drop Weight Method-Drop weight methods
3.4 Viscosity-factors affecting viscosity-Ostwald Viscometer method

Unit-IV: Thermodynamics -I **12 Hours**

4.1. Thermodynamics – Definition and explanation of terms – System, boundary, surroundings – Homogeneous and heterogeneous system – Isolated system – Closed system – Open system. Thermodynamic functions - Intensive and extensive properties – state functions and path functions. Exact differentials
4.2. Thermodynamic processes - First law of thermodynamics Concept of internal energy – Energy changes with work –State functions.
4.3. Enthalpy (Heat) of the reaction- Factors influencing enthalpy-Measuring the enthalpy of combustion (Bomb Calorimeter)
4.4 Heat capacity – at constant pressure and volume – relationship between Cp and Cv

Unit-V: Thermochemistry **12 Hours**

5.1Joule's law – Joule – Thomson effect – Joule – Thomson coefficient and its derivation – inversion temperature, its significance and its derivation.
5.2 Endothermic/Exothermic reaction. Enthalpy of formation and standard enthalpy of formation-importance of standard enthalpy of formation- Hess'a Law of constant heat summation
5.3 Determination of enthalpy of formation – Problems related to Hess's Law Bond enthalpy and application -calculation from thermochemical data
5.4 Application of bond dissociation energies - calculation from thermochemical data –Kirchoff's equation and its significance.

Text Books:

1. B. R. Puri, L. R. Sharma and M. S. Pathania, *Principles of Physical Chemistry*, 47th Edition, Vishal Publishing Co, Jalandar, 2016.
2. R.L. Madan, *Physical Chemistry*, Mc Graw Hill Education Pvt. Ltd. 2015.
3. Peter Atkins and Julio de Paula, *Physical Chemistry*, 10th Edition, W. H. Freeman and Company. (Unit IV)
4. Raymond Chang and John W. Thoman, *Physical Chemistry for the chemical science*,Jr.University Science Books (Unit IV)

Reference:

1. Arun Bahl, B.S. Bahl. G.D.Tuli, Essentials of Physical Chemistry, S. Chand Publications
2. A.S. Negi and S.C. Anand, *A text book of Physical Chemistry*, Wiley Eastern Ltd, New Delhi, 1984.

Learning Outcome:

- Recognize and relate the properties of ideal and real gases
- Describe the properties of liquids
- Describe the thermodynamic parameters in exo and endothermic process.

Mapping of CO with PO and PSO

CO	Programme Outcomes (POs)							Programme Specific Outcomes (PSOs)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	Mean Scores of COs
CO1	3	2	1	2	3	2	2	3	3	2	3	3	3	1	2	2.3
CO2	3	2	2	2	3	2	2	2	2	2	3	3	2	1	3	2.2
CO3	3	2	1	2	3	2	3	2	3	2	3	2	3	1	3	2.3
CO4	3	2	2	2	3	2	1	2	2	2	2	2	3	2	2	2.1
CO5	3	2	1	3	3	3	2	2	2	2	2	2	3	2	2	2.2
Mean Overall Score																2.2
Result																High

Assessment Pattern

Bloom's Category	CA Tests (Marks Allotment)		Term End Exam (100) Marks Allotment
	I CA (50)	II CA (50)	
Remember	10	10	20
Understand	10	10	30
Apply	10	10	20
Analyze	10	10	10
Evaluate	5	5	10
Create	5	5	10

Semester -I & II **PCH209-Volumetric Analysis 3 Hrs/week (3 Credits/ semester)**

Course Code	Type	Total Hours	Lecture	Tutorial	Practical
PCH209	Practical	45	3	0	42
		Course Name		**Max Marks**	**Credits**
		VOLUMETRIC ANALYSIS		100	3

Course Objectives

- To understand and apply the principle of volumetric analysis
- To differentiate substances as primary and secondary standards
- To learn the concept of indicators and their uses in volumetric analysis.
- To learn to handle chemicals and apparatus related to volumetric analysis
- To learn to develop methodologies to estimate the amount of unknown substances
- To differentiate the types of titrations and their utilization in the estimations.

Course Outcomes:

Sl. No.	Course Outcome Statements	Knowledge level
	On successful completion of this Course, students will be able to	
CO1	Match the theoretical aspects including principle with practical	K1
CO2	Differentiate substances as primary and secondary standards and prepare them in required concentration.	K2
CO3	Analyse the water samples for its hardness and other water quality parameters.	K3
CO4	Classify the different types of volumetric estimations and the indicators required for them	K4
CO5	Calculate the amount of substance and interpret the results.	K5
CO6	Develop methods for the estimation of substances volumetrically	K6

Course Content:

Acidimetry

1. Estimation of Borax – Standard Sodium Carbonate
2. Estimation of Sodium Hydroxide – Standard Sodium Carbonate
3. Estimation of HCl – Standard oxalic acid.

Permanganometry

4. Estimation of oxalic acid – Standard FAS
5. Estimation of $FeSO_4$–Standard Oxalic acid

Dichrometry

6. Estimation of Ferrous Iron using Diphenyl amine as indicator.
7. Estimation of ferric ion using Diphenyl amine as indicator

Iodimetry

8. Estimation of Arsenious oxide

Iodometry

9. Estimation of Copper - Standard Potassium dichromate

Complexometry

10. Estimation of Magnesium using EDTA
11. Estimation of Zinc using EDTA
12. Estimation of Calcium using EDTA
13. Estimation of total hardness of water.

Cerimetry

14. Estimation of sodium nitrite.

References

1. V. Venkateswaran, R. Veerasamy, A.R. Kulandaisamy, *Basic principles of Practical Chemistry*, S.Chand publications, New Delhi, 2002.
2. A.O, Thomas. *Practical Chemistry*, 6th Revised Edition, Sharada Press, 1995.
3. J. N. Gurtu and R. Kapoor, *Advanced Experimental Chemistry*, Vol. I –III, S. Chand and Co., 1987.

Mapping of CO with PO and PSO

CO	Programme Specific Outcomes (PSO)								Programme Outcomes (PO)							Mean Scores of Cos
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PO1	PO2	PO3	PO4	PO5	PO6	PO7	
1	3	3	3	3	3	3	2	2	3	3	2	3	2	3	2	2.7
2	3	2	3	3	3	3	2	2	3	3	2	3	3	3	2	2.7
3	3	3	3	3	3	3	2	2	3	3	3	2	2	3	2	2.7
4	3	3	3	2	2	3	3	3	3	3	2	3	2	3	2	2.7
5	3	3	3	3	2	2	2	2	3	3	2	3	3	3	3	2.7
6	3	3	2	3	3	3	3	2	3	3	3	3	3	3	2	2.8
															Mean Overall Score	2.8
															Result	**High**

PCH209 - Volumetric analysis (Scheme of valuation)

Component	Mark
Volumetric	40
Record	10
Total	50

Volumetric marks corresponding to error percentage

% of error	Marks
< 2	40
2 - 3	40 -35
3 - 4	35 – 25
4 - 5	25 - 10
> 5	10

For calculation error 20% of the marks obtained is reduced

Course Code	**Type**	**Total Hours**	**Lecture**	**Tutorial**	**Practical**
CH316	Theory	45	40	5	0
		Course Name		**Max Marks**	**Credits**
		ORGANIC CHEMISTRY II		100	3

Course Objectives:

- Understanding substitution and elimination reactions.
- Understanding metal carbon bonds.
- Ability to differentiate elimination and substitution reactions.
- Knowledge on application of intermediates and mechanism.
- Knowledge on the synthetic nature of organometallic compounds.

Course Outcomes:

On successful completion of this Course, students will be able to

Sl. No.	Course Outcome Statements	Knlowledge level
CO1	Understandand show the effect of pka values on acidic strength and the structure of organic compounds	K1 & K2
CO2	Outline thermodynamic versus kinetic controlledreactions	K3
CO3	Discuss the addition reaction of nucleophiles, electrophiles, free radical in ring and open systems.	K3
CO4	Attribute stereochemical fates for substrates undergoing, addition, and substitution and elimination reactions.	K4
CO5	Investigate the mechanistic pathway of competition between elimination or substitution reactions.	K5
CO6	Develop synthetic routes using organometallic reagents for organic molecules.	K6

Course Content:

Unit 1Delocalisation **9 hours**

1.1 Delocalised electrons and benzene's structure, bonding in benzene, reasonance contributors and reasonance hybrids, stability of reasonance contributors, delocalization energy, delocalized electrons and stability, stability of allylic and benzylic cations., molecular orbital description of stability(1,3 Butadiene and 1,4 Penta diene)

1.2 Effect of delocalized electrons on pKa values and product of a reaction

1.3 Reactions of isolated dienes and conjugated dienes, thermodynamic versus kinetic control of reactions, Diels- alder reaction 1,4 addition, conformations of the diene.

Unit 2Substitution reactions **9 hours**

2.1 Alkyl halides- substitution reactions- S_N2, factors affecting S_N2, reversibility of S_N2 reaction.

2.2 S_N1, factors affecting S_N1, stereochemistry of S_N1 and S_N2

2.3 Competition between S_N1 and S_N2, role of solvents S_N1 and S_N2-Intermolecular versus intramolecular reactions.

Unit 3Elimination reactions **9 hours**

3.1 Elimination reactions, E2 reaction regioselectivity. E1 reaction, competition between E2 and E1 reactions.

3.2 E2 and E1 reactions stereo selectivity, elimination from substituted cyclohexanes.

3.3 Kinetic isotope effect in mechanism determination, competition between substitution and elimination.

Unit 4Alcohols and Amines **9 hours**

4.1 Conversion of alcohols to alkyl halides, alcohols to sulfonate esters, elimination reactions of water from alcohols, oxidation of alcohols.

4.2 Nucleophilic substitution reaction of ethers, epoxides.

4.3 Substitution or elimination reactions in amines, Elimination reactions of quaternary ammonium hydroxides, phase transfer catalysis(concept only). Reactions of thiols, sulfides and sulfonium salts.

Unit 5Organometallic compounds **9 hours**

5.1 Metal carbon bond, Synthesis of Grignard reagents and Organolithium compounds.

5.2 Organo metallics by deprotonating alkynes, Ortholithiation. Primary, secondary and tertiary alcohols from aldehydes and ketones.

5.3 Reactions of organolithium and Grignard reagents with electrophiles, transmetallation, coupling reactions, palladium catalyzed coupling reactions, alkene metathesis.

Reference Books:

Text Book

1. Paula YurkanisBruice, *Organic chemistry*, 6th Edition, Prentice Hall, Illinois, 2011.

Further reading

2. R.T. Morrison and R. N. Boyd, *Organic chemistry*, 6th Edition, Prentice-Hall of India, New Delhi, 2008.
3. Leroy. G. Wade, *Organic chemistry*, 6th Edition, Pearson, New York, 2005.
4. Clayden, J Greeves, N and Warren, S, *Organic Chemistry*, 2nd Edition, Oxford University Press, New York, 2001.
5. Loudon, Marc G, *Organic Chemistry*, 6thEdition,. Oxford University Press, New York, 2016.

Mapping of CO with PO and PSO

CO	Programme Specific Outcomes (PSO)								Programme Outcomes (PO)							Mean Scores of Cos
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PO1	PO2	PO3	PO4	PO5	PO6	PO7	
1	3	3	3	3	3	3	2	2	3	3	2	2	2	3	2	2.6
2	3	2	3	3	2	3	3	2	3	3	2	3	3	2	2	2.6
3	3	3	3	3	3	3	2	2	3	3	2	2	2	3	3	2.7
4	3	3	3	3	2	2	3	3	3	3	2	3	2	2	2	2.6
5	3	3	3	3	2	2	2	2	3	3	2	3	3	3	3	2.7
6	3	3	3	3	2	3	2	2	3	3	3	3	3	3	2	2.7
														Mean Overall Score		2.6
														Result		**High**

Assessment Pattern

Bloom's Category	CA Tests (Marks Allotment)		Term End Exam (100) Marks Allotment
	I CA (50)	II CA (50)	
Remember	10	10	20
Understand	10	10	30
Apply	10	10	20
Analyze	10	10	10
Evaluate	5	5	10
Create	5	5	10

Course Code	Type	Total Hours: 60 h	Lecture: 50	Tutorial: 8	Practical: 2
CH317	**Theory**	**Course Name: Inorganic Chemistry-II**		**Max Marks: 100**	**Credits: 4**

Course Objectives

- To have a sound knowledge about structure and shape using VB and MO theory
- To know about Chemistry of group-14 and 15 and its applications
- To understand the importance of nuclear chemistry and its applications

Course Outcomes

On successful completion of this Course, students will be able to

S.No	Course Outcome Statement	KnlowdgeLevel
CO1	The general characteristics, electronic configuration, and oxidation states of Group 14 and Group 15 elements are introduced to students.	K1
CO2	Using VB and MO theory, the learner can comprehend the molecule's structure and shape.	K2
CO3	The relevance of nuclear chemistry and its applications can be comprehended by the learner.	K2, K3
CO4	Students can demonstrate the manufacture and structure of oxo acids of nitrogenand phosphorus.	K4
CO5	Students can use the 'Q' Value to calculate the amount of energy produced in a nuclear reaction.	K4, K5
CO6	Students will be able to detect and quantify radioactivity, as well as determine the use of particle accelerators and radioisotopes as tracers.	K5, K6

Course Content

Unit-1 VB and MO Theory **12 hours**

1.1 Valence bond theory – postulates and limitations – hybridization – explanation with examples.

1.2 Concept of resonance and resonating structures in various inorganic and organic compounds. MO Approach: Rules for the LCAO method, bonding and antibonding MOs.

1.3 MO treatment of homonuclear diatomic molecules: H_2, N_2, O_2, and F_2 . Heteronuclear diatomic molecules: HF, CO, and NO

1.4 Comparison of VB and MO approaches.

Unit-2 Chemistry of Group 14 **12 hours**

2.1 Group 14: general properties, electronic configuration, metallic character, and oxidation states.

2.2 Uniqueness of Carbon and Silicon in comparison to remaining elements. Carbides-Preparation, classification and applications. Allotropes of Carbon- structure, properties and uses. Oxides of carbon (structure and properties):

2.3 CO, CO_2 and carbon suboxides. Carbon cycle.

2.4 Silicates-classification, properties, structure and uses. Silicones- Polysiloxanes.

Unit-3 Chemistry of Group 15 **12 hours**

3.1 Group 15: general properties, electronic configuration, oxidation states.

3.2 Compounds of group 15: Hydrides of Nitrogen and Phosphorus, Haber's process, Oxides of Nitrogen: NO, NO_2, N_2O, and N_2O_3 (structure, properties and uses).

3.3 Oxo-acids of Nitrogen and Phosphorous- preparation and structure.

3.4 Polyphosphates-preparation and structure.

Unit-4 Nuclear Chemistry **12 hours**

4.1 Fundamental particles of the nucleus- nucleon, nuclides, isotopes, isobars, isotones.

4.2 Nuclear radius, nuclear mass, nuclear density, nuclear forces operating between the nucleons, and packing fraction.

4.3 Natural radioactivity- nuclear reactions, radioactive decay, group displacement law, N/P ratio, curves, stability belts and rate of radioactive disintegration.

4.4 Nuclear binding energy. Mass defect, simple calculations involving mass defect and B.E per nucleon, Q value determination, magic numbers.

Unit-5 Applications of Nuclear Chemistry **12 hours**

5.1 Detection and measurement of radioactivity- G. M counter, and scintillation counter. Application of radioisotopes as tracers: Rock and Carbon dating.

5.2 Artificial radioactivity: artificial transmutation of elements and Particle accelerators- cyclotron. Induced radioactivity and preparation of transuranic elements.

5.3 Nuclear fusion reactions and applications: nuclear fusion in the sun and hydrogen bomb. Safe disposal of radioactive waste.

5.4 Preparation of Inorganic Complexes(Any two)

Learning Outcome:

- The student will understand the chemistry of 14 and 15 group.
- The student can know the importance of nuclear chemistry and its applications
- The student can understand the structure and shape of the molecule using VB and MO theory.

References

(Text Book)

1. R. D. Madan, *Modern Inorganic Chemistry*, Second edition, S. Chand publications, New Delhi, 2000.
2. B. R. Puri, L. R. Sharma and K. C. Kalia, *Principles of Inorganic Chemistry*, 33rd Edition, Vishal Publishing Co, Jalandar, 2004.
3. H. J. Arnikar, *Essentials of nuclear chemistry*, Fourth Edition, New Age International Private Limited, New Delhi, 2011

(Advanced Reading)

1. C. Chambers and A. K. Holliday, *Modern Inorganic Chemistry*, First edition, Butterworth and Co. , Sussex, 1975.
2. Gary L Miessler and Donald A Tarr, *Inorganic Chemistry*, Third edition, Pearson Prentice Hall.
3. G. R. Choppin, and J-O. Liljenzin, and J. Rydberg, *Radiochemistry and Nuclear chemistry*, Butterwoth-Heinemann, Woburn, 2002.
4. P. A. C. McPherson, *Principles of Nuclear Chemistry*, World scientific, Singapore, 2017.

Mapping of CO with PO and PSO

CO	Programme Specific Outcomes (PSO)								Programme Outcomes (PO)							Mean Scores of Cos
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PO1	PO2	PO3	PO4	PO5	PO6	PO7	
1	3	3	3	3	3	3	2	2	3	3	2	2	2	3	2	2.6
2	3	2	3	3	3	3	3	2	3	3	2	3	3	3	2	2.7
3	3	3	3	3	3	3	2	2	3	3	2	2	2	3	2	2.6
4	3	3	3	3	2	3	3	3	3	3	2	3	2	3	2	2.7
5	3	3	3	3	2	2	2	2	3	3	2	3	3	3	2	2.6
6	3	3	3	3	3	3	3	2	3	3	3	3	3	3	2	2.9
														Mean Overall Score		2.7
														Result		**High**

Assessment Pattern

Bloom's Category	CA Tests (Marks Allotment)		Term End Exam (100) Marks Allotment
	I CA (50)	II CA (50)	
Remember	10	10	20
Understand	10	10	30
Apply	10	10	20
Analyze	10	10	10

Evaluate	5	5	10
Create	5	5	10

Course Code	Type	Total Hours: 45 h	Lecture: 40	Tutorial: 5	Practical: 0
CH416	Theory	Organic Chemistry - III		Max Marks: 100	Credits: 3

Course Objectives

- Understanding the fundamentals of organic spectroscopy.
- Understanding Aromatic compounds.
- Understanding the reactivities of carbonyl compounds.
- Learning radical reactions.

Course Outcomes:

On successful completion of this course, students will be able to

Sl. No.	Course Outcome Statements	Knowledge level
CO1	Describe and understand the radical stability and radical reactions of alkyl substituents and benzene	K1
CO2	Relate and infer information organic molecules using the fragmentation pattern of functional groups by mass and IR spectra	K1, K3
CO3	Justify the reactivity of aromatic systems and its aromaticity behaviour in benzene ring and heterocyclic systems.	K1
CO4	Attribute substituted benzene undergoing, nucleophilic aromatic substitution and addition-elimination reactions.	K2, K3
CO5	Summarize and illustrate relative reactivities of carboxylic acids and their derivatives	K4
CO6	Discuss and devise the reaction of acyl halides, anhydrides, and esters	K1, K3

Course Content

Unit 1Radical reactions **9 hours**

1.1 Radical reactions of alkanes, poor reactivity of alkanes, chlorination and bromination of alkanes.

1.2 Radical stability and alkyl substituents, distribution of products and reactivity selectivity principle, formation of explosive peroxides, addition of radicals to alkenes, stereochemistry of radical substitution and addition reactions

1.3 Radical substitution of Benzylic and allylic hydrogens.

Unit 2Organic Spectroscopy 1 **9 hours**

2.1 Mass spectrometry, mass spectrum and fragmentation, isotopes in mass spectrometry, high resolution mass spectrometry, fragmentation pattern of functional groups.
2.2 Infrared spectroscopy, infrared spectrum functional group and fingerprint region, characteristic absorption bands, intensity of absorption bands, position of absorption bands: effect of bond order, delocalization, electron donation, withdrawal and hydrogen bonding. OH and CH absorptions.
2.3 Shape of absorption bands and absence of absorption bands, interpreting and IR spectrum.

Unit 3Aromaticity **9 hours**

3.1 Aromaticity, unusual stability of aromatic compounds, two criteria for aromaticity, applying the criteria for aromaticity, aromatic heterocyclic compounds, chemical consequences of aromaticity,
3.2 Anti-aromaticity, molecular orbital description of aromaticity.
3.3 Reactivity of Benzene, electrophilic aromatic substitution reactions: halogenation, sulfonation, nitration, Friedel crafts acylation, alkylation. Reduction of acylated benzene to alkyl benzene.

Unit 4Substituted Benzenes **9 hours**

4.1 Reaction of Substituted Benzenes: Chemical conversion of substituents on the benzene ring, effect of substituents on reactivity.
4.2 Effect of substituents on orientation of incoming groups, on pKa. Ortho-Para ratio, substituent effects. Synthesis of mono and disubstituted, substituted benzenes using diazonium salts.
4.3 Arene diazonium as an electrophile, Reaction of Amines with Nitrous acid, Nucleophilic aromatic substitution an addition elimination reaction and Benzyne reaction. Dyes: Phenolpthlaein, Methyl orange and Fluorescein.

Unit 5Carbonyl compounds 1 **9 hours**

5.1 Carbonyl compounds, Nomenclature of carbonyls, Structure of carboxylic acid and their derivatives, Physical properties of carbonyl compounds.
5.2 Reactivity of carbonyls, relative reactivities of carboxylic acids and their derivatives. General mechanism of nucleophilic addition and elimination reaction.
5.3 Reaction of acyl halides, anhydrides, esters. Acid and base catalyzed hydrolysis of an ester and transesterification. Hydroxide ion hydrolysis of esters, evidence for nucleophilic addition elimination reaction of carbonyls.

Reference Books:

Text Book

1. Paula YurkanisBruice, *Organic chemistry*, 6th Edition, Prentice Hall, Illinois, 2011.

Further reading

2. R.T. Morrison and R. N. Boyd, *Organic chemistry*, 6th Edition, Prentice-Hall of India, New Delhi, 2008.
3. Leroy. G. Wade, *Organic chemistry*, 6th Edition, Pearson, New York, 2005.
4. Clayden, J Greeves, N and Warren, S, *Organic Chemistry*, 2nd Edition,. Oxford University Press, New York, 2001.
5. Loudon, Marc G, *Organic Chemistry*, 6th Edition,. Oxford University Press, New York, 2016.

Outcomes

- Correlate reactants and products using spectroscopy.
- Knowledge on Aromacity and reactivity.
- Knowledge of the nature of carbonyl compounds.

Mapping of CO with PO and PSO

CO's	Programme Outcomes (PO)							Programme Specific Outcomes (PSO)								Mean Scores of COs
	PO	PO 2	PO 3	PO4	PO 5	PO 6	PO 7	PSO	PSO	PSO	PSO	PSO	PSO 6	PSO 7	PSO	

	1							1	2	3	4	5			8	
CO 1	3.0	3.0	1.0	3.0	2.0	2.0	1.0	3.0	1.0	3.0	2.0	3.0	2.0	3.0	1.0	2.2
CO 2	3.0	3.0	1.0	3.0	3.0	2.0	1.0	3.0	1.0	3.0	3.0	3.0	1.0	3.0	3.0	2.4
CO 3	3.0	3.0	1.0	3.0	3.0	2.0	1.0	3.0	2.0	3.0	3.0	2.0	3.0	3.0	1.0	2.4
CO 4	3.0	3.0	1.0	3.0	3.0	2.0	1.0	3.0	2.0	3.0	3.0	3.0	3.0	3.0	1.0	2.5
CO 5	3.0	3.0	1.0	3.0	3.0	1.0	1.0	3.0	1.0	3.0	3.0	3.0	2.0	3.0	2.0	2.3
CO 6	3.0	3.0	1.0	3.0	3.0	1.0	1.0	3.0	1.0	3.0	3.0	3.0	3.0	3.0	1.0	2.3
Mean Overall Score																2.4
Result																High

Assessment Pattern

Bloom's Category	CA Tests (Marks Allotment)		Term End Exam (100) Marks Allotment
	I CA (50)	II CA (50)	
Remember	10	10	20
Understand	10	10	30
Apply	10	10	20
Analyze	10	10	10
Evaluate	5	5	10
Create	5	5	10

CH417	**Theory**	**4**	**3**	**1**	**0**
		PHYSICAL CHEMISTRY-II		**100**	**4**

Course Objectives

- To understand the important laws of thermodynamics and their implications in chemical systems
- To learn the importance of chemical potential and its significance
- To understand the basic concepts and importance of phase equilibria
- To learn the basics of colloids, surfactants and solutions

Course Outcomes:

On successful completion of this Course, students will be able to

Sl. No.	Course Outcome Statements	Knowledge level
CO1	explain the theory of Quantum Mechanics, also formulate and solve simple problems in QM	K1

CO2	distinguish rate orders and the impact of reaction parameters	K1, K3
CO3	explain the theory for reaction rates	K1
CO4	explain the basics of photochemistry and also enumerate the kinetics of photochemical reactions	K2, K3
CO5	demonstrate the principle of adsorption and the different isotherms used to explain the phenomena	K4
		K1, K3

Course Content

Unit – IThermodynamics - II **12 Hours**

1.1 Need for second Law-Spontaneous Process- Cyclic Process- Carnot cycle- Concept of entropy-Entropy changes in reversible and irreversible process-

1.2 Statement of second law -entropy of mixture of ideal gases, entropy of mixing-physical significance of entropy

1.3 Helmholtz and Gibbs free energy- Maxwell relations-Criteria for spontaneity and equilibrium-Gibbs-Helmholtz equation-Chemical potential

1.4 Gibbs- Duhem equation- Variation of chemical potential with temperature and pressure -Chemical potential in a system of ideal gas-Third Law- Importance of third law, Testing and validity of third law. Residual entropy

Unit IIChemical Equilibrium: **12 Hours**

2.1 State of chemical equilibrium - Characteristics and experimental verification of chemical equilibrium. Law of Mass action – Law of chemical equilibrium

2.2 Types of equilibrium constants, Relationship between Kp, Kc and Kx – Applications of equilibrium constant with solved problems.

2.3 Free energy change - criterion of spontaneity (Problems). Thermodynamic treatment of chemical equilibrium, De Donder's Concept- Chemical affinity. Thermodynamic relations for chemical affinity.

2.4 Van't Hoff reaction isotherm (problems)-Van't Hoff equation (Temperature dependence) (problems) – Le Chatelier's principle – Effect of temperature, pressure and concentration and applications

Unit - III Phase Rule **12 Hours**

3.1 Explanations of terms – Phase, components and Degrees of freedom. Equilibrium – Criteria for equilibrium – Thermal, mechanical and chemical equilibrium. Thermodynamic derivation of Phase rule.

3.2 Clausius-Clapeyron Equation and its application in phase transition-Phase diagram - One component system – Water and sulphur with polymorphism.

3.3 Two component system– Reduced phase rule, types of two component system involving solid – liquid equilibria - General features of two component system – Colling curve method.

3.4 Simple eutectic system: Pb– Ag system. KI – water system – freezing mixture

Unit – IVPhase Equilibria II and Colloids: **12 Hours**

4.1 Two components with compound formation - Congruent Melting point – Ferric chloride – water system – (Activity – Construction of Mg – Zn system phase diagram) - Incongruent Melting point – Na - K system

4.2 Colloids – Types of colloids - Origin of charge on colloids- electrical double layer-Electrokinetic properties (Electrophoresis, electro osmosis)
4.3 Surfactants: Classification- Micelle and reverse micelle formation- shape and structure of micelles-critical micelle concentration, aggregation number
4.4 Factors affecting CMC in aqueous media- Thermodynamics of Micellization (no derivation)

Unit – V Solutions 12 Hours

5.1 Thermodynamics of ideal solutions: Ideal solutions, Henry',s law and Raoult's law, deviations from Raoult's law – non-ideal solutions.
5.2 Temperature composition diagrams – ideal liquid mixture (Toluene – Benzene)-Non-ideal mixture (water – ethanol and water – hydrogen chloride) – Distillation of immiscible liquids.
5.3 Partially miscible liquids: Phenol – Water, Triethylamine – Water and Nicotine – Water systems.
5.4 Nernst distribution law – Thermodynamic derivation-limitations, Applications of Nernst distribution law- Solvent extraction and Determination of Hydrolysis constant.

Text Books:

1. B. R. Puri, L. R. Sharma and M. S. Pathania, *Principles of Physical Chemistry*, 47th Edition, Vishal Publishing Co, Jalandar, 2016.
2. R.L. Madan, *Physical Chemistry*, Mc Graw Hill Education Pvt. Ltd. 2015.

Reference:

1. Arun Bahl, B.S. Bahl. G.D.Tuli, Essentials of Physical Chemistry, S. Chand Publications
2. A.S. Negi and S.C. Anand, *A text book of Physical Chemistry*, Wiley Eastern Ltd, New Delhi, 1984.

Learning Outcome:

- Relate and interpret the various laws of thermodynamics
- Know the relevance of free energy in chemical reactions
- Discuss the fundamental aspects of chemical equilibrium
- Illustrate the behaviour of chemical mixtures using suitable phase diagrams
- Correlate the type of colloids with its properties
- Identify and distinguish the types of solutions

Mapping of CO with PO and PSO

CO	Programme Outcomes (POs)							Programme Specific Outcomes (PSOs)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	Mean Scores of COs
CO1	3	2	2	2	3	2	2	3	3	2	3	3	3	2	2	2.4
CO2	3	2	2	2	3	2	2	2	2	2	3	3	2	3	3	2.4
CO3	3	2	1	2	3	2	3	2	3	2	3	2	3	3	3	2.4
CO4	3	2	2	2	3	2	2	2	2	2	2	2	3	2	2	2.2
CO5	3	2	2	3	3	3	2	2	2	2	2	2	3	2	2	2.3
Mean Overall Score																2.3
Result																High

Assessment Pattern

Bloom's Category	CA Tests (Marks Allotment)		Term End Exam (100) Marks Allotment
	I CA (50)	II CA (50)	
Remember	10	10	20
Understand	10	10	30
Apply	10	10	20
Analyze	10	10	10

Evaluate	5	5	10
Create	5	5	10

Course Code	Type	Total Hours: 45	Lecture: 3	Tutorial: 3	Practical: 39
PCH408	Practical	Course Name: Qualitative Inorganic Analysis		Max Marks: 100	Credits: 3

Course Objectives:

- To enable the student to systematically identify the cations and anions present in a inorganic mixture
- To know the appropriate chemical procedures and apply them to prepare some familiar complexes

Course Outcomes

On successful completion of this Course, students will be able to

S.No.	Course Outcome Statement	Knlowegde Level
CO1	Understand the systematic inorganic salt analysis based on interfering and non-interfering acid radicals and their elimination procedure	K1
CO2	Justify the progress of group specific cations with specific reagents present for specific cations	K3
CO3	Integrate the importance of pH concepts involved in group separation and on solubility	K4
CO4	Predict the appropriate reactions and reagents for specific cation with group specific reagents	K6
CO5	Adapt various interfering elimination procedure for the attainment of original solution and cationic radicals	K5
CO6	Adapt appropriate complexation process for the attainment of various metal complexes	K5

Course Content

1. Qualitative Inorganic Mixture Analysis:

1.1 Analysis of mixture containing two cations and two anions of which one will be interfering.
1.2 Anions: Chloride, Carbonate, Sulphate, Nitrate, Borate, Fluoride, Oxalate, and Phosphate.
1.3 Cations: Lead, Copper, Bismuth, Cadmium, Iron, Aluminium, Zinc, Manganese, Cobalt, Nicke Calcium, Strontium, Barium, Ammonium and Magnesium.

2. Inorganic Preparations

2.1 Tetrammine Copper(II) Sulphate
2.2 Hexammine Nickel (II) Chloride
2.3 Tris (thiourea) Copper(II) Chloride
2.4 Potassium trioxalato ferrate (III)

References

1. V. Venkateswaran, R. Veerasamy, A.R. Kulandaisamy, *Basic principles of Practical Chemistry*, S.Chan publications, New Delhi, 2002.

2. V. V. Ramanujam,*Inorganic Semimicro Qualitative Analysis*, 3rd Edition, The National Publishin Company, 2003.
3. A.O, Thomas. *Practical Chemistry*, 6th Revised Edition, Sharada Press, 1995.

Mapping of CO with PO and PSO

CO	Programme Specific Outcomes (PSO)								Programme Outcomes (PO)							Mean Scores of Cos
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PO1	PO2	PO3	PSO4	PO5	PO6	PO7	
1	3	1	2	3	3	3	3	3	2	2	1	3	2	1	1	2.2
2	3	1	2	3	3	3	2	3	3	1	1	3	2	2	1	2.2
3	3	2	3	3	3	3	2	3	3	2	2	3	2	2	2	2.5
4	3	2	3	3	3	3	2	3	3	2	1	3	2	2	1	2.4
5	3	1	2	3	3	3	3	3	2	2	1	3	2	1	1	2.2
6	3	1	2	3	3	3	3	3	2	2	1	3	2	1	1	2.2
														Mean Overall Score		2.3
														Result		**High**

Assessment Pattern

Bloom's Category	CA Tests (Marks Allotment)		Term End Exam (100) Marks Allotment
	I CA (50)	II CA (50)	
Remember	10	10	20
Understand	10	10	30
Apply	10	10	20
Analyze	10	10	10
Evaluate	5	5	10
Create	5	5	10

Course Code	**Type**	**Total Hours: 60**	**Lecture: 55**	**Tutorial: 5**	**Practical: 0**
CH545	**Theory**	**Course Name: Organic Chemistry-IV**		**Max Marks: 100**	**Credits: 4**

Course Objectives

- Understanding the reactivities of carbonyl compounds.
- Understanding oxidation and reduction reactions.

Course Outcomes:

On successful completion of this Course, students will be able to

Sl. No.	Course Outcome Statements	Knowledge level
CO1	Comment on the rate of reactivity of aldehydes and ketones;outcome of hydrolysis of amides, imides, nitriles; associate the micelle concept with the action of soap and detergents	K1

CO2	sketch the reactions of various functional organic molecules with Grignard reagent and predict the nature of product	K1, K3
CO3	Relate the acidity of alpha-carbon of various carbonyl compounds, enolate ion formation process and its selectivity in product formation	K1
CO4	Integrate the enolate ion chemistry with various naming reactions with mechanism	K2, K3
CO5	Illustrate the carbonyl group interconversion through various oxidation, reduction processes with stereochemistry	K4
CO6	Build the comparative study on acidity and basicity of amines and the chemistry of aromatic six member heterocycle	K1, K3

Course Content

Unit 1Carbonyl compounds 2 **12 hours**

1.1 Soaps, detergents and micelles. Reactions of carboxylic acids, amides.
1.2 Hydrolysis of amides catalyzed by esters, hydrolysis of imides synthesis of primary amines, hydrolysis of nitriles.
1.3 Activation of carboxylic acids. Dicarboxylic acids and their derivatives.
1.4 Relative reactivities of carbonyls, reactivities of aldehydes and ketones.

Unit 2Carbonyl compounds 3 **12 hours**

2.1 Reaction of carbonyls with Grignard reagents, acetylides, hydride.
2.2 Reaction of aldehydes and ketones with hydrogen cyanide, amines and amine derivatives, formation of imine derivatives.
2.3 Wolf-Kishner reduction, Enamine formation, reductive amination, Reaction of aldehydes and ketones with water and alcohols.
2.4 Protecting groups. Addition of sulphur nucleophiles, Wittig reaction.

Unit 3Carbonyl compounds 4 **12 hours**

3.1 Stereochemistry of nucleophilic additions *Re* and *Si* faces. Nucleophilic addition to α, β unsaturated aldehydes, ketones and carboxylic acid derivatives.
3.2 Acidity of α hydrogen in carbonyl compounds, keto-enol tautomers, keto enol interconversion, reactivities of enolates and enols.
3.3 Halogenation at α carbon of aldehydes, ketones and carboxylic acids.
3.4 LDA and formation of enolate ion.

Unit 4Carbonyl compounds 5 **12 hours**

4.1 Alkylation of α carbon of carbonyl compounds,Alkylation and acylation of α carbon using enamine intermediate.Alkylation of β- carbon Michael reaction.
4.2 Aldol addition forming β- hydroxy aldehydes and β- hydroxy ketones, dehydration of aldols forming α, β unsaturated aldehydes, and ketones, crossed aldol addition.
4.3 β- keto ester formation by Claisen condensation, crossed Claisen condensation, intramolecular condensation and addition reactions, Robinson annulation, decarboxylation of carboxylic acids with carbonyl at 3-position.

4.4 Carboxylic acids from Malonic ester, methylketone from acetoacetic ester.

Unit 5Oxidation and Reduction **12 hours**

5.1 Oxidation and reduction reactions an overview, reduction reactions, chemoselective reactions.

5.2 Oxidation of alcohols, oxidation of aldehydes and ketones, oxidation of alkenes to 1,2 diols, oxidative cleavage of 1,2 diols, oxidative cleavage of alkenes, functional group interconversion.

5.3 Acid base properties of amines, amines as bases and nucleophiles.Aromatic five membered heterocycles.

5.4 Aromatic six membered heterocycles, Natural roles of heterocycles.

Reference Books:

Text Book

1. Paula YurkanisBruice, *Organic chemistry*, 6th Edition, Prentice Hall, Illinois, 2011.

Further reading

2. R.T. Morrison and R. N. Boyd, *Organic chemistry*, 6th Edition, Prentice-Hall of India, New Delhi, 2008.
3. Leroy. G. Wade, *Organic chemistry*, 6th Edition, Pearson, New York, 2005.
4. Clayden, J Greeves, N and Warren, S, *Organic Chemistry*, 2ndEdition,. Oxford University Press, New York, 2001.
5. Loudon, Marc G, *Organic Chemistry*, 6thEdition,. Oxford University Press, New York, 2016.

Outcomes

- Knowledge on carbonyl compounds and their reactivities.
- Knowledge about redox reagents in organic reactions.

Mapping of CO with PO and PSO

CO's	Programme Outcomes (PO)							Programme Specific Outcomes (PSO)								Mean Scores of COs
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	
CO 1	3.0	3.0	2.0	3.0	3.0	2.0	1.0	3.0	1.0	3.0	3.0	3.0	3.0	3.0	1.0	2.5
CO 2	3.0	3.0	1.0	3.0	3.0	1.0	1.0	3.0	1.0	3.0	3.0	1.0	3.0	3.0	2.0	2.3
CO 3	3.0	3.0	1.0	3.0	3.0	2.0	1.0	3.0	1.0	3.0	3.0	3.0	2.0	3.0	1.0	2.3
CO 4	3.0	3.0	1.0	3.0	3.0	2.0	1.0	3.0	1.0	3.0	3.0	3.0	2.0	3.0	1.0	2.3
CO 5	3.0	3.0	1.0	3.0	3.0	3.0	1.0	3.0	1.0	3.0	3.0	3.0	3.0	3.0	3.0	2.6
CO 6	3.0	3.0	1.0	3.0	3.0	3.0	1.0	3.0	2.0	3.0	3.0	3.0	3.0	3.0	1.0	2.5
Mean Overall Score																2.4
Result																High

Assessment Pattern

Bloom's Category	CA Tests (Marks Allotment)		Term End Exam (100) Marks Allotment
	I CA (50)	II CA (50)	
Remember	10	10	20
Understand	10	10	30
Apply	10	10	20
Analyze	10	10	10
Evaluate	5	5	10
Create	5	5	10

Course Code	Type	Total Hours: 60	Lecture: 55	Tutorial: 5	Practical: 0
CH546	Theory	Course Name: Inorganic Chemistry-III		Max Marks	Credits: 4

Course Objectives:

- To study the chemistry of main groups elements
- To understand the variation in the periodic behavior
- To learn the methods of extraction of lanthanides and actinides

Course Outcomes

On successful completion of this Course, students will be able to

S.No.	Course Outcome Statement	Cognitive Level
CO1	Students comprehend why and how lanthanide and actinide contractions occur.	K1, K2
CO2	The chemistry of ozone, as well as allotropes of oxygen and sulphur, may be mastered by students.	K3, K4
CO3	By studying the synthesis, characteristics, and structure of interhalogen compounds, students will grasp and appreciate the differences in electronegativity among halogens.	K2, K3
CO4	The students can assess periodic trends, chemical reactivity and physical properties of d and f-block elements	K3, K4
CO5	Students are able to tell the differencebetween 3d and 4f block components.	K4, K5
CO6	The variations in ionic radius, coordination number, metal-metal bonding, and oxidation state between 3d, 4d, and 5d block elements can be compared and contrasted by students.	K5, K6

Course Content

Unit-1 Chemistry of Group 16 **12 hours**

1.1 Group 16- chalcogens: general properties, electronic configuration, oxidation states. Oxides- classification, structure and properties.
1.2 Oxo-acids and peroxo-acids of Sulphur.
1.3 Hydrogen peroxide and Hydrogen sulphide- preparation and properties.
1.4 Allotropes of Oxygen and Sulphur. Chemistry of Ozone.

Unit-2 Chemistry of Halogens and Noble gases **12 hours**

2.1 Group 17: electronic configuration, oxidation states, ionization energies, and electron affinity. Hydrogen halides- preparation, properties and uses. Halides- ionic, molecular and bridging.
2.2 Preparation and properties of Oxo-acids- Hypohalous acids, halous acids, Halic acids and perhalic acids. Pseudo halogens and halides.
2.3 Preparation, properties and structure of Interhalogen compounds – types; ICl, BrF_3, ClF_5 and IF_7.

2.4 Noble gases: Xenon clatharates. Preparation properties and structure of Xenon fluorides.

Unit-3 Transition elements **12 hours**

3.1 General group trends, electronic configuration.

3.2 General characteristics: metallic character, molar volume and densities, ionisation energies, variable valency, stability of oxidation states, and colour.

3.3 Magnetic properties- para-magnetism, diamagnetism and effective magnetic moment, catalytic properties, determination of magnetic properties

3.4 Comparison between first, second and third transition series. (Ionic radius, coordination number, metal – metal bonding and oxidation state)

Unit-4 Chemistry of lanthanides and actinides **12 hours**

4.1 Electronic structure, configuration and position of lanthanides and in the periodic table.

4.2 Properties of lanthanides and actinides: basic character, solubility, double salts and chemical reactivity

4.3 Chemical properties of lanthanides and actinides-oxidation state, magnetic properties, colour and spectral properties.

4.4 Lanthanide and actinide contraction and its consequences.

Unit-5 Extraction of Lanthanides and Actinides **12 hours**

5.1 Extraction of lanthanides from monazite sand

5.2 Separation of the lanthanides (Precipitation, fractional crystallization, complex formation, solvent extraction, valency change). Uses of lanthanides.

5.3 Extraction of Thorium and uranium and compounds of thorium and uranium

5.4 Comparative studies of lanthanoids and actinoids with transition elements.

Learning Outcomes

- Identify the chemistry of p-block elements (Group 16 and 17) and noble gases
- Explain the periodic trends, chemical reactivity and physical properties of d and f-block elements
- List out important inorganic compounds of d and f block elements, their extraction and applications

References

(Text Book)

1. R. D. Madan, *Modern Inorganic Chemistry,* Second edition, S. Chand publications, New Delhi, 2000.
2. B. R. Puri, L. R. Sharma and K. C. Kalia, *Principles of Inorganic Chemistry*, 33rd Edition, Vishal Publishing Co, Jalandar, 2004.
3. 1. J. D. Lee, *Concise Inorganic Chemistry,* Chapman and Hall: London, 1961.

(Advanced Reading)

1. C. Chambers and A. K. Holliday,*Modern Inorganic Chemistry,* First edition, Butterworth and Co., Sussex, 1975.
2. Gary L Miessler and Donald A Tarr, *Inorganic Chemistry,* Third edition, Pearson Prentice Hall.
3. A. G. Sharpe and C. E. Housecraft, *Inorganic Chemistry* Vol-I, 3rd edition, Pearson prentice Hall, New York, 2008.

Mapping of CO with PO and PSO

CO	Programme Specific Outcomes (PSO)								Programme Outcomes (PO)							Mean Scores of Cos
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PO1	PO2	PO3	PO4	PO5	PO6	PO7	
1	3	3	3	3	3	3	3	1	3	3	3	3	3	3	2	2.8
2	3	3	3	3	3	3	3	3	3	3	3	2	2	3	2	2.8

3	3	3	3	3	2	3	3	2	3	3	3	2	2	3	3	2.7
4	3	3	3	3	3	3	3	3	3	3	2	3	3	3	2	2.9
5	3	3	3	3	3	2	3	2	3	3	3	3	3	3	2	2.8
6	3	3	3	3	3	3	3	3	3	3	2	3	3	3	2	2.9
Mean Overall Score																2.8
Result																High

Assessment Pattern

Bloom's Category	CA Tests (Marks Allotment)		Term End Exam (100) Marks Allotment
	I CA (50)	II CA (50)	
Remember	10	10	20
Understand	10	10	30
Apply	10	10	20
Analyze	10	10	10
Evaluate	5	5	10
Create	5	5	10

Course Code	**Type**	**Total Hours: 60**	**Lecture: 60**	**Tutorial: 5**	**Practical: 0**
CH547	**Theory**	**Course Name: Physical Chemistry-III**		**Max Marks: 100**	**Credits: 4**

Course Objectives

- To have a good foundation about the quantum chemistry and learn the application to simple system
- To learn the concepts regarding chemical kinetics and apply them for kinetics related problems in chemical reactions
- To learn the importance of photophysical and photochemical processes

Course Outcomes:

On successful completion of this Course, students will be able to

Sl. No.	Course Outcome Statements	Knowledge level
CO1	Explain the theory of Quantum Mechanics, also formulate and solve simple problems in QM	K1 & K3
CO2	Distinguish rate orders and the impact of reaction parameters	K2
CO3	Explain the theory for reaction rates	K3
CO4	Explain the basics of photochemistry and also enumerate the kinetics of photochemical reactions	K2 & K4
CO5	Demonstrate the principle of adsorption and the different isotherms used to explain the phenomena	K4

Course Content

Unit – IFundamentals of quantum Chemistry **12 Hours**

1.1 Need for quantum mechanics-Black body radiation, Quantum theory of radiation, Photoelectric effect.
1.2 Rutherford's model of atom and its failure, Bohr's theory of hydrogen atom, spectrum of hydrogen atom – Sommerfeld theory
1.3 Dual behaviour of matter and radiation -de Broglie's relation, Davisson-Germar experiment, Compton effect, Heisenberg Uncertainty principle.
1.4 Solving One-dimensional wave equation for a standing wave-Separation of variables- Interpretation of results

Unit - II Quantum Mechanics **12 Hours**

2.1 Schrodinger's wave equation-Eigen value/Eigen Function-Postulates of Quantum mechanics –
2.2 Operators – Algebra of operators – commutative property – Linear operator and Hermitian property – momentum operator, KE operator, Hamiltonian operator.
2.3 Solution of Schrodinger's wave equation for simple systems: Free particle- Particle in one dimensional box (Origin of quantization)
2.4 Particle in one dimensional box (Expectation Values for momentum and position, Verification of Heisenberg's Uncertainty Principle)-Applications of particle in a box -and particle in three-dimensional box.

Unit - III Chemical Kinetics I **12 Hours**

3.1 Introduction to reaction rates - Rate of a Chemical Reaction-Reactant and Product Concentrations as a Function of Time - Average, Instantaneous, and Initial Reaction Rates -Factors affecting rate of a reaction (nature of reactants, concentration of reactants, effect of temperature, effect of catalyst)-Molecularity-Elementary Steps-Order of a reaction-Rate Determining Step-Determining the Order of a Reaction by changing concentration of reactants (including numerical problems)
3.2 Derivations of Zero, First, Second (2A→ products & A +B→ products)
3.3 Third order reactions (3A→ products)–Half-life (Zero/First/Second/Third)- study of kinetics by Volumetric (Ester hydrolysis) and Polarimetric (Inversion of Sucrose)
3.4 Determination of order of the reactions-Graphical method, rate equation method, half-life method and Ostwald's method.
*Numerical Problems related to above topics

Unit - IVChemical Kinetics II and Catalysis **12 Hours**

4.1 Effect of temperature on reaction rate – temperature coefficient - concept of activation energy-Arrhenius equation.
4.2 Theories of reaction rates: Bimolecular collision theory – Transition state theory – Lindemann's unimolecular theory.
4.3 Catalysis – General characteristics. Activation energy (for catalyst/ without catalyst). Theories of catalysis – Adsorption theory / Intermediate compound formation theory.
4.4 Enzyme catalysis: theory – Mechanism and kinetics of enzyme catalysed reaction-Michaleis-Menton equation – Lineweaver-Burk Plot
*Numerical Problems related to the above topic

Unit - V Photochemistry and Adsorption **12 Hours**

5.1 Interaction of radiation with matter- Difference between thermal & photochemical processes – Laws of photochemistry: Grotthus – Draper law, Stark Einstein law-Jablonski diagram depicting various processes occurring in the excited state.
5.2 Qualitative description of fluorescence, phosphorescence, non-radioactive processes (internal conversion, inter system crossing), quantum yield, photosensitized reactions.
5.3 Adsorption – Distinction between physical and chemical adsorption-Factors influencing adsorption-
5.4 Adsorption isotherm – Freundlich isotherm. Langmuir isotherm- theory and derivation.

Text Books:

1. B. R. Puri, L. R. Sharma and M. S. Pathania, *Principles of Physical Chemistry*, 47th Edition, Vishal Publishing Co, Jalandar, 2016.
2. R.L. Madan, *Physical Chemistry*, Mc Graw Hill Education Pvt. Ltd. 2015.

Reference:

1. Arun Bahl, B.S. Bahl. G.D.Tuli, Essentials of Physical Chemistry, S. Chand Publications
2. A.S. Negi and S.C. Anand, *A text book of Physical Chemistry*, Wiley Eastern Ltd, New Delhi, 1984.

Learning Outcome:

- Explain the fundamental principles of quantum mechanics
- Describe the kinetics of chemical reactions
- Explain the characteristics of catalysis
- Describe the various photophysical and photochemical processes.
- Identify the different types of adsorption

Mapping of CO with PO and PSO

CO	Programme Outcomes (POs)							Programme Specific Outcomes (PSOs)								
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO6**	**PO 7**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO 6**	**PSO7**	**PSO8**	**Mean Scores of COs**
CO 1	3	3	1	3	3	3	1	3	2	2	2	2	3	2	2	2.3
CO 2	3	3	1	3	3	2	1	3	2	2	2	2	3	2	2	2.3
CO 3	3	3	1	2	3	2	1	3	2	2	3	2	3	2	2	2.3
CO 4	3	3	1	2	2	2	1	2	2	2	2	3	3	2	2	2.1
CO 5	3	3	1	2	2	2	1	2	2	2	2	2	3	2	3	2.1
Mean Overall Score																2.2
Result																High

Assessment Pattern

Bloom's Category	CA Tests (Marks Allotment)		Term End Exam (100) Marks Allotment
	I CA (50)	II CA (50)	
Remember	10	10	20
Understand	10	10	30
Apply	10	10	20
Analyze	10	10	10
Evaluate	5	5	10
Create	5	5	10

Course Code	Type	Total Hours: 60	Lecture: 60	Tutorial: 5	Practical: 0
CH548	Theory	Course Name: Analytical Chemistry-II		Max Marks: 100	Credits: 4

Course Objectives:

- To study the principle, instrumentation and applications of colorimetric analysis and UV-Visible spectroscopy.
- To learn about the fundamentals of mass spectrometry and applied it to determine molecular formula and molecular weight.
- Make to know about the molecular vibrations, instrumentation and applications of IR and Raman spectroscopies to simple systems.
- To know about the principle, instrumentation and applications of NMR and ESR spectroscopies.
- To understand about the principle and instrumentation of AAS and AES and to make a comparison between them.
- To learn the basics and principles of polarographic and amperometric techniques.

Course Outcomes:

- On successful completion of this Course, students will be able to

S.NO.	COURSE OUTCOME	Cognitive Level
CO1	Explain and evaluate the principle and instrumentation of colorimetric analysis and UV-Visible spectroscopy, various factors involved in analysis and its applications.	K1,K5
CO2	Understand the fundamentals of mass spectrometry including fragmentation pattern of simple molecules and how to determine molecular formula and molecular weight of various compounds.	K2,K6
CO3	Understand about the molecular vibrations in IR and Raman spectroscopies and applied to structural elucidation, detection of presence of hydrogen bonding etc.	K2,K3
CO4	Illustration of NMR spectroscopy and application for structural elucidation and ESR spectroscopy for coordination compounds.	K3,K4
CO5	Comparing Atomic Absorption spectroscopy and Atomic Emission spectroscopy. Application of AAS like Determination of Mg in water and Lead in Petrol by AAS.	K2,K5
CO6	Evaluation of polarographic waves for qualitative and quantitative applications. Explore amperometric titration and its applications.	K3,K6

Course Content

Unit - I: Colorimetric Analysis, UV-Visible Spectroscopy and Mass Spectrometry
12 Hours

1.1 Introduction to spectroscopy-spectrum-Electromagnetic Radiation-Planck's equation-wavelength-frequency-wave number.
1.2 Mass Spectrometry-Principle-Instrumentation- Dampster spectrometer. McLaffertary rearrangement - The Mass spectrum-fragmentation with illustration: CH_4, C_2H_5OH, CH_3COCH_3, Determination of molecular formula and molecular weight: Example-Acetic acid.
1.3 Colorimetric analysis-laws of colorimetry-photoelectric Colorimeter-Estimation of Fe and Ni. Determination of composition of complex Job's Methods-Example: Ni-EDTA complex.
1.4 UV-Visible Spectroscopy-Types of transition in Organic Compounds-Types of absorption band-chromophore-auxochrome-bathochromic shift, hypsochromic shift, hyperchromic shift and hypochromic shift. Instrumentation-single and double beam and applications of simple systems.

Unit - II: IR and Raman Spectroscopy 12 Hours

2.1 IR Spectroscopy-theory-types of Vibrations-Examples: H_2O and CO_2.
2.2 Instrumentation and sampling techniques.
2.3 Applications: Structure of NO_2, study of Hydrogen Bonding-Identification of simple organic compounds: alcohols, acids, amines, esters, ketones and unsaturated compounds.
2.4 Raman Spectroscopy-theory-advantages over IR Spectroscopy. Instrumentation and sample Handling-Depolarization Effect-Mutual Exclusion principle, applications-structure of CO_2, nitrous oxide and mercurous chloride.

Unit - III: NMR and ESR Spectroscopy 12 Hours

3.1 NMR Principle: theory-allowed orientation-spin states and relaxation- chemical shift.
3.2 Factors affecting chemical shift, spin-spin coupling, and hydrogen exchange.
3.3 Instrumentation and sample Handling-Applications: Structural identification- Examples:1-Bromo Propane, 2-Bromo Propane, Toluene, Phenol and Vinyl Chloride.
3.4 ESR Principle-Theory-Selection rule for Transition-Instrumentation- Zero Field Splitting-Hyperfine splitting. Applications-ESR of simple organic radicals: CH_3-ESR of V^{4+}, Mn^{2+} and Cu^{2+} ions.

Unit - IV: AAS and AES 12 Hours

4.1 Atomic absorption Spectroscopy-Principle-Advantages and disadvantages of AAS.
4.2 Instrumentation of AAS, Interferences in AAS. Applications of AAS-Determination of Mg in water and Lead in Petrol.
4.3 Atomic Emission Spectroscopy- Principle of Flame photometry, AES-Principle-Advantages and Disadvantages.
4.4 Instrumentation of AES, Applications- Comparison of AAS and AES.

Unit - V: Polarography and Amperometry 12 Hours

5.1 Polarography-principle and instrumentation -current-voltage curves
5.2 Evaluation of Polarographic waves-half-wave potential, Ilkovic equation.
5.3 Applications of polarography for organic and inorganic systems.
5.4 Amperometry- Principle-Instrumentation-Types of curves. Advantages of amperometric titrations-applications of amperometric titrations.

References

1. R.Gopalan, P. S. Subramanian and K. Rengarajan, *Elements of analytical chemistry*, 3rd Edition., Sultan Chand, New Delhi, 2003
2. A. K. Srivatsava and P. C. Jain, *Chemical Analysis and Instrumental Approach*, 3rdEdition, S. Chand and Company Ltd., New Delhi, 2010.
3. A. I. Vogel, *A text book of quantitative inorganic analysis*, Longman, New York, 1985.
4. H. H. Willard, L. L. Merritt and J. A. Dean,*Instrumental methods of analysis*, 7thEdition., East West Press, New Delhi, 1986.
5. D. A. Skoog and D. M. West, *Principles of instrumental analysis*, Holt Saunders, Tokyo, 2001.
6. Gurdeep R Chatwal, *Instrumental Methods of Chemical Analysis*, 5thEdition. Himalaya Publications, 2005.

7. S. M. Khopkar, *Basic Concepts of Analytical Chemistry*, New Age Publishers, 2nd Edition. 2000.
8. V. Suryanarayanarao, *Polarography and Allied techniques*, University Press, 2002.

Learning Outcomes

- To learn and understand the basic analytical techniques and their applications

To understand the basic principles that makes each analytical technique possible and useful

Mapping of CO with PO and PSO

CO	Programme Outcomes (POs)							Programme Specific Outcomes (PSOs)								
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**Mean Scores of COs**
CO1	3	3	1	2	3	2	1	3	3	3	3	1	3	3	3	2.5
CO2	3	3	1	2	3	2	1	3	3	3	3	1	3	3	3	2.5
CO3	3	3	1	2	3	2	1	3	3	3	3	1	3	3	3	2.5
CO4	3	2	1	2	3	2	1	3	3	3	3	1	3	3	3	2.4
CO5	3	3	1	3	3	3	1	3	3	2	3	1	3	3	3	2.5
Mean Overall Score																2.48
Result																High

Assessment Pattern

Bloom's Category	CA Tests (Marks Allotment)		Term End Exam (100) Marks Allotment
	I CA (50)	II CA (50)	
Remember	10	10	20
Understand	10	10	30
Apply	10	10	20
Analyze	10	10	10
Evaluate	5	5	10
Create	5	5	10

CH549A	**Theory**	**4**	**3**	**1**	**0**
	CH549A	**PHARMACEUTICALCHEMISTRY**		**100**	**4**

Course Objectives

- To acquire a sound knowledge about the chemistry of drugs and their mechanism of action.
- To learn about various types of diseases, their cause and cure through conventional and modern medicine.

Course Outcomes:

On successful completion of this Course, students will be able to

S.No	Course Outcome Statement	Knowledge level
CO1	Define and explain the basic concepts involved in the pharmaceutical chemistry	K1 & K2
CO2	Describe and summarise about the cause and treatment of several diseases and practice methods to treat and prevent them	K2 & K3
CO3	Recognize the existence of various drugs available and compare the mechanism of action	K4
CO4	Describe the utility of various drugs and learn to employ them whenever needed	K3
CO5	Observe the cause and treatment of various disorders and recommend measures to prevent or rectify them	K5
CO6	Explain the effectiveness of drugs and hypothesize drug designing strategies	K4 & K6

Course Content

Unit - I: Pharmacology **9 Hours**

1.1 Introduction: Important terminologies used in medicinal chemistry – Drugs, Dose, Pharmacology, Pharmacopoeia, therapeutics, toxicology, chemotheraphy, pharmacophore, metabolite, antimetabolite and mutation. Naming of drugs: Chemical name, proprietary name and non – proprietary name with suitable examples.

1.2 Modes of administration of drugs: Enteral routes: oral, buccal, rectal. Parenteral routes: intradermal, subcutaneous, intramuscular, intravenous, intraarterial, intrathecal, intraperitoneal, intramedullary, intraarticular, inhalation, topical (meanings Only) - Enteral dose forms. Disadvantages of enteral and parenteral routes -Definition of LD50, ED50 and therapeutic index.

1.3 Drug Stability –causes of drug degradation and their prevention.

- Hydrolysis (procaine, Chloramphenical, aspirin)
- Oxidation (ascorbic acid, adrenaline)
- Polymerisation (formaldehyde)
- Decarboxylation (procaine)

Drug design:New drugs, Lead compounds, SAR method,

Unit - II: Viral Infections **9 Hours**

2.1 General Pharmacology: Meaning of receptor, agonist, antagonist, partial agonist, pharmaco dynamics and pharmacokinetics. Process of drug adsorption, distribution, metabolism and excretion – Plasma half life period and its significance.

2.2 Viral diseases and antiviral drugs: Small pox, jaundice, rabies, influenza and AIDS – causes,symptoms and treatment. SARS / COVID / Antiviral Drugs – obstacles in antiviral therapy – Structure and uses of acyclovir, iodoxuridine, amantadine and zidovudine (AZT).

2.3 Protozoal Infections: malaria – the four malarial parasites – life cycle of malarial parasites – antimalarials: chloroquine, primaquine and quinine.

Unit - III: **Bacterial Infections** **9 Hours**

3.1 Bacterial Infections: Meaning of bacteristat and bacteriocide, Gram-positive and Gram-negative bacteria.Antibacterial agents: Structure, uses and side effects of pencillins, streptomycin, chloramphenicol and tetracyclines.

3.2 Sulphonamides: Preparation and uses of sulphanilamide, sulphapyridine, sulphadiazine, Sulphathiazole, sulphaguanidine and prontosil-mode of action of sulphadrugs –General side effects of sulphadrugs.

3.3 Tuberculosis – cause, symptoms and treatment of TB, tetanus and typhoid

Unit - IV: Types of Drugs **9 Hours**

4.1 Inflammation and anti-inflammatory drugs: Examples for steroidal and non-steroidal anti-inflammatory drugs, Antihistamines - Uses and side effects,

4.2 Analgesics: Narcotic analgesics- Exaction, physiological action, uses and side effects of morphine. Synthetic analgesics: preparation and uses of pethidine and methadone. Antipyretic analgesics: preparation, physiological action, uses and side effects of aspirin and paracetamol.

4.3 Sleep and hypnotics: Meaning of sleep,somnambulism, insomnia hypnotics, sedatives, tranquillisers.Preparation,uses and side effects of benzodiazepines and barbiturates. Psychotropicdrugs:Psycho stimulants – Caffeine, Amphetamine - structure, adverse effects and detection of LSD, Drug abuse Drug dependence, Evil effects of alcohol, tobacco, cannabis.

Unit - V: OtherDiseases **9 Hours**

5.1 Epilepsy, Parkinsonism: Meaning, causes, Symptoms and treatment (two drugs for each.

5.2 Cancer: Meaning of cancer – causes and symptoms – Treatment-Surgery, Radiation Therapy, Chemotherapy – Anti neoplastic agents, Alkylating agents (Nitrogen&Sulphur Mustards), Antimetabolites (mercaptopurines, Fluorourcil),

5.3 Diabetes: Meaning, kind, cause and symptoms. Hyperglycaemia and hypolglycaemia- carbohydrate metabolism, Insulin and its action, Types of diabetes mellitus, Treatment of diabetes- Insulin therapy. Hypoglycaemic agents (Sulphonyl urea and biguanidines).

References

1. A. Jayashree Ghosh, *Textbook of Pharmaceutical chemistry*, Rajendra ravindra printers pvt. Ltd., New Delhi, 2010.
2. James Cross land, Lewis, *Pharmacology*, 5th Edition, Churchill Livingstone Publications, New York.1980
3. D. Sriram, P. Yogeeswari, *Medicinal Chemistry*, Second edition, Pearson publications, 2007
4. Alex Gringauz, *Introduction to Medicinal chemistry*, Wiley India Pvt Ltd., New Delhi, 2011.
5. Burger. *Medicinal Chemistry and Drug Discovery*, Vol-1, Ed. M. E. Wolff, John Wiley, 1994.
6. Goodman & Gilman. *Pharmacological Basis of Therapeutics*, McGraw-HilI, 2005.
7. S. S. Pandeya& J. R. Dimmock, *Introduction to Drug Design*, New Age International, 2000.
8. D. Lednicer, *Strategies for Organic Drug Synthesis and Design*, John Wiley, 1998.
9. Graham & Patrick. *Introduction to Medicinal Chemistry*, 3rd edition, OUP, 2005.
10. Rama Rao Nadendla, *Principles of Organic Medicinal Chemistry*, 2nd Edition, New Age Publications, 2008.
11. Ashutosh Kar, *Medicinal Chemistry*, 2nd Edition, New Age Publications, 2000.

MappingofCO withPOandPSO

CO	ProgrammeOutcomes(POs)							ProgrammeSpecificOutcomes(PSOs)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	Mean Scores ofCos
CO1	3	2	2	2	2	2	2	3	2	2	2	3	2	2	2	2.2
CO2	3	2	3	2	2	2	2	3	2	2	3	3	3	2	2	2.4
CO3	3	3	2	2	3	2	2	3	2	2	3	2	3	2	2	2.4
CO4	3	3	2	2	2	2	2	2	2	2	2	3	3	2	2	2.26
CO5	3	3	3	2	2	2	2	2	2	2	2	2	3	2	3	2.33
CO6	3	2	3	2	2	3	2	2	2	2	2	2	2	2	3	2.26
MeanOverallScore																2.3
Result																High

AssessmentPattern

Bloom'sCategory	CATests(MarksAllotment)		TermEndExam(100)MarksAllotment
	ICA (50)	IICA(50)	
Remember	10	10	20
Understand	10	10	30
Apply	10	10	20
Analyze	10	10	10
Evaluate	5	5	10
Create	5	5	10

CH549B	**Theory**	**4**	**3**	**1**	**0**
	CH549B	**Forensic Chemistry**		**100**	**4**

Course Objectives

- To understand the basic knowledge about forensic.
- To learn how chemistry supports in crime scene investigation and detection.
- To understand the determination of the crime using serology and identification of drugs usage.

Course Outcomes:

On successful completion of this Course, students will be able to

S.No	Course Outcome Statement	Knowledge level
CO1	The relevance of chemistry in forensic science is well grasped by the students.	K1

CO2	Distinguish between the tests that were employed to obtain the fingerprint for analysis.	K2
CO3	Comprehend the procedures for gathering material evidence from various things such as paint and glass.	K3
CO4	Explain the notion of antigen–antibody interactions and how it may be used to identify species and drugs present in the body.	K2 & K4
CO5	Describe the various forensic tests which are used to identify a stain inblood.	K3 & K5
CO6	Define standard field sobriety tests used to evaluate drug impairment, as well as the societal implications of drug and importance of chemistry in toxicology.	K4 & K6

Course Content

Unit-1Introduction to forensic chemistry, and crime scene assessing 9 hours

1.1 Introduction-Forensic science, origin of forensic science, earlier and advancement in forensic science.[1] Crime Scene: Securing isolating, Photography, Search for evidence, Collecting and packing evidence.[2]

1.2 Physical Evidences: Identification, Comparison. Assessing significance and value of physical evidence.[2]

1.3 Cautions and Limitations in Dealing with Physical Evidence. Forensic databases(Fingerprint and DNA databases).[2]

Unit-2Detection Using fingerprints and DNA Finger printing 9 Hours

2.1. History and Usage of fingerprints. Early Classification of finger prints. Adoption of fingerprinting. Fundamental Principles of fingerprinting. Classification of finger prints.[2]

2.2. Methods of detecting fingerprinting: fingerprint powders, Iodine fuming, and ninhydrin.[2] Powder test, chemical test and light test.[1]

2.3. DNA Fingerprinting-Chemistry behind biology-Application of DNA Testing.[1] Forensic DNA Typing-Procedure for DNA Typing-Slot-blot Test-Yield Gel Method-Methods of DNA Typing.[1]

Unit-3 Examining Matter, Light, Paint, and glass 9 hours

3.1 Nature of matter, Elements and compounds. States of matter. Physical properties and basic units and measurements, Density and Refractive indexes.[2]

3.2. Paint Chemistry, Binders, pigments. Architectural coatings. Paint evidence interpretation, Analytical methods (microscopic examination, and infrared spectroscopy).[3] Inorganic and Organic pigment analysis. Any one case studies on analyzing crime using paint analysis.[3]

3.3. Hairs and fibers-Forensic examination of Hair-Identification and comparison of hair-Forensic examination of fibers-types of fibers-Chemical composition Identification.[2]

Unit-4 Forensic Serology 9 hours

4.1. Nature of Blood: Antigens and antibodies.[2] Type of Bloods, polymorphic proteins and isoenzymes.[1] Identification of bloods (redox reaction and microcrystal assays).[3]

4.2. Forensic Characterization of blood stains (color, Luminol and bluestar, and microcrystalline test).[2]

4.3. Species identification: Immunochromatographic assays and Crossed-Over Immunoelectrophoresis.[3]

Unit-5Drug testing **9 Hours**

5.1. Alcohol and Human Body, Role of Forensic toxicology-Toxicology of alcohol.[2] Testing Blood Alcohol Concentration. Field tests-Drunkometer, Alcometer, Breathanalyzer, Fuel cell-based device.[1] Lab Analysis-Gas Chromatography.[2]

5.2. Techniques used in Toxicology. Drug dependence, (Psychological and Physical). Societal aspects of drug usage.[2] Types of Drugs(narcotics, Hallucinogens, and depressants). Forensic drug analysis. Quantitative and qualitative determination.[7] Confirmatory tests (FTIR, Chromatography and GC).[1]

5.3. Testing for poisons-Confirmatory tests(FTIR, GC and Mass).[1] Detecting Nondrug Poisons(Heavy Metals and CO), Significance of Toxicological findings.[2]

Learning Outcome

- The student can explain the importance of chemistry in forensic science.
- The student can opt forensic science as their career.

References

(Text Book)

1. David E. Newton, *Forensic Chemistry*, Facts on File Science library, New York, **2007**.
2. Richard Saferstein, *An Introduction to Forensic Science,* 12th Edition, Pearson Education, New York, **2018**.
3. Lawrence Kobilinsk, *Forensic Chemistry Handbook*, John Wiley and Sons, New Jersy, **2012**.

(Further reading)

4. Jay. A. Siegal, *Forensic Chemistry Fundamentals and Applications*, Wiley Blackwell, West Sussex, **2016**.
5. *Forenscis Laboratory Manual,* The McGraw-Hill Companies.
6. William G. Eckert, *Introduction to Forensic Sciences,* 2nd Edition, CRC Press, New York, **1992**.
7. Steven B. Karch, *Toxicology and Clinical Pharmacology of Herbal Products*, Humana Press, New Jersy, **2000**.

MappingofCO withPOandPSO

CO	ProgrammeOutcomes(POs)							ProgrammeSpecificOutcomes(PSOs)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	Mean Scores ofCos
CO1	3	3	3	2	3	2	2	3	2	2	3	3	3	2	2	2.6
CO2	3	3	3	2	3	2	2	3	2	2	3	3	3	2	2	2.6
CO3	3	3	2	2	3	2	2	3	2	2	3	2	3	2	2	2.4
CO4	3	3	2	2	3	2	2	2	2	2	3	3	3	2	3	2.4
CO5	3	3	3	2	3	2	2	2	2	2	3	2	3	2	3	2.4
CO6	3	3	3	2	3	2	2	2	2	2	3	2	3	2	3	2.4
MeanOverallScore																2.5
Result																High

AssessmentPattern

Bloom'sCategory	CATests(MarksAllotment)		TermEndExam(100)MarksAllotment
	ICA (50)	IICA(50)	
Remember	10	10	20
Understand	10	10	30
Apply	10	10	20
Analyze	10	10	10
Evaluate	5	5	10
Create	5	5	10

CH549C	**Theory**	**4**	**3**	**1**	**0**
	CH549C	**Bioinorganic Chemistry**		**100**	**4**

Course Objectives:

- To understand the scope of bioinorganic chemistry
- To learn the chemistry of metelloporphyrin, metelloenzyemes.
- To know the significance of metals in medicine.

Course Outcomes:

On successful completion of this Course, students will be able to

S.NO.	COURSE OUTCOME	Knowledge level
CO1	Compare the scope of bioinorganic chemistry	K2
CO2	Discover the chemistry of metalloporphyrin	K4
CO3	Describe the chemistry of metalloenzymes	K3
CO4	Explain the significance of metals in medicine	K1
CO5	Define nitrogen fixation and photosynthesis	K2
CO6	Creating awareness and diagnosis, therapy for cancer	K5

Course Content

Unit - I: Scope of Bioinorganic Chemistry **9 Hours**

1.1 Introduction to Inorganic elements in biological systems and cells.

1.2 Biologically important compounds amino acids, proteins, nucleotides, carbohydrates and lipids, basic bioenergetics.

1.3 Classification of enzymes. Biochemistry: Distribution, biological roles, active transport of cations across membranes, the sodium pump.

Unit - II: Metalloporphyrins **9 Hours**

2.1 Structure and optical spectra; heme proteins.

2.2 Magnetic susceptibility, epr and electronic spectra; hemoglobin and myoglobin: molecular structures.

2.3 Thermodynamics and kinetics of oxygenation, electronic and spatial structures, synthetic oxygen carriers

Unit - III: Metalloenzymes **9 Hours**

3.1 Copper enzymes, superoxide dismutase, cytochrome oxidase and ceruloplasmin.

3.2 Coenzymes; Molybdenum enzyme: xanthine oxidase;

3.3 Zinc enzymes: carbonic anhydrase, carboxy peptidase and interchangeability of zinc and cobalt in enzymes.

Unit - IV: Metals in Medicine **9 Hours**

4.1 Metal deficiency and disease; toxicity of mercury, cadmium, lead, beryllium, selenium and arsenic.

4.2 Biological defence mechanisms; chelation therapy; metals used for diagnosis.

4.3 Enzyme and chemotherapy, platinum complexes as anticancer drugs, Pt-DNA binding.

Unit -V: Nitrogen fixation and photosynthesis **9 Hours**

5.1 Nitrogenase enzyme: reactivity, reduction involving nitride / diazene intermediate,

5.2 Dinitrogen complexes and their reactivity in vitro nitrogen fixation.

5.3 Photosynthesis: Structure of chlorophyll, in green plants (Z- scheme), ATP synthesis,

References

1. S. J. Lippard & J. M. Berg. *Principles of Bioorganic Chemistry*, Panima Publ. Corpn., 2005.
2. E.-I. Ochiai. *Bioinorganic Chemistry – An Introduction*, Allyn and Bacon Inc., 1977.
3. M. N. Hughes. *The Inorganic Chemistry of Biological Processes*, Wiley, 1981.
4. R.P. Hanzlik. *Inorganic Aspects of Biological and Organic Chemistry*, Academic Press, 1976.
5. K. Hussain Reddy, *Bioinorganic chemistry*, New Age International Publishers, 2007.
6. H. Kraatz& N. Metzler-Nolte, *Concepts and Models in Bioinorganic Chemistry*, Wiley, 2006.
7. I. Bertini, H. B. Gray, S. J. Dippard& J. S. Valentine, *Bioinorganic Chemistry*, Viva Books Pvt. Ltd., 2004.
8. A.W. Addison, W.R. Cullen, D. Dolphin & B.R. James, *Biological Aspects of Inorganic Chemistry*, John Wiley, 1977.
9. R.J.P. Williams & J.R.R.F. Dasilva. *New Trends in Bioinorganic Chemistry*, Academic Press, 1978.
10. A. E. Martel. *Inorganic Chemistry in Biology and Medicine*, ACS Symp. Series, ACS, 1980.
11. S. J. Lippard. *Progress in Inorganic Chemistry: Bioinorganic Chemistry*, Vol. 38, John Wiley, 1990.
12. N. Kaim& B. Schwederski. *Bioinorganic Chemistry: Inorganic Elements in the Chenistry of Life*, John Wiley, 1994.

MappingofCO withPOandPSO

CO	ProgrammeOutcomes(POs)							ProgrammeSpecificOutcomes(PSOs)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	Mean Scores ofCos
CO1	3	3	2	2	2	3	2	3	2	2	3	3	2	2	2	2.46
CO2	3	3	2	2	2	3	2	3	2	2	3	3	3	2	2	2.4
CO3	3	3	2	2	3	3	2	3	2	2	3	2	3	2	2	2.46
CO4	3	3	2	2	2	3	2	2	2	2	2	3	3	2	2	2.3
CO5	3	3	3	2	3	3	2	2	2	2	2	2	3	2	2	2.4
CO6	3	3	3	2	3	3	2	2	2	2	2	2	3	2	2	2.4
MeanOverallScore																2.4
Result																High

AssessmentPattern

Bloom'sCategory	CATests(MarksAllotment)		TermEndExam(100)MarksAllotment
	ICA (50)	IICA(50)	
Remember	10	10	20
Understand	10	10	30
Apply	10	10	20
Analyze	10	10	10
Evaluate	5	5	10
Create	5	5	10

CH550A	**Theory**	**4**	**3**	**1**	**0**
	CH550A	**Applied Chemistry**		**100**	**4**

Course Objectives:

- To inculcate the latest sophisticated analytical techniques
- To characterize the solid-state materials which found applications in day-to-day life.

Course Outcomes:

On successful completion of this Course, students will be able to

S.No	Course Outcome Statement	Knowledge level
CO1	Gain knowledge about the latest sophisticated analytical techinques	K1
CO2	Correlate the amount of calcium and magnesium in soil and water	K2
CO3	Relate and asses the applications of voltammetry	K3
CO4	Analyse the solid materials which found application in our day-to-day life	K4
CO5	Understand and analysis of the food products, food adulteration and preservation	K4 & K5
CO6	Develop innovation methods to produce soft water for industrial use and potable water at cheaper cost	K6

Course Content

Unit - I: Analysis of Redox Potentials **9 Hours**

1.1. Basic Principles of Voltammetry-Nernst Equation-Applications of Voltammetry- Applications of cathodic and anodic peak potentials and current.

1.2. Linear sweep voltammetry, differential pulse voltammetry, square-wave voltammetry, stripping methods-electrode materials, hydrodynamic effects, microelectrodes, and voltammetric sensors.

1.3 Determination redox potentials of some inorganic samples.

Unit - II: Analysis of Soil **9 Hours**

2.1. Analysis of soil: Composition of soil, Concept of pH and pH measurement,

2.2 Complexometric titrations, Chelation, Chelating agents, use of indicators

2.2. Estimation of Calcium and Magnesium ions as Calcium carbonate by complex ometrictitration. (Theory only)

Unit - III: Analysis of Water **9 Hours**

3.1. Analysis of water: Definition of pure water, sources responsible for contaminating water, water sampling methods, water purification methods.

3.2. Dissolved oxygen in water. Determination of dissolved oxygen (DO) of a water sample.

3.3 Determination of pH, acidity and alkalinity of a water sample.(Theory only)

Unit - IV: Analysis of Food Products **9 Hours**

4.1. Analysis of food products: Nutritional value of foods, idea about food processing-food preservations, Methods of food preservations and adulteration.

4.2. Identification of adulterants in some common food items like coffee powder, asafoetida, chilli powder, turmeric powder, coriander powder and pulses, etc.

4.3 Analysis of preservatives, flavorants, and colouringmatter. (Theory only)

Unit - V: Analysis using Chromatographic Techniques **9 Hours**

5.1. Chromatography: Definition, general introduction on principles of chromatography,

5.2 paper chromatography, TLC-Identification and comparison of samples using TLC method (Organic, inorganic, paints, etc.,)

5.3. Separation of compounds using Column (Neutral, acidic and basic columns), ion exchange chromatography.

References

1. H. H. Willard, L. L. Merritt, J. Dean, & F. A. Settoe, *Instrumental Methods of Analysis*. 7th Ed. Wadsworth Publishing Co. Ltd., Belmont, California, USA, 1988.
2. Douglas A. Skoog,; F. James Holler,; Stanley R. Crouch, *Principles of Instrumental Analysis*, 6thEdition;Cengage Learning, 2006.
3. D. A. Skoog, D. M. West, & F. J. Holler, *Fundamentals of Analytical Chemistry*, 6th Ed., Saunders College Publishing, Fort Worth, 1992.
4. Harris, D. C. *Quantitative Chemical Analysis*, W. H. Freeman, 2010.
5. Dean, J. A. Analytical Chemistry Notebook, 2nd edition, McGraw Hill, 2004.
6. Reuben Alexander Day,; Arthur Louis Underwood, *Quantitative Analysis*, 6thEdition;Prentice Hall India Learning Private Limited, 1992.
7. D. Freifelder, *Physical Biochemistry*, 2nd Edition, W.H. Freeman and Co., N.Y. USA, 1982.
8. T. G. Cooper, *The Tools of Biochemistry*, John Wiley and Sons, N.Y. USA, 1977.
9. Vogel, A. I. Vogel's Qualitative Inorganic Analysis 7th Ed., Prentice Hall, New Delhi, 2009.
10. Robinson, J.W. *Undergraduate Instrumental Analysis*, 5th Ed., Marcel Dekker, Inc., New York, 1995.

MappingofCO withPOandPSO

CO	ProgrammeOutcomes(POs)							ProgrammeSpecificOutcomes(PSOs)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	Mean Scores ofCOs
CO1	3	3	3	2	2	2	2	3	2	3	3	3	3	2	2	2.53
CO2	3	3	3	2	2	2	2	3	2	3	3	3	3	2	2	2.53
CO3	3	3	3	3	2	2	2	3	2	3	3	3	3	3	2	2.66
CO4	3	3	3	3	2	2	2	2	2	3	3	3	3	3	2	2.6
CO5	3	3	3	2	2	2	2	2	2	3	3	3	3	3	2	2.53
CO6	3	3	3	2	2	3	2	2	2	3	3	3	3	3	2	2.6
MeanOverallScore																2.58
Result																High

AssessmentPattern

Bloom'sCategory	CATests(MarksAllotment)		TermEndExam(100) MarksAllotment
	ICA (50)	IICA(50)	
Remember	10	10	20
Understand	10	10	30
Apply	10	10	20
Analyze	10	10	10
Evaluate	5	5	10
Create	5	5	10

CH550B	**Theory**	**4**	**3**	**1**	**0**
	CH550B	**Protein Chemistry**		**100**	**4**

Course Objectives

- To learn the chemistry of Amino acids and proteins.
- To learn the importance of enzymes and enzyme catalysis

Course Outcomes:

On successful completion of this Course, students will be able to

S.No	Course Outcome Statement	Knowledge level
CO1	Explain the general concepts of drug design and discovery	K1
CO2	Illustrate the essential concepts of SAR/QSAR	K2
CO3	Explain the different concepts of computer aided drug design	K2
CO4	Demonstrate how receptors and enzymes can act as targets for drug discovery	K3
CO5	Explain about the Chemistry if Co-Enzyme	K2

Unit - I: Introduction to Proteins **9 Hours**

1.1 Amino acids-properties and classification of 20 amino acids-Isoelectric point-titration curvepeptide bond-polypeptide-protein-N-ter and C-ter-protein sequence

1.2 Primary, secondary-Ramachandran plot-

1.3 Tertiary structure Stability of protein structure-protein folding

Unit - II: Purification of Proteins **9 Hours**

2.1 Separation of proteins-dialysis-column chromatography-ion-exchange chromatography-size-exclusion chromatography-Affinity chromatography,

2.2 Electrophoresis-Isoelectric focussing-two-dimensional electrophoresis. Determination of proteins sequence – N-terminal amino acid analysis

2.3 Sanger's Method-Edman degradation-C-terminal amino acid-carboxypeptidases

Unit - III: Enzymes **9 Hours**

3.1 Definition-classification of enzymes. Thermodynamics model for enzyme catalysis-Proximity effects-transition state stabilisation-Acid/base catalysis in enzymatic reactions-use of strain energy in enzyme catalysis-

3.2 Enzyme Kinetics-Michaelis - Menton Equation; Lineweaver–Burk plot-

3.3 Factors affecting catalytic activity of enzymes-temperature-pH-concentration. Allosteric enzymes.

Unit - IV: Chemistry of Enzyme Catalysis **9 Hours**

4.1 Mechanism of chymotrypsin (hydrolytic peptide cleavage)-catalytic triad (nucleophilic addition/hydrolysis)Lysosyme-mechanism-cleavage of peptidoglycans (S_N1/S_N2)

4.2 Mechanism of Alcohol dehydrogenase-Oxidation of alcohol (Redox reaction)

4.3 Mechanism of Class I fructose-1,6-bisphosphate aldolase (Carbon–Carbon Bond Formation).

Unit -V: Chemistry of Co-Enzymes **9 Hours**

5.1 The pyridine nucleotide coenzyme-niacin deficiency-the flavin nucleotide coenzyme.

5.2 Structure and significance of Thiamine phosphate-

5.3 Biotin-pyridoxal phosphate-tetrahydrofolate.

References

1. Lehninger, Nelson, Cox, *Biochemistry*, 6th edition, W H Freeman & Co, USA, 2013.
2. Berg, Stryer, Tymoczko, *Biochemistry*, 3rd edition, W H Freeman & Co, USA, 2015.
3. T. D. H Bugg, *Introduction to enzyme and coenzyme chemistry*, 3rd edition, Wiley-Blackwell, 2012.
4. Paula YurkanisBruice, *Organic chemistry*, 6th edition, Pearson Edition, New York, 2006.

MappingofCO withPOandPSO

CO	ProgrammeOutcomes(POs)							ProgrammeSpecificOutcomes(PSOs)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	Mean Scores ofCos
CO1	3	3	2	2	3	2	2	3	2	2	3	2	2	2	2	2.3
CO2	3	3	2	2	3	2	2	3	2	2	3	2	2	2	2	2.3
CO3	3	3	2	2	3	2	2	3	2	2	3	2	2	2	2	2.3
CO4	3	3	2	2	3	2	2	2	2	2	2	2	2	2	2	2.2
MeanOverallScore																2.3
Result																High

AssessmentPattern

Bloom'sCategory	CATests(MarksAllotment)		TermEndExam(100)MarksAllotment
	ICA (50)	IICA(50)	
Remember	10	10	20
Understand	10	10	30
Apply	10	10	20
Analyze	10	10	10
Evaluate	5	5	10
Create	5	5	10

CH550C	**Theory**	**4**	**3**	**1**	**0**
	CH550C	**Elective-II Cheminformatics**		**100**	**4**

Course Objectives

- To enable the students to understand the basics of computers
- To enable them to operate computers draw chemical structures using some chemistry software's
- To make chemical calculations using computer programs.

Course Outcomes:

On successful completion of this Course, students will be able to

S. NO	Course Outcomes Statement	Knowledge level
CO1	Describe the various methods of representing molecules in a chemical database	K1
CO2	Analyze the data available in various databases	K3
CO3	Interpret the process involving the drug designing	K2
CO4	Draw the structure of simple organic molecules and derive and write the SMILES notation and name using the softwares	K4 & K5
CO5	Built a molecule and optimising the energy using ARGUSLAB	K6
CO6	Integrate the docking of small molecules using ARGUSLAB	K5 & K6

Unit – I: Introduction to Chemoinformatics **9 Hours**

1.1 Definition of Chemoinformatics, History of chemoinformatics, Uses of Chemoinformatics

1.2 Representing the molecules: Older systems – Connection tables, Line notation – INCHI, SMILES, WLN canolications.

1.3. Line notation versus connection tables. Query languages - SMARTS. Nomenclature: IUPAC names, trade names, common names. Introduction to chemical structure file formats – 2D and 3D

Unit – II: Structure Searching **9 Hours**

2.1 2D-Fingerprints-Structural Keys – Hashed fingerprints, Exact structure searching, Substructure search, Sub similarity search

2.2 Ways to measure Similarity - 2D topology, 3D configuration. Physical properties, clustering.

2.3 Basics of computation of physical and chemical data and structure descriptors, data visualization.

Unit – III: Databases and Packages for chemists **9 Hours**

3.1 Introduction-Database concepts-**types**-chemical, proteomic, genomic and literature databases-source, content and design, applications.

3.2 Chemical databases-Chembank, ChemPDB, Combichem, NCI- Pubchem (Compounds, Substances, Bioassay), PubMed, DrugBank,ChemSpider

3.3 ChemDraw, Chem sketch, OriginLab, essential FT IR etc, kinetics. Chemistry free softwares (Argus Lab, Avogadro)

Unit IV: Introduction to drug design: 9 Hours

4.1 Target Identification and Validation; Lead Finding and Optimization;

4.2 Analysis of HTS data; Virtual Screening; Design of Combinatorial Libraries; Ligand-Based and Structure-Based Drug Design;

4.3 Application of Chemoinformatics in Drug Design

Unit V: Practicals 9 Hours

5.1 Draw the structure of simple organic molecules-derive name using the softwares-Chemdraw

5.2 Building a molecule and energy optimization using ARGUSLAB

5.3 Docking of small molecules using ARGUSLAB

Reference Books:

1. Andrew R. Leach, Valerie J. Gillet. An Introduction to Chemoinformatics, revised edition, Springer, Netherland, 2007.

2. Larsen et al (ed), Textbook of Drug Design and Discovery, 3rd edition, Taylor and Francis, London and NewYork, 2004.

3. Leach A.R, Molecular Modelling: Principles and applications, 2nd edition, Prentice Hall, New Delhi, 2001.

4. K.V. Raman, Computer Applications in Chemistry, Tata McGraw Hill, New Delhi, 2008.

5. Vikas Gupta, Computer Course Kit, Dream Tech Press, 2010

Web sources:

1. https://open-babel.readthedocs.io/en/latest/Cheminf101/index.html
2. https://open-babel.readthedocs.io/en/latest/Cheminf101/represent.html#iupac-names-trade-names-common-names
3. https://open-babel.readthedocs.io/en/latest/Cheminf101/similarity.html
4. http://insideinformatics.cambridgesoft.com/webinars/info/Default.aspx?webinarID=632
5. http://www.acdlabs.com/resources/freeware/chemsketch/
6. http://www.acdlabs.com/download/technotes/2016/technote_chemsketch_advanced.pdf
7. accelrys.com/products/pdf/**isis-draw**.pdf
8. http://www.originlab.com/doc/Tutorial
9. http://www.inflibnet.ac.in/
10. https://www.**khanacademy**.org/

Learning Outcomes:

- Describe the various methods of representing molecules in a chemical database
- Explain the fundamentals principles of the various computational methods
- Chemical calculations using computer programs and docking process were learned.

MappingofCO withPOandPSO

C O	ProgrammeOutcomes(POs)							ProgrammeSpecificOutcomes(PSOs)								
	PO1	**PO2**	**PO3**	**PO4**	**PO1**	**PO2**	**PO3**	**PSO1**	**PO1**	**PO2**	**PO3**	**PSO5**	**PO1**	**PO2**	**PO3**	**Mean Scores ofCOs**
CO1	3	3	3	CO1	3	3	3	CO1	3	3	3	CO1	3	3	3	CO1
CO2	3	3	3	CO2	3	3	3	CO2	3	3	3	CO2	3	3	3	CO2
CO3	3	3	3	CO3	3	3	3	CO3	3	3	3	CO3	3	3	3	CO3
CO4	3	3	3	CO4	3	3	3	CO4	3	3	3	CO4	3	3	3	CO4
CO5	3	3	3	CO5	3	3	3	CO5	3	3	3	CO5	3	3	3	CO5
CO6	3	3	3	CO6	3	3	3	CO6	3	3	3	CO6	3	3	3	CO6
MeanOverallScore																2.58
Result																High

AssessmentPattern

Bloom'sCategory	CATests(MarksAllotment)		TermEndExam(100)MarksAllotment
	ICA (50)	IICA(50)	
Remember	10	10	20
Understand	10	10	30
Apply	10	10	20
Analyze	10	10	10
Evaluate	5	5	10
Create	5	5	10

Course Code	Type	Total Hours: 60	Lecture: 60	Tutorial: 5	Practical: 0
CH639	Theory	Course Name: Organic Chemistry-V		Max Marks: 100	Credits: 4

Course Objectives

- Understanding the reactions of bioorganic compounds.
- Understanding photochemical reactions.
- Learning the structure and reactions of bioorganic and natural molecules.

Course Outcomes:

On successful completion of this Course, students will be able to

Sl. No.	Course Outcome Statements	Knowledge level
CO1	Identify the stereochemistry of aldoses and ketoses; relate the structure and product formation with various reagents involved with carbohydrate molecules	K1
CO2	Summarize the fundamentals of amino acids and discuss about their structural activation process	K1, K3
CO3	Discriminate various catalytic processes with suitable examples	K1
CO4	Validate the structures of representative alkaloids and terpenoids through their structural elucidation and synthesis	K2, K3
CO5	Illustrate with various natural pigments structure and their characteristic chemical reactions	K4
CO6	Integrate the concept of natural products synthetic routes in modern organic synthesis through understanding reagents role	K1, K3

Course Content

Unit 1Carbohydrates **12 Hours**

1.1 Classification of carbohydrates. D,L notation, configuration of aldoses and ketoses.Reactions of monosaccharides in basic solution, oxidation, reduction reactions.

1.2 Osazones, Chain lengthening of aldoses, shortening the chain. Stereochemistry of glucose fishcers proof.

1.3 Cyclic hemiacetals of monosaccharides. Glucose the most stable aldohexose, formation of glycosides, anomeric effect, reducing and nonreducing sugars.

1.4 Disaccharides and polysaccharides.

Unit 2Aminoacids and catalysis **12 Hours**

2.1 Amino acids classification, configuration of aminoacids, acid base properties of amino acids, isoelectric point.

2.2 Synthesis of amino acids, peptide and disulfide bonds, synthesis of peptide bonds N-protection and C-activation, determining the primary structure of proteins.

2.3 Acid catalysis, base catalysis, nucleophilic catalysis, metal ion catalysis

2.4 Intramolecular reactions and catalysis.

Unit 3Photochemistry **12 Hours**

3.1 Laws of Photochemical equivalence, primary, secondary processes, quantum yield, light induced reactions, photosensitized reactions, photolysis and flash photolysis.

3.2 Photochemical elimination reactions, Norrish I and II, Barton reaction, Photochemical reductions, photochemical oxidations.

3.3 Photochemical isomerisations, phantom triplet, photochemical rearrangements.

3.4 Photochemical cyclisations and intermolecular cycloadditions.

Unit 4Natural products I **12 Hours**

4.1 Alkaloids: isolation, determination of structure of alkaloids (functional nature, estimation of C-methyl, degradation of alkaloids.

4.2 Structural elucidationof alkaloids: Adrenaline, piperine, nicotine and cocaine.

4.3 Terpenoids: isolation, general characteristics of terpenoids, determination of structure of terpenoids and monoterpenoids or terpenes.

4.4 Structural elucidation of terpenoids: Myrcene, citral, limonene and menthol.

Unit 5Natural products II (Natural pigments) **12 Hours**

5.1 Carotenoids: isolation and separation, general properties and principal methods in elucidating the constitution of carotenoids, functions and classification of carotenoids.

5.2 Carotenes: geometrical isomerism, structural elucidation of carotenes: β-carotene, α- carotene and lycopene.

5.3 Fatty acids, waxes, fats and oils are triacylglycerols, phospholipids and spingholipids.

5.4 Chemistry of nucleic acids: Nucleosides and nucleotides, composition of nucleic acids.

Reference Books:

Text Books

1. Paula YurkanisBruice, *Organic chemistry*, 6th Edition, Prentice Hall, Illinois, 2011.
2. O. P. Agarwal, *Organic Chemistry of Natural Products Vol I & II*, Goel Publishing House, New Delhi, 2002.
3. Petr Klán, Jakob Wirz, Photochemistry of Organic Compounds: From Concepts to Practice, 1st Edition,. Wiley-Blackwell, Chichester, 2001.

Further reading

4. R.T. Morrison and R. N. Boyd, *Organic chemistry*, 6th Edition, Prentice-Hall of India, New Delhi, 2008.
5. Leroy. G. Wade, *Organic chemistry*, 6th Edition, Pearson, New York, 2005.
6. Clayden, J Greeves, N and Warren, S, *Organic Chemistry*, 2ndEdition,. Oxford University Press, New York, 2001.
7. Loudon, Marc G, *Organic Chemistry*, 6thEdition,. Oxford University Press, New York, 2016.

Outcomes

- Knowledge on bioorganic compounds.
- Ability to apply reactions and reagents to synthetic aspects of natural products.

Mapping of CO with PO and PSO

CO's	Programme Outcomes (PO)							Programme Specific Outcomes (PSO)								Mean Scores of COs
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	
CO 1	3.0	3.0	1.0	3.0	3.0	1.0	1.0	3.0	1.0	3.0	3.0	3.0	2.0	3.0	1.0	2.3
CO 2	3.0	3.0	1.0	3.0	3.0	1.0	1.0	3.0	1.0	3.0	3.0	3.0	2.0	3.0	1.0	2.3
CO 3	3.0	3.0	1.0	3.0	3.0	3.0	1.0	3.0	1.0	3.0	3.0	3.0	3.0	3.0	1.0	2.5
CO 4	3.0	3.0	1.0	3.0	3.0	3.0	1.0	3.0	1.0	3.0	3.0	3.0	2.0	3.0	3.0	2.5
CO 5	3.0	3.0	1.0	3.0	3.0	3.0	1.0	3.0	1.0	3.0	3.0	3.0	3.0	3.0	1.0	2.5
CO 6	3.0	3.0	1.0	3.0	3.0	3.0	1.0	3.0	1.0	3.0	3.0	3.0	3.0	3.0	3.0	2.6
Mean Overall Score																2.4
Result																High

Assessment Pattern

Bloom's Category	CA Tests (Marks Allotment)		Term End Exam (100) Marks Allotment
	I CA (50)	II CA (50)	
Remember	10	10	20
Understand	10	10	30
Apply	10	10	20
Analyze	10	10	10
Evaluate	5	5	10
Create	5	5	10

Course Code	Type	Total Hours: 60	Lecture: 55	Tutorial: 5	Practical: 0
CH640	Theory	Course Name: Inorganic Chemistry-IV		Max Marks: 100	Credits: 4

Course Objectives:

- To study the chemistry of coordination compounds and organometallic compounds
- To understand the chemistry of bioinorganic molecules and chemistry of solids.

Course Outcomes

On successful completion of this Course, students will be able to

S.No.	Course Outcome Statement	Cognitive Level
CO1	Using diverse theories of coordination compounds, students may acquire the fundamentals concepts of ligand types, coordination numbers, and complicated geometries.	K1, K2
CO2	Students can differentiate between low spin and high spin complexes, as well as analyze the applications of spectrochemical series, Jahn-Teller distortion, and Trans effect	K3, K4
CO3	Students can learn about the various organometallic compounds and their synthetic applications such as Wilkinson catalyst and Fischer-Tropsch reaction	K2, K3
CO4	Students will be able to comprehend the significance of nitrogen fixation and cycle, as well as the structure and functions of porphyrin ring systems and metelloenzyme biochemistry.	K3, K4
CO5	In solid states, students can describe the fundamental crystal systems and their symmetries.	K4, K5
CO6	To get a better understanding of the structural and chemical characteristics of organometallics, which serve as a link between inorganic and organic chemistry.	K1, K4

Course Content

Unit-1 Coordination Compounds I **12 hours**

1.1 Double salts and coordination compounds. Werner's work: primary and secondary valencies.
1.2 Sidgwick's theory and Pauling's theory Effective atomic numbers (EAN).
1.3 Classification of ligands. IUPAC nomenclature of coordination compounds. Chelates and their uses-stereochemistry of complexes.
1.4 Isomerism: Ionization, hydrate, ligand, linkage, coordination, position, geometrical and optical. Methods of detecting complex formation-conductivity and precipitation studies.

Unit-2 Coordination Compounds II **12 hours**

2.1 Valence bond theory- hybridization-geometry and magnetic properties-demerits of VBT.
2.2 Crystal field theory- crystal field splitting in octahedral, tetragonal, square planar and tetrahedral complexes- CFSE calculation of octahedral complexes.

2.3 Low spin and high spin complexes, spectrochemical series, and explanation of magnetic properties, colour and geometry using CFT. Jahn Teller distortion and *trans* effect.
2.4 Labile and inert complexes, thermodynamic stability, kinetic stability, factors affecting the stability of complexes.

Unit-3 Organometallic compounds **12 hours**

3.1 Metal carbonyls: 18 electron rule, mono and binuclear carbonyls of Ni, Fe, Co and Mn-preparation, structure, chemical properties and uses.
3.2 Structure and bonding in π-metal alkenyl, alkynyl and cyclopentadienyl complexes. Olefin organometallics: preparation and uses. Allyl organometallics: preparation and uses.
3.3 Cyclopentadienyl organometallics: preparation and reactions.
3.4 Synthetic applications of organometallic compounds as homogenous catalyst- Wilkinson catalyst, Fischer-Tropsch reaction.

Unit-4: Bioinorganic Chemistry

4.1 Porphyrin ring systems: cytochromes, structure and functions of Haemoglobin and Myoglobin.
4.2 Chlorophyll: structure, functions and Photosynthesis. Structure and functions of Vitamin B_{12}.
4.3 Biochemistry of Iron. Metalloenzymes- Carboxypeptidase and Carbonic anhydrase.
4.4 Biological fixation of Nitrogen and Nitrogen cycle.

Unit-5 Chemistry of solids

5.1 Crystalline and amorphous solids-Definition and differences. Symmetry in solid crystals-Basic crystal systems with example to each system.
5.2 Structure of solids- close packing of spheres- Primitive cube-BCC-FCC- Radius ratio rule.
5.3 Types of crystals-ionic-covalent-metallic and molecular crystal with one example. and shape of ionic crystals (AB= NaCl, AB_2 = CaF_2).
5.4 Defects in solids-stoichiometric defects (Schottky, Frenkel) and nonstoichiometric defects (metal excess and metal deficiency).

Learning Outcomes

- Explain the basics and advance concepts of coordination compounds
- Explain the bonding and isomerism in coordination compounds
- Outline the different organometallic compounds and explain their synthetic applications.
- Explain the basics of bioinorganic chemistry and solid states

References

(Text Book)

1. R. D. Madan, *Modern Inorganic Chemistry,* Second edition, S. Chand publications, New Delhi, 2000.
2. B. R. Puri, L. R. Sharma and K. C. Kalia, *Principles of Inorganic Chemistry*, 33rd Edition, Vishal Publishing Co, Jalandar, 2004.
3. 1. J. D. Lee, *Concise Inorganic Chemistry*, Chapman and Hall: London, 1961.
4. R. Gopalan and V. Ramalingam, *Concise Coordination Chemistry*, First Edition, S.Chand (G/L) & Company, 2001

(Advanced Reading)

1. C. Chambers and A. K. Holliday, *Modern Inorganic Chemistry*, First edition, Butterworth and Co., Sussex, 1975.
2. Gary L Miessler and Donald A. Tarr, *Inorganic Chemistry*, Third edition, Pearson Prentice Hall.
3. A. G. Sharpe and C. E. Housecraft, *Inorganic Chemistry* Vol-I, 3rd edition, Pearson prentice Hall, New York, 2008.
4. G. A. Lawrence, *Introduction to Coordination Chemistry*, Wiley, 2009
5. F. A. Cotton and G. Wilkinson,Advanced Inorganic Chemistry, Fourth Edition. Wiley-Interscience Publication, US, 1980.

Mapping of CO with PO and PSO

CO	Programme Specific Outcomes (PSO)								Programme Outcomes (PO)							Mean Scores of Cos
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PO1	PO2	PO3	PSO4	PO5	PO6	PO7	
1	3	3	3	3	2	3	3	3	3	3	2	3	3	3	2	2.8
2	3	3	3	3	3	3	3	3	3	3	2	3	3	3	2	2.9
3	3	3	3	3	3	3	3	3	3	3	1	3	3	3	2	2.8
4	3	3	3	3	3	3	2	3	3	3	3	3	3	3	2	2.9
5	3	3	3	3	2	3	3	3	3	3	2	3	3	3	2	2.8
6	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2.9
Mean Overall Score																2.8
Result																**High**

Assessment Pattern

Bloom's Category	CA Tests (Marks Allotment)		Term End Exam (100) Marks Allotment
	I CA (50)	II CA (50)	
Remember	10	10	20
Understand	10	10	30
Apply	10	10	20
Analyze	10	10	10
Evaluate	5	5	10
Create	5	5	10

Course Code	Type	Total Hours: 60	Lecture: 55	Tutorial: 5	Practical: 0
CH641	Theory	Course Name: Physical Chemistry-IV		Max Marks: 100	Credits: 4

Course Objectives

- To know the fundamentals theories that govern the electrolytic conductance in solids and solutions and apply them to solve problems related to it.
- To learn about the acids and base equilibria
- To know about the different types of electrochemical cells and their importance

Course Outcomes:

On successful completion of this Course, students will be able to

S.No.	Course Outcome Statement	Knowledge level
CO1	Illustrate the concepts of conductance, their measurement and their applications	K1
CO2	Enumerate the applications of ionic equilibria like buffer, hydrolysis of salts	K2
CO3	Illustrate the foundations of electrochemistry, the reactions of a cell and different electrodes	K2 & K3
CO4	Apply Nernst equation and also demonstrate the applications of electrochemical series.	K4
CO5	Demonstrate the applications of electrochemistry like Fuel cells	K5

Unit - I: Ionic Equilibria -I **12 Hours**

1.1 Electrolytic conduction: conductor – non-conductor – types of conductors-Electrolytic and metallic conductors.

1.2 Specific conductance, equivalent conductance and molar conductance – measurement of these quantities Variation of equivalent conductance with dilution.

1.3 Arrhenius theory of Ionization (and Limitations of the theory)-Factors governing degree of dissociation of an electrolyte-Ostwald Dilution Law*-(Limitation of Ostwald's Law-Factors that explain the failure of Ostwald's law in case of strong electrolytes) -

1.4 Kohlraush's law and its applications. Debye Huckel theory of strong electrolytes – Onsagar equation (No derivation) significance and limitations.

Unit - II: Ionic Equilibria -II **12 Hours**

2.1 Migration of ions –ionic mobility and its determination. Transport number and its determination by Hittorf and moving boundary methods.

2.2 Applications of conductance measurements: Determination of degree of dissociation of weak electrolytes, ionic product of water, solubility of sparingly soluble salts.

2.3 Conduct metric titrations: Strong acid – strong base, weak acid – strong base, Strong acid – weak base, mixture of strong acid and weak acid – strong base, Precipitation titration.

2.4 pH and pOH: Definition and explanation. Calculation of weak acids and base

Unit - III: Ionic Equilibria-III **12 Hours**

3.1 Buffer solutions: definition and examples- Explanation of buffer action of acid buffer and basic buffer – Henderson - Hasselbalch equation.

3.2 Solubility product and its relationship to solubility. Application in qualitative analysis
3.3 Common ion effect – applications in analysis.
3.4 Hydrolysis of salts: Expression for hydrolysis constants, degree of hydrolysis and pH of salt solution, strong acid and weak base, weak acid strong base, weak acid and weak base.

Unit - IV: Electromotive Forces **12 Hours**

4.1 Electromotive force: Galvanic cells – reversible and irreversible cells Daniel cell – EMF of the cell and its determination by potentiometric method. Standard cell (Weston cadmium cell).
4.2 Reversible electrodes –representation, construction and reaction of metal –metal ion electrode, gas electrode (hydrogen, oxygen, chlorine), calomel electrode, single electrode potential and its determination.
4.3 Derivation of Nernst equation for EMF of the cell and single electrode potential. Standard electrode potential, sign and convention.
4.4 Electrochemical series and its significance. Derivation of relationship between thermodynamic quantities ΔG, ΔH, ΔS, and cell EMF.

Unit - V: Applications of EMF **12 Hours**

5.1 Chemical cell with and without transport. Concentration cells with and without transport. Expressions for EMF-Liquid junction potential
5.2 Application of EMF measurements: Determination of activity coefficient, transport number, valence of doubtful ions, solubility of sparingly soluble salts and equilibrium constant.
5.3 Determination of P^H using hydrogen electrode, quinhydrone electrode and glass electrode. Potentiometric titrations. (Acid base titration, precipitation titration and redox titration).
5.4 Fuel cells. Storage cells- Lead storage battery and Lithium-ion battery Li polymer battery.

Text Books:

1. B. R. Puri, L. R. Sharma and M. S. Pathania, *Principles of Physical Chemistry*, 47th Edition, Vishal Publishing Co, Jalandar, 2016.
2. R.L. Madan, *Physical Chemistry*, Mc Graw Hill Education Pvt. Ltd. 2015.

Reference:

1. Arun Bahl, B.S. Bahl. G.D.Tuli, Essentials of Physical Chemistry, S. Chand Publications
2. A.S. Negi and S.C. Anand, *A text book of Physical Chemistry*, Wiley Eastern Ltd, New Delhi, 1984.

Learning Outcome

- Discuss the fundamental and important aspects of chemical and ionic equilibrium
- Predict the electrochemical properties of a cell reaction.

Mapping of CO with PO and PSO

CO	Programme Outcomes (POs)							Programme Specific Outcomes (PSOs)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	Mean Scores of COs
CO1	3	2	1	2	3	2	1	3	3	2	3	3	3	1	2	2.3
CO2	3	2	1	2	3	2	1	2	2	2	3	3	3	1	3	2.2
CO3	3	2	1	2	3	2	1	2	3	2	3	2	3	1	2	2.1
CO4	3	2	1	2	3	2	1	2	2	2	2	2	3	2	2	2.1
CO5	3	3	1	3	3	3	1	2	2	2	2	2	3	2	3	2.3
Mean Overall Score																2.2
Result																High

Assessment Pattern

Bloom's Category	CA Tests (Marks Allotment)		Term End Exam (100) Marks Allotment
	I CA (50)	II CA (50)	
Remember	10	10	20
Understand	10	10	30
Apply	10	10	20
Analyze	10	10	10
Evaluate	5	5	10
Create	5	5	10

Subject Skill

CH642A	**Theory**	**4**	**3**	**1**	**0**
	CH642A	**Polymer Chemistry**		**100**	**4**

Course Objectives

- To understand the mechanism of polymerization, various techniques of polymerization
- To learn about the characterization of polymers by molecular weight, reactions and degradation of polymers.
- To learn the applications and appreciate the recent developments of polymers.

Course Outcomes:

- On successful completion of this Course, students will be able to

S.NO	COURSE OUTCOME	Knowledge level
CO-I	Students will Understand about the basics of polymer and the differences between crystalline melting temperature and glass transition temperature, as well as the effect of kinetics on both.	K1
CO-II	Students will develop specific skills, competencies, and thought processes sufficient to support further study or work in this field of Polymer Chemistry.	K1, K3
CO-III	Students will be able to evaluate the effect of factors such as polymer structure, molecular weight, branching and diluents on crystallinity.	K1
CO-IV	Students will also able to about the mechanical properties and applications of polymers.	K2, K3
CO-V	Understand basic aspects of the solution properties of polymers, interactions and the relationship to chemical structure, including phase behaviour and the measurement of molecular weight.	K4

Course Content

Semester - VI **Polymer Chemistry** **5 Hrs/week (4 Credits)**

Unit - I: Introduction to Polymers and Mechanism of Polymerization **15 Hours**

1.1 Polymer: introduction, classification of polymers: natural, synthetic, organic, inorganic, elastomers, fibers, resins, and plastics: thermoplastic and thermosetting.
1.2 Copolymers and its types. Types of Polymerisation methods
1.3 Addition- radical and ionic polymerization, Coordination polymerization.
1.4 Step polymerization-poly condensation, poly addition and ring opening.
1.5 Miscellaneous polymerization reactions: electrochemical, metathetical,

Unit - II: Molecular Weight, Structure and Properties of Polymers **15 Hours**

2.1 Molecular weight of polymers: number average, weight average, sedimentation and viscosity average molecular weight, degree of polymerization and practical significance of polymer molecular weight with problem solving
2.2 Molecular weight determination methods: ultracentrifugation and viscometry.
2.3 Physical properties of Polymers: Mechanical properties (Impact resistance, Tensile strength and Melt viscocity)-Tacticity- nature of chain packing-Chain flexibility.
2.4 Glass transition temperature-Factors affecting Tg- Molecular weight and Tg-Plasticisers and Tg-Importances of Tg.
2.5 Reactions-Hydrolysis, Hydrogenation, addition, substitution, cross linking, vulcanization and cyclisation.

Unit - III: Polymerisation Techniques and Polymer Processing **15 Hours**

3.1 Polymerisation techniques: Bulk, solution, suspension and emulsion polymerization –melt polycondensation.
3.2 Polymer processing- Calendaring -Casting methods: Die casting, rotational casting and Film casting.
3.3 Moulding techniques-Compression, Injection, Blow and Extrusion Moulding.
3.4 Thermoforming-Foaming- Reinforcing (hand Lay-up, Filament winding and Spray-up Techniques).
3.5 Fibre spinning methods: (Melt spinning-Dry spinning and Wet spinning)

Unit - IV: Commercial Polymers **15 Hours**

4.1 Preparation, properties and uses of the following: Polyethylene, Polystyrene, TEFLON and PVC.
4.2 Preparation, properties and uses of the following: -Polyesters, Polyamides, Polycarbonates Polyurethanes, Polypropylene Glycols (PPG).
4.3 Preparation of Epoxy resins, Styrene butyl rubber, Rayon and Carboxy Methyl cellulose.
4.4 Polymer additives: Fillers (Wood, Flour, Asbestos, Graphite and Mica), Plasticizers (Tricresyl phosphate, Dimethyl Phthalate and Camphor)- Structure and uses
4.5 Fire Retardants - Pyro Check 68PB and Halogen free fire retarding plastics and Colourants.

Unit -V: Introduction to Recent Trends in Polymer **15 Hours**

5.1 Biodegradable polymers: Polyhydroxyalkonates (Biodegradation and application), Poly Lactic acid (synthesis and application), Aliphatic and aromatic polyesters (Degradation)-.
5.2 Conducting Polymers: Ionic conduction in solid electrolyte systems, Electronic conducting materials in non – conducting polymers
5.3 Electronically conducting polymer - Poly sulphur nitride, Polyacetylene and Poly phenylene.
5.4 Polymers as Biomaterials: artificial heart, artificial skin, contact lenses, Artificial kidneys.
5.5 Inorganic Polymers: Preparation and properties of Silicones, Phosphonitriles.

References

1. F.W. Bill Meyer, *Text Book of polymer science*, Wiley & Sons, 1984.
2. Gowariker. V.R. Viswanathan, N.V. Jayader Sreedhar. *Polymer*, Wiley Eastern Ltd., New Delhi, 1978.
3. B.K. Sharma, *Polymer Chemistry*, Goel Publishing house, Meerut, 1989.
4. Polymer Chemistry by M.K. Mishra, New Age Publications, New Delhi.
5. M.G.Arora, M.S.Vadar, *Polymer Chemistry*. Anmol publication (p) Ltd., New Delhi, 1989.
6. Jagadamba Singh and R.C.Dubey, *Organic Polymer chemistry*- Pragati Publishers Meerut, 2012.

MappingofCO withPOandPSO

CO	ProgrammeOutcomes(POs)							ProgrammeSpecificOutcomes(PSOs)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	Mean Scores ofCOs
CO1	3	3	3	2	2	2	2	3	2	3	3	2	3	2	2	2.46
CO2	3	3	3	2	2	2	2	3	2	3	3	2	3	2	2	2.46
CO3	3	3	3	2	2	2	2	3	2	3	3	2	3	2	2	2.46
CO4	3	3	3	2	2	2	2	2	2	3	2	2	3	3	2	2.46
CO5	3	3	3	2	2	2	2	2	2	2	2	2	3	3	2	2.4
CO6	3	3	3	2	2	2	2	2	2	2	2	2	3	3	2	2.4
MeanOverallScore																2.46
Result																High

Assessment Pattern

Bloom's Category	CA Tests (Marks Allotment)		Term End Exam (100) Marks Allotment
	I CA (50)	II CA (50)	
Remember	10	10	20
Understand	10	10	30
Apply	10	10	20
Analyze	10	10	10
Evaluate	5	5	10
Create	5	5	10

CH642B	**Theory**	**4**	**3**	**1**	**0**
	CH642B	**Industrial and Environment Chemistry**		**100**	**4**

Course Objectives:

- To introduce the students about industrial extraction processes.
- The pollution induced by the industrial development and the care towards the environment is focused.

Course Outcomes:

- On successful completion of this Course, students will be able to

S.No	COURSE OUTCOME	Knowledge level
CO1	Students will Understand about the basics of polymer and the differences between crystalline melting temperature and glass transition temperature, as well as the effect of kinetics on both.	K1
CO2	Students will develop specific skills, competencies, and thought processes sufficient to support further study or work in this field of Polymer Chemistry.	K1, K3
CO3	Students will be able to evaluate the effect of factors such as polymer structure, molecular weight, branching and diluents on crystallinity.	K1
CO4	Students will also able to about the mechanical properties and applications of polymers.	K2, K3
CO5	Understand basic aspects of the solution properties of polymers, interactions and the relationship to chemical structure, including phase behaviour and the measurement of molecular weight.	K4
CO6		K1, K3

Course Content

Unit - I: Chemical Technology **15 Hours**

1.1. Basic principles of distillation, solvent extraction, methods of leaching separation by absorption and adsorption.

1.2. An introduction into the scope of different types of equipment needed in chemical technology, including chemical reactors, distillation columns, extruders, pumps, mills,

1.3. Scaling up operations in chemical industry. Problems involving the scaling up of the process. Scale up and process development-Scale up and modeling

1.4. Introduction to clean technology for speciality chemicals-economic, environment and safety needs. Clean technology route to waste management

Unit - II: Industrial Metallurgy **15 Hours**

2.1. General Principles of Metallurgy
2.2. Hydrometallurgy, Methods of purification of metals - Al, Pb, Ti, Fe, Cu, Ni, Zn.
2.3 Refining of metal - electrolytic, oxidative refining, Kroll process, Parting process, van Arkel-de Boer process and Mond's process.
2.4 Ultrapure metals for semiconductor technology and their applications.
2.5. Alloys - Composition and its importance.

Unit - III: Eco systems and Air Pollution **15 Hours**

3.1. Ecosystems. Biogeochemical cycles of carbon, nitrogen and sulphur.
3.2. Air Pollution: Major regions of atmosphere. Chemical and photochemical reactions in atmosphere. Air pollutants: types, sources, particulate size and chemical nature;
3.3 Photochemical smog: its constituents and photochemistry. Environmental effects of ozone, Major sources of air pollution.
3.4. Pollution by SO_2, CO_2, CO, NO_x, H_2S and other foul smelling gases. Effects of air pollution on living organisms and vegetation.
3.5. Greenhouse effect and Global warming, Ozone depletion by oxides of nitrogen, chlorofluorocarbons and Halogens, removal of sulphur from coal.

Unit - IV: Aquatic Ecosystems and Purification Systems **15 Hours**

4.1. Water Pollution: Hydrological cycle, water resources, aquatic ecosystems, Sources and nature of water pollutants, Techniques for measuring water pollution, Impacts of water pollution on hydrological and ecosystems.
4.2. Water purification methods. Effluent treatment plants (primary, secondary and tertiary treatment).
4.3 Industrial effluents from the following industries and their treatment: electroplating, textile, tannery.
4.4. Industrial waste management, incineration of waste. Water treatment and purification (reverse osmosis, electro dialysis, ion exchange).
4.5. Water quality parameters for waste water, industrial water and domestic water.

Unit - V: Energy & Environment **15 Hours**

5.1. Classification renewable and non-renewable. Sources of energy: Coal, petrol and natural gas. Uses and its impact on environment.
5.2. Nuclear Fusion/Fission. Process, its uses and its environmental impacts to aquatic life.
5.3. Nuclear Pollution: Disposal of nuclear waste, nuclear disaster and its management.
5.4. Clean energy: Solar energy, Wind Energy, Hydrogen, geothermal, Tidal and Hydraulic energy, etc.
5.5. Fuel cells, bio mass, biogas preparation and its environmental impacts

Books for Reference

1. E. Stocchi: *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK. 1990.
2. R.M. Felder, R.W. Rousseau: *Elementary Principles of Chemical Processes*, Wiley Publishers, New Delhi, 2015
3. K. De, *Environmental Chemistry*, New Age International Pvt., Ltd, New Delhi, 2006
4. S. M. Khopkar, *Environmental Pollution Analysis*: Wiley Eastern Ltd, New Delhi, 2007
5. W. Hoyle, *Clean Technology for the Manufacture of Speciality Chemicals*,Royal Society of Chemistry, Manchester, UK, 2001

MappingofCO withPOandPSO

CO	ProgrammeOutcomes(POs)							ProgrammeSpecificOutcomes(PSOs)								
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**Mean Scores ofCos**
CO1	3	3	3	2	2	2	2	3	2	3	3	3	3	2	2	2.53
CO2	3	3	3	3	2	2	2	3	2	3	3	3	3	2	2	2.6
CO3	3	3	3	2	2	2	2	3	2	3	3	3	3	2	2	2.53
CO4	3	3	3	2	2	2	2	2	2	3	2	3	3	2	2	2.4
CO5	3	3	3	2	2	2	2	2	2	3	2	3	3	3	2	2.46
CO6	3	3	3	2	2	2	2	2	2	3	2	3	3	2	2	2.4
MeanOverallScore																2.47
Result																High

Assessment Pattern

Bloom's Category	CA Tests (Marks Allotment)		Term End Exam (100) Marks Allotment
	I CA (50)	II CA (50)	
Remember	10	10	20
Understand	10	10	30
Apply	10	10	20
Analyze	10	10	10
Evaluate	5	5	10
Create	5	5	10

Semester -VI **Green Chemistry** **5 Hrs / week (4 Credits)**

CH642C	**Theory**	**4**	**3**	**1**	**0**
	CH642C	**Green Chemistry**		**100**	**4**

Course Objectives

- To understand the environmental concern and shrinking resources
- To learn the environmentally friendly products and procedure.
- To take a natural view of different chemical processes

Course Outcomes:

- On successful completion of this Course, students will be able to

S.No	Course Outcome Statement	Knowledge level
CO1	Gain knowledge about the environmentally friendly products and procedure.	K1
CO2	Appraising Micro Wave and Ultra sound assist organic synthesis	K1, K3
CO3	Relate and asses the applications of green synthesis.Comparison of heterogeneous and homogenous catalysisand photo catalysis	K1
CO4	Analyse the organic compounds which found in application green synthesis	K2, K3
CO5	Understand the environmental concern and shrinking resources	K4
CO6	Designing next generation agrochemicals from natures, using green reagents and bio catalyst.	K1, K3

Course Content

Unit - I: Introduction to Green Chemistry **15 Hours**

1.1 Introduction to Green chemistry- What is Green chemistry- Need for green chemistry

1.2 Explanation of the twelve Principles of green chemistry

1.3 Planning a green synthesis in a chemical laboratory- percentage atom utilization, evaluating the type of the reaction involved, selection of appropriate solvent, starting materials, use of protecting group, catalyst, microwaves and sonication

1.4 Atom economy- synthesis of Ibuprofen. Solvent free reactions- scope, utility of solvent free conditions and controlling solvent free reactions.

Unit - II: Green Synthesis - I **15 hours**

2.1 Organic synthesis in water as Green solvents-pericyclic reaction, Claisen rearrangement, wittig-horner reaction, Aldol condensation, pinacol coupling

2.2 Oxidation, Reduction, Electrochemical synthesis, Carbon- carbon bond formation in aqueous medium (H_20)

2.3 Organic synthesis in supercritical carbon dioxide(SC- CO_2)- properties, phase diagram, as dry cleaning, solvent for organic reaction, asymmetric catalyst, SC polymerization, free radical bromination, Kolbe schmitt reaction

2.4 Hydroformylation, hydrogenation, oxidation, coupling reaction, photochemical reaction and biotransformation in SC- CO2. Formation of silica nano particles using SC- CO2.

Unit - III: Green Synthesis - II **15 Hours**

3.1 Green synthesis – compounds like adipic acid, alcohols, cyclohexane oxime, progesterone, paracetamol and polyaspartates

3.2 Using Green catalysts – Phase Transfer catalyst- mechanism, types, advantages and applications. Cobalt carbonyl catalysed carbonylation, esterification by PTC.

3.3 Comparison of heterogeneous and homogenous catalysis, bio catalysis, asymmetric and photo catalysis. Photolysis of benzophenone, olefins, free radicals and Barton reactions

3.4 Dye removal- Chemical methods- oxidative processes using fentons reagent, NaOCl and Electrochemicalprocess. Physical methods and Biological treatments

Unit - IV: Green Synthesis - III **15 Hours**

4.1 Microwave assisted organic synthesis- Hydrolysis of benzyl chlorides, benzamide, benzoic acid and N-phenyl benzamide. Oxidation of toluene, Coupling of amines with halides and Heterocyclisation

4.2 Ultrasound assisted organic synthesis- Instrumentation, types of sonochemical reactions- organometallic reactions, saponification and alkylation. Sonolysis of Fe(CO)5.

4.3 Organic synthesis using polymer supported catalysts- photosensitizers, metalloporphyrin, super acid catalyst and crown ethers

4.4 Organic synthesis using Ionic liquids and solids- Knoevenagel reactions, Michael reactions, Wittig reactions and Grignard reaction

Unit - V: Future of Green Chemistry **15 Hours**

5.1 Future trends in green chemistry-designing next generation agrochemicals from natures- biopesticides approach, classical, innundative approach and its limitation of biological control.

5.2 Source of biorational pesticides- allelopathy and microbials. Botanicals as source of agrochemicals. Isolation and identification of the natural products

5.3 Organic synthesis using green reagents- ozone, H2O2, dioxiranes, peroxy acids, dimethylcarbonates and polymer supported reagents.

5.4 Organic synthesis using biocatalysts- biochemical oxidation, biochemical reduction and enzymes catalysed hydrolytic processes

References

1. V. K. Ahluwalia, A textbook *Green chemistry,* published by N. K. Mehra, Narosa Publishers., 2013
2. Rashmi sanghi& M M Srivastava, *Green chemistry, Environmental friendly alternatives,* Alpha Science International, 2003
3. M. A. Ryan &Tinnesand, *Introduction to Green chemistry,* Amerian chemical society, Washington, 2002.
4. A. S. Matlack, *Introduction to Green Chemistry,* MercelDeckkar, 2001.
5. M. C. Cann& M. E. Connely, *Real world in green chemistry,* ASC, Washington, 2000.
6. P. T. Anastas& J. K. Warners, *Green chemistry- Theory and practical,* Oxford University press, 1998.
7. V.K Ahluwalia, *Green chemistry, Environmentally benign reactions,* 2009

MappingofCO withPOandPSO

CO	ProgrammeOutcomes(POs)							ProgrammeSpecificOutcomes(PSOs)								
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**Mean Scores ofCOs**
CO1	3	3	3	2	2	2	2	3	2	3	3	3	3	2	2	2.53
CO2	3	3	3	2	2	2	2	3	2	3	3	3	3	2	2	2.53
CO3	3	3	3	3	2	2	2	3	2	3	3	3	3	3	2	2.66
CO4	3	3	3	3	2	2	2	2	2	3	3	3	3	3	2	2.6
CO5	3	3	3	2	2	2	2	2	2	3	3	3	3	3	2	2.53
CO6	3	3	3	2	2	3	2	2	2	3	3	3	3	3	2	2.6
MeanOverallScore																2.58
Result																High

Assessment Pattern

Bloom's Category	CA Tests (Marks Allotment)		Term End Exam (100) Marks Allotment
	I CA (50)	II CA (50)	
Remember	10	10	20
Understand	10	10	30
Apply	10	10	20
Analyze	10	10	10
Evaluate	5	5	10
Create	5	5	10

CH642D	**Theory**	**4**	**3**	**1**	**0**
	CH642D	**Materials Chemistry**		**100**	**4**

Course Objectives

- To understand the basic concepts of crystal structures and their characterization
- To learn about different properties of solid state materials and their characteristic structural features

Course Outcomes:

- On successful completion of this Course, students will be able to

S.No	Course Outcome Statement	Knowledge level
CO1	Explain and rationalise chemical bonding in the solid state and how structure affects the properties of materials.	K1
CO2	Understand basic crystallographic and crystal chemical concepts such as unit cells, Bravais lattices and apply the Bragg's equation.	K1, K3
CO3	Elucidate and contemplate the physical properties of a range of functional materials including superconductors, semi-conductors, ferroelectric and piezoelectric materials	K1
CO4	Synthesis and analyse of nanomaterials by gas phase and chemical methods.	K2, K3
CO5	Analyse and understand the size relationships of chemistry of nanomaterials properties and its applications.	K4
CO6	Evaluate the properties of nanomaterials based on quantum size effect and physical properties and to relate the uses	K1, K3
CO7	Formulate and validate the chemicalandcatalyticaspects of nanostructured adsorbent materials.	K5

Course Content

Unit - I: Solid State **15 Hours**

1.1 Structure of solids- close packing of spheres- Primitive cube-BCC-FCC- structure type AX-NaCl.
1.2 Types of cubic systems- simple, BCC and FCC.
1.3 Metallic Bond-Electron gas and band theories.
1.4 Defects in solids-stoichiometric and non-stoichiometric defects.
1.5 X-ray Diffraction-Principle-Bragg's equation.

Unit - II: Analysis of Solid States **15 Hours**

2.1 Neutron diffraction – Principle-Comparison of X-ray and Neutron Diffraction.
2.2 Structure of AX_2-CaF_2, Rutile, CdI_2, nickel arsenide
2.3 Structure of perovskite and spinels
2.4 Electrical, Magnetic and optical properties of solids, semiconductors, superconductors,
2.5 Solid-state Electrolytes-Semiconductors and Super conductors - BCS theory

Unit - III: Magnetic Properties **15 Hours**

3.1 Magnetic dipole moment- Magnetization-magnetic flux density-magnetic permeability, susceptibility.
3.2 Types of magnetic behavior: Dia, para, ferro, antiferro and ferrrimagnetism: Hysterisis.
3.3 Pyroelectricity-piezo electricity- relationship between ferro, piezo and pyroelectricity.
3.4 Reactions of solid state and phase transitions, Diffusion, Diffusion coefficient, Diffusion mechanisms, Vacancy and interstitial diffusion, Formation of Spinel's.
3.5 Solid state lasers, inorganic phosphors, Ferrites, Garnets.

Unit - IV: Nanomaterials **15 Hours**

4.1 Nanomaterials-Size dependent properties- melting points, magnetism, colors, conductivity-applications of nanometals-colors-catalysis, electronics
4.2 Synthesis of nanometals-gasphase and chemical synthesis.
4.3 Semiconductor nanocrystals, quantum dot conductors, syntheses-CdTe, CdS-spherical and triangular nanocrystals.
4.4 Introduction-topical areas-pharmacy, therapeutic drugs, ceramics, insulators, metals, environmental chemistry, catalysts, polymers, paints, batteries.
4.5 Size relationships of chemistry, nanoparticles and condensed matter-classification of nanomaterials.

Unit - V: Nanocrystals **15 Hours**

5.1 Ceramic nanocrystals-synthesis-physical methods-vapor condensation, spray pyrolysis
5.2 Chemical methods-sol-gel technique, reverse micro emulsions/micelles method, Mechano-chemical synthesis
5.3 Chemical and physical properties. Chemical and catalytic aspects of nanocrystals
5.4 Catalytic properties of metals-metal oxides, sulfides and halides,
5.5 Nanostructured adsorbents-nanoparticles as new chemical reagents.

References

1. A. R.West, *Basic Solid state chemistry*, John Wiley, 1991.
2. W. E.Addison, *Structural Principle in inorganic chemistry*, Longman, 1961.
3. D.M. Adams, *Inorganic solids*, John Wiley Sons, 1974.
4. C. N. R. Rao, *Advances in Solid State Chemistry*, Cambridge University Press, 1997
5. Guozhong Cao, *Nanostructures & Nanomaterials Synthesis, Properties & Applications*, Imperial College Press, 2004
6. T.Pradeep, *Nano: The Essentials*, Mcgraw-Hill Professional, 2008.
7. V.Rajendran Materials Science, McGraw Hill Education, 2011.
8. M.Arumugam, Materials Science, Anuradha Publications, Chennai, 2016.

MappingofCO withPOandPSO

CO	ProgrammeOutcomes(POs)							ProgrammeSpecificOutcomes(PSOs)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	Mean Scores ofCOs
CO1	3	3	3	2	2	2	2	3	2	3	3	3	3	2	2	2.53
CO2	3	3	3	2	2	2	2	3	3	3	3	3	3	2	2	2.6
CO3	3	3	3	2	2	2	2	3	2	3	3	3	3	2	2	2.53
CO4	3	3	3	3	2	2	2	2	2	3	2	3	3	3	2	2.66
CO5	3	3	3	3	2	2	2	2	2	3	2	3	3	3	2	2.53
CO6	3	3	3	3	2	2	2	2	2	3	2	3	3	3	2	2.53
CO7	3	3	3	3	2	3	2	2	2	3	2	3	3	3	2	2.6
MeanOverallScore																2.20
Result																High

Assessment Pattern

Bloom's Category	CA Tests (Marks Allotment)		Term End Exam (100) Marks Allotment
	I CA (50)	II CA (50)	
Remember	10	10	20
Understand	10	10	30
Apply	10	10	20
Analyze	10	10	10
Evaluate	5	5	10
Create	5	5	10

CH642E	**Theory**	**4**	**3**	**1**	**0**
	CH642E	**Water Chemistry and Inorganic Materials of Industrial Importance**		**100**	**4**

Course Objectives

- To learn the principles of Water Chemistry and industrial water treatment process
- To understand the principles and properties of Inorganic materials of Industrial importance.
- To study the significance and its applications of Inorganic materials of Industrial importance.

Course Outcomes:

- On successful completion of this Course, students will be able to

S.NO.	COURSE OUTCOME	Knowledge level
CO1	Identify the water quality parameters learn to calculate them	K1
CO2	Describe the various processes involved in water treatment and compare them	K1, K3

CO3	Understand the fundamental processes involved in glass manufacture and apply them for practical applications	K1
CO4	Differentiate the types of silicates and ceramics and classify them	K2, K3
CO5	Explain and analyse the forms of cement and fertilizers available and formulate their uses	K4
CO6	Understand the various types of coatings available and learn to apply them	K1, K3

Course Content

Unit - I: Water Chemistry-I **15 Hours**

1.1 Introduction- Origins and scope of water chemistry- Physico-chemical Characteristics of Natural Waters- water quality- Organic load- Chemical parameters governing water quality-

1.2 Classification of water quality- Examples of surface water quality in India Waters of Hydration-Hydrogen Bonding-Free and clustered water.

1.3 Common concentration units used in water analysis- chemical concentration units- Interconversion among common and chemical concentration units- Alkalinity and Hardness

1.4 Properties of Water at High Temperatures and Pressures- Thermo physical and thermochemical-Properties of water below and above 100°C- Effects of temperature on the ion product of water.

1.5 Material Compatibility and Corrosion- Corrosion in aqueous systems- Deposit formation vs. Role of zeta potential- Role of alkalinity in steam-water circuits- De-oxygenation

Unit -II: Water Chemistry-II **15 Hours**

2.1 Treatment of Natural Waters for Industrial Cooling- Bio fouling in natural waters- Operational practice of chlorination

2.2 Materials in a cooling water circuit Ferrous sulphate injection- Cooling water treatment

2.3 Demineralization by Ion Exchange- Ion exchange resins-Ion exchange process- Properties of ion exchange resins

2.4 Demineralization of natural waters- Quality of DM water

2.5 Water side corrosion and deposition problems- Chemical treatment of water for industrial and power plant boilers

Unit - III: Silicate and Ceramics **15 Hours**

3.1 *Glass*: Glassy state and its properties, classification (silicate and non-silicate glasses).

3.2 Manufacture and processing of glass.

3.3 Composition and properties of the following types of glasses: Soda lime glass, lead glass, armoured glass, safety glass, borosilicate glass, fluorosilicate, coloured glass, photosensitive glass.

3.4 *Ceramics*: Important clays and feldspar, ceramic, their types and manufacture.

3.5 High technology ceramics and their applications, superconducting and semiconducting oxides. Composites: fullerenes, carbon nanotubes and carbon fibre.

Unit - IV Cements and Fertilizers **15 Hours**

4.1 Cements: Classification of cement, ingredients and their role.

4.2 Manufacture of cement and the setting process, quick setting cements.

4.3 *Fertilizers*: Ammonia Synthesis: Haber's process and Contact Process:Sulphuric acid Nitric acids.

4.4 Different types of fertilizers. Manufacture of the following fertilizers: Urea, ammonium nitrate, calcium ammonium nitrate, ammonium phosphates;

4.5 Manufacture of the following fertilizers: polyphosphate, superphosphate, compound and mixed fertilizers, potassium chloride, potassium sulphate.

Unit - V: Surface Coatings and Batteries **15 Hours**

5.1 *Surface Coatings*: Objectives of coatings surfaces, preliminary treatment of surface, classification of surface coatings. Paints and pigments-formulation, composition and related properties.

5.2 Oil paint, Vehicle, modified oils, Pigments, toners and lakes pigments, Fillers, Thinners, Enamels, emulsifying agents. Special paints (Heat retardant, Fire retardant, Eco-friendly paint, Plastic paint),

5.3 Dyes, Wax polishing, Water and Oil paints, additives, Metallic coatings, metal spraying and anodizing.

5.4 *Batteries*: Primary and secondary batteries, battery components and their role.

5.5 Characteristics of Battery. Working of following batteries: Pb acid, Li-Battery, Solid state electrolyte battery. Fuel cells, Solar cell and polymer cell.

References

1. K.S. Venkateswarlu, *Water Chemistry-Industrial and Power Station Water Treatment*, New Age International (P) Limited, Publishers, 1996.
2. Patrick Brezonik, William Arnold, *Water Chemistry: An Introduction to the Chemistry of Natural and Engineered Aquatic Systems*, Oxford University Press, USA, 2011
2. R. M. Felder, R. W. Rousseau: *Elementary Principles of Chemical Processes*, Wiley Publishers, New Delhi, 2015.
3. W. D. Kingery, H. K. Bowen, D. R. Uhlmann: *Introduction to Ceramics,* Wiley Publishers, New Delhi, 2007.
4. J. A. Kent: *Riegel's Handbook of Industrial Chemistry*, CBS Publishers, New Delhi, 2010.
5. P. C. Jain & M. Jain: *Engineering Chemistry*, Dhanpat Rai& Sons, Delhi, 1998.
6. R. Gopalan, D. Venkappayya, S. Nagarajan: *Engineering Chemistry*, 4th edition,Vikas Publications, New Delhi, 2013.
7. B. K. Sharma: *Engineering Chemistry*, Goel Publishing House, Meerut, 1998.

MappingofCO withPOandPSO

CO	ProgrammeOutcomes(POs)							ProgrammeSpecificOutcomes(PSOs)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	Mean Scores ofCos
CO1	3	3	3	2	2	2	2	3	2	3	3	3	2	2	2	2.46
CO2	3	3	3	3	2	2	2	3	2	3	3	3	2	2	2	2.53
CO3	3	3	3	2	2	2	2	3	2	3	3	3	3	2	2	2.53
CO4	3	3	3	3	2	2	2	2	2	3	2	3	3	2	2	2.46
CO5	3	3	3	3	2	2	2	2	2	3	2	3	3	2	2	2.46
CO6	3	3	3	3	2	2	2	2	2	3	2	3	3	2	2	2.46
MeanOverallScore																2.48
Result																High

Assessment Pattern

Bloom's Category	CA Tests (Marks Allotment)		Term End Exam (100) Marks Allotment
	I CA (50)	II CA (50)	
Remember	10	10	20
Understand	10	10	30
Apply	10	10	20
Analyze	10	10	10
Evaluate	5	5	10
Create	5	5	10

CH642F	**Theory**	**4**	**3**	**1**	**0**
	CH642F	**Chemistry of Drug Design**		**100**	**4**

Course Objectives:

- Introduce the basic concepts of drug design and discovery process
- Learn the techniques of SAR/QSAR
- Introduce the concepts of molecular modeling
- Introduce the concepts of receptor inhibition and enzyme inhibition in drug design

Course Outcomes:

- On successful completion of this Course, students will be able to

S.NO.	COURSE OUTCOME	Knowledge level
CO1	Explain the general concepts of drug design and discovery	K1
CO2	Illustrate the essential concepts of SAR/QSAR	K1, K3
CO3	Explain the different concepts of computer aided drug design	K1
CO4	Demonstrate how receptors and enzymes can act as targets for drug discovery	K2, K3

Course Content

Unit -I An introduction to drugs, their action and discovery 15 hours

1.1 Drugs-discovery and design: a historical outline-Leads and analogues-therapeutic index
1.2 Sources of leads and drugs-Leads and analogues: some desirable propertiesIntroduction to drug action-Potency-Selectivity-
1.3 ADME (Absorption, Distribution, Metabolismand Excretion)-Classification of drugs
1.4 Drug structure and Solubility-Stereochemistry and drug design-Solubility-The importance of water solubility
1.5 Partition - determination of partition coefficients (Practical /Theoretical)

Unit II Structure–activity and quantitative structure relationships 15 hours

2.1 Structure–activity relationship (SAR/QSAR)-Changing size and shape (Changing the number of methylene groups in chains and rings-increasing or decreasing the degree of unsaturation-introducing or removing a ring system).
2.2 Introduction of new substituents (methyl/hydroxy/halogen/basic/Carboxylic and sulphonic acid groups/thiols, sulphides and other sulphur groups), Changing the existing substituents of a lead
2.3 QSAR- (Case study: a SAR investigation to discover potent geminal bisphosphonates)
2.4 Descriptors*-The lipophilic parameters-Electronic parameters- Steric parameters
2.5 Deriving a QSAR equation-simple and multiple linear regression (The Squared Correlation Coefficient, R^2, Cross-Validation).*

Unit III: Computer Aided Drug Design 15 hours

3.1 Introduction – Models Molecular modelling methods-Molecular mechanics-force field
3.2 Molecular dynamics Docking De novo design Pharmacophores and some of their uses

3.3 Modelling protein structures-Homology Modeling-web servers for protein modeling
3.4 2D-QSAR-Descriptors-Types of Descriptor-Regression Analysis
3.5 3D QSAR-CoMFA-Advantages and disadvantages

Unit IV: Receptors and messenger **15 hours**

4.1 The chemical nature of the binding of ligands to receptors-Structure and classification of receptors-
4.2 General mode of operation (Superfamily Type 1,2,3,4)-Ligand–response relationships (Experimental determination of ligand concentration–response curves: Agonist concentration–response relationships, Antagonist concentration–receptor relationships,Partial agonists,Desensitisation)
4.3 Ligand–receptor theories (Clark's occupancy theory, The rate theory, The two-state model)
4.4 Drug action and design Agonists, Antagonists
4.5 Citalopram, an antagonist antidepressant discovered by a rational approach, β-Blockers

Unit V: Enzymes **15 hours**

5.1 Active sites and catalytic action - Allosteric activation
5.2 Regulation of enzyme activity (Covalent modification, Allosteric control, Proenzyme control)
5.3 Enzyme inhibitors-Reversible inhibitors Irreversible inhibition, Transition state inhibitors,
5.4 Enzymes and drug design-some general considerations Examples of drugs used as enzyme inhibitors (Sulphonamides, Captopril, Statins)
5.5 Enzymes and drug resistance (Changes in enzyme concentration, An increase in the production of the substrate, Changes in the structure of the enzyme,The use of an alternative metabolic pathway)

Main Text:

1. Medicinal Chemistry (2nd Edition) by Gareth Thomas, John Wiley and Sons Ltd.
2. *Chemoinformatics by Andrew R. Leach and V.J. Gillet, Springer

MappingofCO withPOandPSO

CO	ProgrammeOutcomes(POs)							ProgrammeSpecificOutcomes(PSOs)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	Mean Scores ofCos
CO1	3	3	3	2	2	2	2	3	2	2	2	2	2	2	2	2.26
CO2	3	3	3	3	3	2	2	3	2	3	3	2	3	2	3	2.66
CO3	3	3	3	3	3	3	2	3	2	3	3	2	2	2	2	2.6
CO4	3	3	3	3	2	3	2	2	2	3	3	2	2	3	3	2.46
MeanOverallScore																2.495
Result																High

Assessment Pattern

Bloom's Category	CA Tests (Marks Allotment)		Term End Exam (100) Marks Allotment
	I CA (50)	II CA (50)	
Remember	10	10	20
Understand	10	10	30
Apply	10	10	20
Analyze	10	10	10
Evaluate	5	5	10
Create	5	5	10

Chemistry Lab Work – III

PCH621-Gravimetric Estimations and Organic Analysis

Semester - V & VI **3 Hrs/week (3 Credits/semester)**

Course Code	Type	Total Hours	Lecture	Tutorial	Practical
PCH621	Practical	45	3	0	42
		Course Name		**Max Marks**	**Credits**
		Gravimetric Estimations and Organic Analysis		100	3

Course Objectives

- To acquire sound practical knowledge in the gravimetric estimations.
- To prepare the students for analysing various organic compounds through systematic analysis.
- To enable the student to understand the principles behind the preparations of different organic compounds.

Course Outcomes:

On successful completion of this Course, students will be able to

S.NO.	COURSE OUTCOME	Knowledge level
CO1	Demonstrate the necessary practical skill to perform quantitative estimation gravimetrically	K1 and K2
CO2	Analyze and identify qualitatively the functional group and nature of the given organic compound	K3 & K4
CO3	Set-up synthesis of simple organic reactions	K5 & K6

Course Content

Gravimetric Estimations

1. Estimation of water of crystallization of hydrated Barium chloride
2. Estimation of Bariumas Barium sulphate
3. Estimation of Sulphate as Barium sulphate
4. Estimation of Bariumas Barium chromate
5. Estimation of Lead as Lead chromate
6. Estimation of Calcium as Calcium oxalate monohydrate

Organic Analysis

Analysis of organic compounds containing one functional group and characterization with a derivative.
Reactions of the following functional groups:
Aromatic aldehydes, ketones, Aromatic carboxylic acids, esters, carbohydrates, phenols, aromatic primary amines, amides, nitro compounds and anilides.

Organic Preparations

1. **Acetylation:**
   a) Acetanilide from aniline
   (or)
   b) Aspirin from salicylic acid

2. **Benzoylation:**
   a) Benzanilide from aniline
   (or)
   b) 2-Naphthyl Benzoate from 2-Naphthol
3. **Bromination:**
   a) p-Bromoacetanilide from acetanilide
   (or)
   b) 2,4,6-Tribromoaniline from aniline
4. **Oxidation:**
   a) Benzoic acid from benzaldehyde
   (or)
   b) Benzoic acid from Toluene
5. **Nitration:**
   a) m-dinitrobenzene from nitrobenzene
   (or)
   b) Picric acid from phenol
6. **Hydrolysis:**
   a) Benzoic acid from ethylbenzoate
   (or)
   b) Salicylic acid from methyl salicylate

References

1. Arthur I. Vogel, *A Textbook of Practical Organic Chemistry*, 4th Edition. ELBS, 1986.
2. N.S. Gnanapragasam and B. Ramamoorthy, *Organic Chemistry Lab Manual*, S. Visvanathan Printers & Publishers, 2006.
3. A.O, Thomas. *Practical Chemistry*, 6th Revised Edition, Sharada Press, 1995.
4. J. N. Gurtu And R. Kapoor, *Advanced Experimental Chemistry, Vol. I Physical Chemistry, Vol. II Inorganic Chemistry, Vol. III Organic Chemistry, Organic Reactions & Reagents* [B.Sc., (Hons.)& M.Sc.], Himalaya Publications, 1974.

Mapping of CO with PO and PSO

CO	Programme Specific Outcomes (PSO)								Programme Outcomes (PO)							Mean Scores of Cos
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PO1	PO2	PO3	PO4	PO5	PO6	PO7	
1	3	3	3	3	3	3	3	2	3	3	2	3	2	3	2	2.7
2	3	2	3	3	3	3	3	2	3	3	2	3	3	3	3	2.8
3	3	3	3	3	3	3	3	2	3	3	3	2	3	3	3	2.9
														Mean Overall Score		2.8
														Result		**High**

Chemistry Lab Work – III Gravimetric Estimations and Organic Analysis
Scheme of valuation

External Component (50 Marks)

Component	Marks
Gravimetric	40
Record (Gravimetric)	05
Organic analysis	30
Record (Organic)	05
Preparation	20
Total	100

The total marks 100 to be converted into 50 marks

Internal Component (50 Marks)

Component	Marks
Gravimetric Class work @70% + Organic Preparation(10 +5)	15
Organic Class work @70%	15
Theory of practical's (I + II)	5
Viva (I + II)	5
Model Examination	10
Total	**50**

Gravimetric result evaluation: maximum 40 marks

Percentage of error	Marks
<2	40
2-3	40-35
3-4	35-25
4-5	25-15
>5	10

Analysis of organic compound: maximum of 30 marks

Component	Identification With proper procedure	Spot evaluation of tests displayed	Total marks
Preliminary tests	5		5
Aliphatic/Aromatic	2		2
Saturated/Unsaturated	2		2
Special elements	4	2	6
Tests for detecting Functional group	3	2	5
Confirmative tests	2	3	5
Derivative	2	3	5
Total			**30**

Reporting the correct organic compound without writing the full procedure and without displaying the tests for evaluation yields only 5 marks.

Preparation of organic compounds: maximum of 20 marks

Crude sample	:	15 marks
Recrystallization	:	5marks
Total	:	20marks

Chemistry Lab Work - IV

PCH622-Physical Chemistry Experiments

Semester - V & VI **3 Hrs/week (3 Credits/semester)**

CH645	**Practicals**	**4**	**3**	**1**	**0**
		PHYSICAL CHEMISTRY		**100**	**4**

Course Objectives

- To understand about physical behaviour of compounds.
- To impart sound practical knowledge in understanding the reaction pathways and calculations involved in them.

Course Outcomes:

- On successful completion of this Course, students will be able to

S.NO.	COURSE OUTCOME	Knowledge level
CO1	apply the theoretical knowledge to measuring and determining the rate, order, rate constants of chemical reactions	K1
CO2	use the concept of distribution coefficient	K1, K3
CO3	Apply the concept of optical activity to measure the rate constant for hydrolysis of sucrose	K1
CO4	Know and illustrate the working principle and functions Polarimeter, conductometer, potentiometer, colorimeter and pH meter	K2, K3
CO5	enumerate the basics in electrochemistry and calculate the dissociation constant and equivalent conductance of a given solution	K4
CO6	Construct the TC diagram for phenol water system and estimate the CST	K1, K3

Course Content

1. Phenol - Water system
2. Determination of Transition temperature of hydrated salts
3. Determination of molecular weight of a solute – Rast method
4. Determination of rate constant of acid catalysed ester hydrolysis
5. Determination of rate constant of inversion of sucrose-polarimetry
6. Determination of distribution coefficient of iodine between water and CCl_4 (or)benzoic acid between water and benzene
7. Determination of λ_∞ of a strong electrolyte
8. Determination of dissociation constant of a weak electrolyte
9. Phase Diagram

10. Measurement of Viscosity
11. Conductometric titration (strong acid and strong base)
12. Flame photo meter (Estimation of Na, K, Li)
13. Potentiometric titration (Redox titration)
14. pH Meter (strong acid and strong base)
15. Colorimeter- Determination of concentration of given solution

References

1. V. Venkateswaran, R. Veerasamy, A.R. Kulandaisamy, *Basic principles of Practical Chemistry*, S.Chand publications, New Delhi, 2002.
2. J. N. Gurtu And R. Kapoor, *Advanced Experimental Chemistry, Vol. I Physical Chemistry, Vol. II Inorganic Chemistry, Vol. III Organic Chemistry, Organic Reactions & Reagents* [B.Sc., (Hons.)& M.Sc.], Himalaya Publications, 1974.
3. V. D. Athavale and Parul Mathur, *Experimental Physical Chemistry*, 1st Edition., New Age Publishers, 2008.
4. R. C. Das, *Experimental Physical Chemistry*, Tata McGraw-Hill Publications, 1986.
5. S. Giri, D. N. Pandey, O. P Pandey, *Pratical Chemistry*, S.Chand& Company, 1998.

Mapping of CO with PO and PSO

CO	Programme Outcomes (POs)							Programme Specific Outcomes (PSOs)								
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**Mean Scores of COs**
CO1	3	2	1	2	3	2	1	3	3	2	2	2	3	3	2	2.2
CO2	3	2	1	2	3	2	1	3	3	1	2	2	3	3	2	2.2
CO3	3	2	1	2	3	2	1	3	3	3	3	2	3	3	2	2.4
CO4	3	2	1	2	3	2	1	3	3	2	1	1	3	3	2	2.1
CO5	3	3	1	3	3	3	1	3	3	2	1	1	3	2	2	2.2
Mean Overall Score																2.2
Result																High

Assessment Pattern

Bloom's Category	CA Tests (Marks Allotment)		Term End Exam (100) Marks Allotment
	I CA (50)	II CA (50)	
Remember	10	10	20
Understand	10	10	30
Apply	10	10	20
Analyze	10	10	10
Evaluate	5	5	10
Create	5	5	10