

## DEPARTMENT OF CHEMISTRY

### PREAMBLE

**UG** : Syllabi of programme offered in semester III and IV along with III and IV evaluation components (With effect from 2018 – 2021 batch onwards)

**PG** : Syllabi of programme offered in semester III and IV along with III and IV evaluation components (With effect from 2018 – 2020 batch onwards) are presented in this booklet.

### PROGRAMME PROFILE B.Sc. (Chemistry)

**PSO1:** Development of the skills in handling various chemicals, apparatus and instruments.

**PSO2:** Application of the principles of thermodynamics and chemical kinetics in chemical reactions

**PSO3:** Acquiring the knowledge on heterocyclic compounds and natural products

**PSO4:** Ability to apply the basic principles of various spectroscopic, electro and thermo analytical methods to characterize the compounds

**PSO5:** Industrial insights on polymers, textile dyes, fibre and medicinal chemistry.

Semester	Part	Category	Course code	Course Title	Contact Hrs/Week	Credits	
						Min	Max
I	I	Tamil/Hindi/French	UTAL105/ UTAL106/ UHIL101/ UFRL101	Basic Tamil-I/ Advanced Tamil-I/ Hindi-I/ French-I	4	2	3
	II	English	UENL107/ UENL108	General English-I/ Advanced English-I	5	3	4
	III	Core I	UCHM104	Fundamentals of Chemistry	2	1	1
		Core II	UCHM105	General Chemistry –I	4	4	4
		Core III	UCHM106/ UCHM107	Analytical Chemistry	4	4	4
		Core Practical I	UCHR204/ UCHR205	Volumetric Analysis	3	-	-
		Allied I	UPHA102	Allied Physics - I	3	3	3
		Allied Practical I	UPHR103	Allied Physics Practical-I	3	2	2
	IV	Value Education			2	1	1
<b>Total</b>					<b>30</b>	<b>20</b>	<b>22</b>
II	I	Tamil/Hindi/French	UTAL205/ UTAL206/ UHIL201/ UFRL201	Basic Tamil-II/ Advanced Tamil-II/ Hindi-II/ French-II	4	2	3
	II	English	UENL207/ UENL208	General English-II/ Advanced English-II	5	3	4
	III	Core IV	UCHM202	General Chemistry –II	6	6	6
		Core Practical I	UCHR204/ UCHR205	Volumetric Analysis	3	4	4
		Allied II	UPHA201	Allied Physics II	3	3	3
		Allied Practical I	UPHR202	Allied Physics Practical-II	3	2	2
	IV	NME			4	2	2
		Soft skill			2	1	1

	V	Extension Programme/ Physical Education/NCC			-	1	2	
<b>Total</b>					<b>30</b>	<b>24</b>	<b>27</b>	
III	I	Tamil/Hindi/French	UTAL305/ UTAL306/ UHIL301/ UFRL301	Basic Tamil-III/ Advanced Tamil-III/ Hindi-III/ French-III	4	2	3	
	II	English	UENL307/ UENL308	General English-III/ Advanced English-III	5	3	4	
	III	Core V		UCHM305	General Chemistry –III	5	5	5
		Core Practical II		UCHR404/ UCHR405	Semi micro Qualitative Inorganic Analysis	3	-	-
		Core VI		UCHM306	Separation & Purification Techniques	3	3	3
		Core VII			Online Course (NPTEL/ST)	3	1	2
	Allied		UMAA304	Algebra, Differential Calculus and Trigonometry	5	5	5	
	IV	Value Education			2	1	1	
<b>Total</b>					<b>30</b>	<b>20</b>	<b>23</b>	
IV	I	Tamil/Hindi/French	UTAL405/ UTAL406/ UHIL401/ UFRL401	Basic Tamil-IV/Advanced Tamil-IV/ Hindi-IV/ French-IV	4	2	3	
	II	English	UENL407/ UENL408	General English/ Advanced English	5	3	4	
	III	Core VIII		UCHM405	General Chemistry –IV	5	5	5
		Core Practical II		UCHR404/ UCHR405	Semi micro Qualitative Inorganic Analysis	3	4	4
		Core IX		UCHM406	Instrumental Method of Analysis	4	4	4
		Allied		UMAA406	Integral Calculus, Laplace Transform & Ordinary Differential Equation	5	5	5
	Core X Project/ paper		UCHP501/ UCHM507	Project/Dairy and its products	2	-	-	
	IV	Soft skill		USKS401		2	1	1
V	Extension Programme/ Physical Education/NCC				-	-	2	
<b>Total</b>					<b>30</b>	<b>24</b>	<b>28</b>	
V	III	Core XI	UCHM504	Inorganic Chemistry – I	5	4	4	
		Core XII	UCHM505	Organic Chemistry –I	6	5	5	
		Core XIII	UCHM506	Physical Chemistry –I	5	4	4	
		Core Practical III	UCHR501	Gravimetric Analysis	4	4	4	
		Core Practical IV	UCHR605	Physical Chemistry Practical	4	-	-	
	Core X paper/ Project	UCHP501/ UCHM507	Project / Dairy and its products	4	4	5		
IV	Value education			2	1	1		
<b>Total</b>					<b>30</b>	<b>22</b>	<b>23</b>	
VI	III	Core XIV	UCHM607	Inorganic Chemistry II	4	4	4	
		Core XV	UCHM608	Organic Chemistry II	4	4	4	

	Core XVI	UCHM609	Physical Chemistry II	4	4	4
	Core XVII	UCHM610	Physical Chemistry III	4	4	4
	Major elective	UCHO602	Polymer Chemistry	4	4	4
		UCHO603	Medicinal Chemistry			
		UCHO604	Forensic Chemistry			
		UCHO605	Chemistry of Dye			
	Core Practical IV	UCHR605	Physical Chemistry Practical	4	4	4
	Core Practical IV	UCHR606	Organic Analysis and Preparation	4	4	4
	Viva –Voce	UCHM605	Comprehensive Viva-Voce	-	1	1
IV	Soft Skill	USKS601		2	1	1
V	Extension Programme/ Physical Education			-	-	2
<b>Total</b>				<b>30</b>	<b>30</b>	<b>32</b>
<b>Grand Total</b>				<b>180</b>	<b>140</b>	<b>155</b>

### ALLIED COURSES OFFERED TO OTHER DEPARTMENTS

Semester	Part	Category	Course code	Course title	Contact hrs per week	Credits	
						Min	Max
I	III	Allied-I	UCHA102	Chemistry-I	5	4	4
IV	III	Allied-I	UCHA402/403	Chemistry for Physics	3	3	3
I/IV	III	Allied Practical	UCHR104/ UCHR404	Volumetric Analysis	3	2	2
V	III	Allied Optional	UCHA502 UCHA504 UCHA505 UCHA506	Industrial Chemistry Dairy Chemistry Agricultural Chemistry Environmental Chemistry	5	4	4

### NON- MAJOR ELECTIVE COURSES

Semester	Part	Category	Course code	Course title	Contact Hrs/per week	Credits	
						Min	Max
II	IV	Non major elective	UCHE206	Cosmetics and Detergents	4	2	2
			UCHE207	Green Chemistry	4	2	2
			UCHE204	Food Chemistry	4	2	2
			UCHE205	Health and Hygiene	4	2	2
			UCHE208	Health Chemistry	4	2	2

### EXTRA CREDIT EARNING PROVISION

Semester	Category	Course code	Course title	Hrs per week	Credits	
					Min	Max
II	Core	UCHI201	Internship	-	-	1
IV	Core	UCHI401	Internship	-	-	1
V	Core	UCHM507	Green Chemistry (Self Study Paper)	2	-	1

## UCHM305 GENERAL CHEMISTRY - III

<b>Semester</b>	<b>: III</b>	<b>Credit</b>	<b>: 5</b>
<b>Category</b>	<b>: Core V</b>	<b>Hours/ week</b>	<b>: 5</b>
<b>Class &amp; Major</b>	<b>: II B.Sc. Chemistry</b>	<b>Total Hours</b>	<b>: 65</b>

### Objectives

#### To enable the students

- Understand the characteristics of Boron and carbon family.
- Write the mechanism of electrophilic substitution reaction.
- Apply the principles of thermodynamics in chemical reactions.

### UNIT- I CHEMISTRY OF P-BLOCK ELEMENTS 13 Hrs

**Boron family:** Group discussion, anomalous behavior of boron, electron deficiency & electron acceptor behavior of borontrihalides. Bonding in diborane. Preparation, properties, uses & structure of Borazole, boron nitride.

**Carbon family:** Group discussion, comparison of properties of C, Si - valency, oxides, halides, hydrides & oxyacids. Classification & preparation, properties & uses of carbides, silicates and silicones. Introduction to allotropes of carbon.

### UNIT- II CHEMISTRY OF ALKYL, ARYL AND ARALKYL HALIDES 12 Hrs

General method of preparation and properties of alkyl, aryl and aralkyl halides.

**Organometallic compounds:** Grignard reagent, preparation, physical and chemical properties. organolithium compounds, organocopper reagent, organozinc reagent and tetra methyl lead.

### UNIT - III ALKENES, ALKYNES AND HYDROCARBONS 12 Hrs

Method of preparation and properties of alkenes like ethylene and propene. Dienes – preparation properties and uses of 1,3 butadienes. Methods of preparation and properties of alkynes with special reference to acetylene

**Electrophilic substitution reactions in aromatic compounds:** General mechanism - nitration, halogenation, sulphonation, Friedal Craft's acylation & alkylation. Directive influence - orientation - o/p ratio- of benzene derivatives.

### UNIT - IV FIRST LAW OF THERMODYNAMICS 13 Hrs

**First law of thermodynamics:** statement, Calculation of W,Q,  $\Delta E$  &  $\Delta H$  for the expansion of ideal gases under reversible, isothermal and adiabatic conditions, molar heat capacities at constant volume and constant pressure and its relations.

**Thermo Chemistry:** Bond energy, bond dissociation energy. Calculation from thermo chemical data, Hess's law of heat of summation –statement, illustration, application -bond variation of heat of a reaction with temperature - Kirchoff's Equation.

## UNIT - V SECOND LAW OF THERMODYNAMICS

15 Hrs

**Second law of Thermodynamics:** Need for the II law, different statements of II law, Significance of Entropy.

**Gibb's free energy:** Helmholtz free energy-their variation with temperature, pressure and volume. Maxwell's equations and thermodynamic equation of state - Gibbs Helmholtz equation-derivation and applications. Criteria for spontaneity-free energy, entropy.

### Text Books

- Bahl. S and ArunBahl, *Advanced Organic Chemistry*, Revised Edition, S. Chand and Company Ltd, Ram Nagar, New Delhi, 2010.
- Madan .R.D, *Modern Inorganic Chemistry*, 3<sup>rd</sup> Edition, S.Chand& Company Limited, New Delhi, 2011.
- Puri.B.R, Sharma.L.R & Pathania.M.S, *Principles of Physical Chemistry*, Millennium Edition, Vishal publishing & Co, Jalandhar, 2004.

### Reference Books

- Finar.I.L, *Organic Chemistry Volume I and II*, 6<sup>th</sup> Edition, England Addison Wesley Longman Ltd, New Delhi 2006.
- Puri.B.R, Sharma.L.R and Kallia K.C, *Inorganic Chemistry*, Milstone Publisher, New Delhi, 2003.
- Soni.P.L, *Text book of physical chemistry*, 22<sup>nd</sup> Revised Edition, Sultan Chand, New Delhi, 2001.

## UCHR404/UCHR405 SEMIMICRO QUALITATIVE INORGANIC ANALYSIS

**Semester** : III & IV  
**Category** : Core practical - II  
**Class & Major** : II B.Sc., Chemistry

**Credit** : 4  
**Hours/Week** : 3+3  
**Total Hours** : 78

### Objectives

#### To enable the students

- Identify the basic and acid radicals
- Develop analytical skills in qualitative inorganic analysis

### INORGANIC ANALYSIS

1. Analysis of simple salt and binary salt containing cations and anions
2. Analysis of a mixture containing two cations and two anions, one of which will be an interfering ion by Semi-micro methods using the conventional scheme and identify simple acid radical, interfering radical and Elimination of Interfering acid radical for the following anions: carbonate, sulphide, sulphate, fluoride, chloride, bromide, nitrate, oxalate, phosphate, borate and chromate.
3. Separation of basic radicals into groups and analysis of groups for the following: cations, lead, copper, cadmium, bismuth, aluminium, iron, manganese, zinc, cobalt, nickel, calcium, strontium, barium, magnesium and ammonium.

### Reference Books

- Dr.Ramanujam.V.V, *Inorganic Semi Micro Qualitative Analysis*, The National Publishing Company, 2009.
- Thomas.A.O, *Practical chemistry*, 2<sup>nd</sup> Edition, Scientific book center, Cannanore, 2006.
- Venkateswaran.V, Veerasawamy.R & Kulandaivelu.A.R, *Basic Principles of practical Chemistry*, 2<sup>nd</sup> edition, S. Chand & Sons Publications, New Delhi, 2005.

## UCHM306 SEPARATION AND PURIFICATION TECHNIQUES

Semester	: III	Credit	: 3
Category	: Core VI	Hours/Week	: 3
Class &Major	: II B.Sc. chemistry	Total Hours	: 39

### Objectives

#### To enable the Students

- Understand principles of Separation and Purification techniques.
- Use the Separation and Purification techniques through lab demonstration.

### UNIT - I SEPARATION TECHNIQUES 6 Hrs

Principle – precipitation ,solvent extraction ,paper electroprocess and ultra centrifuge.

### UNIT – II PURIFICATION TECHNIQUES 6 Hrs

Desiccants , distillation- principle and types – fractional, steam azeotropic, recrystallisation and sublimation. test of purity – melting point and boiling point

### UNIT- III CHROMATOGRAPHY 9 Hrs

**Chromatography:** principle, classification –partition, adsorption, mobile and stationary phases, types of adsorbents- choice of eluents

### UNIT- IV PAPER, THIN LAYER AND COLUMN CHROMATOGRAPHY 9 Hrs

Principle- techniques-applications and limitations-Paper, Thin layer chromatography and Column. Superiority of TLC over PC.

### UNIT- V ADVANCED TECHNIQUES IN CHROMATOGRAPHY 9 Hrs

Principle, techniques and applications of Gas Chromatography- High Performance Liquid Chromatography- Ion exchange Chromatography.

### Text Books

- Gopalan .R, Subramanian P.S, Rangarajan. K, *Elements of Analytical Chemistry*, Sultan Chand and Sons, 2009.
- Srivastava .V.K., Srivastava .K.K, *Introduction to Chromatography: Theory and Practice*, S. Chand and company, New Delhi, 2006.

### Reference Books

- Sharma B.K., *Instrumental methods of Analysis*, Geol Publications, 2008.
- Skoog .D.A., West.D.M and Holler .F.J., *Analytical Chemistry: An Introduction*, 7th edition, Saunders college publishing, Philadelphia,2010.

- Kaur H, *Instrumental methods of Chemical Analysis*, Pragathi Prakasan Publications, Meerut, 2006.

### UCHM405 GENERAL CHEMISTRY- IV

<b>Semester</b>	<b>: IV</b>	<b>Credit</b>	<b>: 5</b>
<b>Category</b>	<b>: Core VIII</b>	<b>Hours/Week</b>	<b>: 5</b>
<b>Class &amp; Major</b>	<b>: II B.Sc., Chemistry</b>	<b>Total Hours</b>	<b>: 65</b>

#### Objectives

##### To enable the Students

- Understand the properties of Nitrogen, Oxygen, Halogen & Noble gas family.
- Apply the concepts of Second and Third Law of Thermodynamics.
- Find the mechanism of various organic chemical reactions.

#### UNIT - I CHEMISTRY OF NITROGEN AND OXYGEN FAMILY 14 Hrs

**Nitrogen Family:** General characteristics of nitrogen group elements – electronic configuration, similarities & gradation in physical & chemical properties, uses of N, P, As, Sb, & Bi. Preparation, properties & uses of hydrides, oxides, oxyacids. Structure of oxides and oxyacids. Structure & uses of hydrazine & hydroxylamine.

**Oxygen family:** General characteristics of oxygen group elements – electronic configuration, similarities & gradation in physical & chemical properties, uses of O, S, Se & Te. Preparation, properties & uses of hydrides, oxides, halides & oxyacids of sulphur, peroxyacids & thionic acids. Structure of oxides and oxyacids.

#### UNIT - II CHEMISTRY OF HALOGENS AND NOBLE GASES 14 Hrs

**Halogens:** General characteristics of halogen group elements – electronic configuration, similarities & gradation in physical & chemical properties, uses of F, Cl, Br, I & At. Preparation, properties & uses of hydracids, oxides & oxyacids. Interhalogen compounds, pseudohalogens & positive iodine. Fluorides of oxygen. Exceptional properties of fluorine.

**Noble gases:** General characteristics of noble gas elements – electronic configuration - reason for placing in zero group - position in the periodic table - Applications - Clathrates - compounds of xenon - hybridization and geometries of  $\text{XeF}_2$ ,  $\text{XeF}_4$ ,  $\text{XeF}_6$  &  $\text{XeOF}_4$ .

#### UNIT – III AROMATICITY AND REACTION MECHANISM 13 Hrs

**Aromaticity:** Modern theory of aromaticity -non aromatic ,anti aromatic with simple examples.

**Reaction Mechanism:** general mechanism of  $\text{S}_\text{N}^1$ ,  $\text{S}_\text{N}^2$ ,  $\text{S}_\text{N}^i$ ,  $\text{E}^1$ ,  $\text{E}^2$ ,  $\text{SE}^1$  and  $\text{SE}^2$  reactions.

#### UNIT - IV STEREOCHEMISTRY 12 Hrs

Fischer, flying wedge, sawhorse and Newmann projection formulae. Optical Activity in Compounds not containing asymmetric carbon atoms-biphenyl-allenes and spiranes. racemisation - methods of racemisation (by substitution and tautomerism) - resolution - methods of resolution (mechanical Seeding, biochemical and conversion to diastereoisomerism). Notation of

optical isomerism-Cahn-Ingold-Prelog rules-R-S-notations for optical isomers with one and two asymmetric carbon atom-erythro and threo representations.

#### **UNIT-V CHEMICAL EQUILIBRIUM AND THIRD LAW OF THERMODYNAMICS 12Hrs**

**Law of Mass Action:** Various forms of equilibrium constants, Relationship between  $K_p$  and  $K_c$ .

Thermodynamic derivation of the law of chemical equilibrium - reaction isotherm - standard free energy change and equilibrium constant - variation of equilibrium constant with temperature - Van't Hoff Isochore.

**Third Law of Thermodynamics:** Nernst Heat theorem -statement of III law of thermodynamics-evaluation of entropy of heat capacity measurements - exceptions to III law-residual entropy.

#### **Text Books**

- Puri Sharma Pathania- *Principles of Physical Chemistry*- Shoban Lal Nagin Chand & Co,Jalandhar.(2006).
- Madan.R.D, – *Modern Inorganic Chemistry* – S.Chand & Company Limited, 2006.
- Bahl and Arun Bahl – “*Advanced Organic Chemistry*” – S. Chand, 2008.

#### **Reference Books**

- Huheey.J.E, Harper and Collins – “*Inorganic chemistry*” – NY IV edition, 2007.
- Morrison.R.T. and Boyd – “*Organic Chemistry*” – VI Edition – prentice Hall of India, New Delhi, 2006.
- Kundu and Jain – “*Physical Chemistry*” – S. Chand, 2010.

### **UCHR404/UCHR405 SEMIMICRO QUALITATIVE INORGANIC ANALYSIS**

<b>Semester</b>	<b>: III &amp; IV</b>	<b>Credit</b>	<b>: 4</b>
<b>Category</b>	<b>: Core practical - II</b>	<b>Hours/Week</b>	<b>: 3+3</b>
<b>Class &amp; Major</b>	<b>: II B.Sc., Chemistry</b>	<b>Total Hours</b>	<b>: 78</b>

#### **Objectives**

##### **To enable the students**

- Identify the basic and acid radicals
- Develop analytical skills in qualitative inorganic analysis

#### **INORGANIC ANALYSIS**

1. Analysis of simple salt and binary salt containing cations and anions
2. Analysis of a mixture containing two cations and two anions, one of which will be an interfering ion by Semi-micro methods using the conventional scheme and identify simple acid radical, interfering radical and Elimination of Interfering acid radical for the following anions: carbonate, sulphide, sulphate, fluoride, chloride, bromide, nitrate, oxalate, phosphate, borate and chromate.

3. Separation of basic radicals into groups and analysis of groups for the following: cations, lead, copper, cadmium, bismuth, aluminium, iron, manganese, zinc, cobalt, nickel, calcium, strontium, barium, magnesium and ammonium.

#### Reference Books

- Dr.Ramanujam.V.V, *Inorganic Semi Micro Qualitative Analysis*, The National Publishing Company, 2009.
- Thomas.A.O, *Practical chemistry*, 2<sup>nd</sup> Edition, Scientific book center, Cannanore, 2006.
- Venkateswaran.V, Veerasawamy.R & Kulandaivelu.A.R, *Basic Principles of practical Chemistry*, 2<sup>nd</sup> edition, S. Chand & Sons Publications, New Delhi, 2005.

### UCHM406 INSTRUMENTAL METHODS OF ANALYSIS

<b>Semester</b>	<b>: IV</b>	<b>Credit</b>	<b>: 4</b>
<b>Category</b>	<b>: Core IX</b>	<b>Hours/Week</b>	<b>: 4</b>
<b>Class &amp;Major</b>	<b>: II B.Sc Chemistry</b>	<b>Total Hours</b>	<b>: 52</b>

#### Objectives

##### To enable the students

- Acquire the fundamentals and principles of spectroscopic techniques.
- Enhance the knowledge in thermo and electro analytical methods.

#### UNIT - I FUNDAMENTALS OF SPECTROSCOPY 9 Hrs

Electromagnetic spectrum: Electromagnetic radiation - properties, wave parameters - interaction of light with matter - types of spectroscopy: Atomic & Molecular spectroscopy - Absorption and Emission spectra.

#### UNIT - II UV AND IR SPECTROSCOPIC TECHNIQUES 10 Hrs

UV-Visible spectroscopy – Principle, instrumentation - photocolimeter and spectrophotometer. Infrared spectroscopy - principle, instrumentation - source - monochromator – cell - sampling techniques - detector and recorders.

#### UNIT-III ATOMIC ABSORPTION AND EMISSION SPECTROSCOPIC TECHNIQUES 10 Hrs

Flame Spectroscopy, Atomic Absorption Spectroscopy (AAS): Principle, theory, instrumentation and application. Luminescence Spectroscopy, Fluorescence Spectroscopy: Principle, theory, instrumentation and application.

#### UNIT - IV ELECTRO ANALYTICAL METHODS 12 Hrs

Polarography - principle - concentration polarization- dropping mercury electrode- advantage and disadvantage - convection, migration and diffusion currents - illkovic equation(derivation not needed) and its significance - Amperometry - principle and uses.

#### UNIT - V THERMO ANALYTICAL METHODS 11 Hrs

Principles and instrumentation thermo gravimetric analysis and differential gravimetric analysis – characteristics and curves - factors affecting TGA and DTA curves- calcium oxalate monohydrate and silver nitrate- thermometric titrations-principle and applications

### Text Books

- Gopalan .R, *Elements of analytical chemistry*, Sultan Chand, 2009.
- Kaur, *Instrumental methods of chemical analysis*.

### Reference Books

- Khopkar S.M, *Analytical Chemistry*, New Age International, 2006.
- Skog.A and West .M, *Fundamentals of analytical chemistry*, Saunders College Publications, 2004.
- Sharma B.K, *Instrumental methods of chemical analysis* God Publications, 2007.
- Usharani. S, *Analytical Chemistry*, Macmillan, 2008.

## UCHM507 DAIRY AND ITS PRODUCTS

<b>Semester</b>	<b>: IV &amp; V</b>	<b>Credit</b>	<b>: 4</b>
<b>Category</b>	<b>: Core X</b>	<b>Hours/Week</b>	<b>: 2 + 4</b>
<b>Class &amp; Major:</b>	<b>II &amp; III B.Sc Chemistry</b>	<b>Total Hours</b>	<b>: 78</b>

### Objectives

#### To enable the students

- Locate various bodies to recognize and unorganized marketing
- Analyze the various components present in the milk products
- Evaluate the various properties and processes incorporating with milk products

### UNIT – I MARKET MILK INDUSTRY 15Hrs

Introduction to MMI - Market milk Industry. Organized, Unorganized marketing system. Study of major aided projects such as NDDB, OF, Technology mission in dairy development and National dairy plans - Milk Production, Utilization and consumption pattern, seasonal and regional variation - Dairy development policy in India.

### UNIT – II PROCESSING OF MILK – I 15Hrs

Straining, filtration, clarification of market milk - Reception and preliminary testing of incoming milk - Methods of milk preservation – methods of cooling and chilling of milk, farm cooling, refrigeration, LP system. Bio-protective factors for raw milk preservation. Bio-Preservation of Milk-bactofugation - Homogenization of Milk

### UNIT – III PROCESSING OF MILK – II 16Hrs

Processing of Milk-pasteurization of milk principle, methods, LTLT, HTST, in bottle pasteurization, UHT, Uperization, stassanization, vacration. Sterilization of milk - Manufacturing of special milks-Soya milk, Groundnut milk, irradiated milk, fortified milk-Milk distribution systems. Problems of return and unsold milk.

### UNIT – IV TECHNOLOGY OF WESTERN DAIRY PRODUCTS 16Hrs

Classification of western dairy products - Cream-Definition, Composition, methods of cream separation, types of cream, factors affecting cream skimming efficiency and defects in

cream - Butter-History, definition, composition, types, churning theories, methods of manufacturing, overrun, defects and storage.

### UNIT – V FROZEN DAIRY PRODUCTS

**16Hrs**

Ice-cream – History, development and status of ice-cream industry. Definition, Composition methods of manufacturing and nutritive value. Types and standards of Ice-cream. Role of milk constituents in manufacturing of Ice-cream. Study and role of dairy and non-dairy ingredients in Ice-cream.

#### Text Books

- B Srilakshmi “*Food Science*”, New Age International Publishers, 2015.
- Swaminathan .M - “*Advanced text book on Food and Nutrition*’, Vol II – Applied aspects, Bapcco Publishers, 2015
- Harish Sharma, Dairy Science and Technology and Food and Dairy Engineering, CBS Publishers & Distributors, 2005

#### Reference Books

- Awapapa.J - “*Introduction to biological chemistry*” – prentice hall,2013.
- N.P. Wong, R. Jenness, M.Keeney and E.H.Marh - “*Fundamentals of dairy chemistry*”, CBS Publishers, 2001.

### UCHP501 PROJECT

**Semester : IV & V**  
**Category : Core X**  
**Class & Major: II & III B.Sc., Chemistry**

**Credit : 4**  
**Hours/Week : 2 + 4**  
**Total Hours : 78**

#### I. Guidelines

- This course offered as group project
- No of students is limited 5 to 6

#### II. Evaluation Pattern for the Project

S.No	Components	CIA	ESE
1	Deign the Research origin	10	
2	Review of Literature	10	
3	Experimentation	10	
4	Experimentation result	10	
5	Project Report	10	
6	Viva voce	10	
<b>Total</b>		<b>60</b>	<b>40</b>

## ALLIED COURSES OFFERED TO OTHER DEPARTMENTS

### UCHA402/UCHA403 CHEMISTRY FOR PHYSICS

<b>Semester</b>	<b>: IV</b>	<b>Credit</b>	<b>: 3</b>
<b>Category</b>	<b>: Allied</b>	<b>Hours  Week</b>	<b>: 3</b>
<b>Class &amp;Major</b>	<b>: II B.Sc., Physics</b>	<b>Total Hours</b>	<b>: 39</b>

#### Objectives

##### To enable the Students

- Understand the fundamentals atomic structure and nuclear chemistry.
- Analyse the conductance of solutions and electromotive forces using electro analytical techniques.
- Differentiate the types and properties of solids.

#### UNIT- I ATOMIC STRUCTURE 7 Hrs

Different of model atomic structure: Dalton, Thomson's model and Rutherford, Quantum numbers - n, l, m, s. Pauli exclusion Principle. Energy level diagram, Hund's rule of maximum multiplicity, Stability of half filled & completely filled orbitals. Shapes of s,p,d,f block elements. Electronic configuration of few elements.

#### UNIT - II NUCLEAR CHEMISTRY 7 Hrs

Fundamentals particles of the nucleus - nucleon terminology , nuclides, isotopes, isobars ,isotones, mirror nuclei-induced radio activity of radio isotopes - nuclear energy - fission - fusion - Nuclear reactors - accelerators (charged particles)

#### UNIT - III SOLID STATE AND PHOTOCHEMISTRY 10 Hrs

**Solid State :** Crystal lattice - laws of crystallography - elements of symmetry - crystal systems - unit cell- space lattice - Bravais lattice - structure of NaCl - structure of CsCl - Miller indices.

**Photochemistry:** Grothus - Drapers law, Stark Einsteins law - Quantum yield - photosynthesis, phosphorescence - fluorescence - chemiluminescence - photosensitisation

#### UNIT- IV ELECTRO CHEMISTRY AND GALVANIC CELLS 8 Hrs

**Electro Chemistry:** Specific and equivalent conductivity - their determination, effect of dilution

**Galvanic Cells:** EMF and its origin, standard electrode potentials ,reference electrode (SHE& Calomel).Electrochemical series and its applications. Formation of standard cells, cell reaction and lead storage cell.

#### UNIT - V POLYMERS 7 Hrs

Introduction- classification of polymers: natural and synthetic-types of polymerization- Thermoplastic and Thermosetting polymers- uses of Nylon 6, 6 and Epoxy resins.

#### Text Books

- Madan. R.D, *Modern Inorganic Chemistry*, 2<sup>nd</sup> Edition, S.Chand& Company Limited, New Delhi, 2005.

- Puri.B.R, Sharma.L.R, & Pathania.M.S, *Principles of Physical Chemistry*, Millennium Edition, Vishal publishing & Co, Jalandhar, 2004.

#### Reference Books

- Soni.P.L, *Text Book of Physical Chemistry*, 25<sup>th</sup> Revised Edition, Sultan Chand, New Delhi, 2004.
- Puri.B.R, Sharma.L.R and Kallia.K.C, *Inorganic Chemistry*, Milstone Publisher, New Delhi, 2003.

### UCHR104/ UCHR404 VOLUMETRIC ANALYSIS

<b>Semester</b>	<b>: I/IV</b>	<b>Credit</b>	<b>: 2</b>
<b>Category</b>	<b>: Allied Practical</b>	<b>Hours/ week</b>	<b>: 3</b>
<b>Class &amp; Major</b>	<b>: I B.Sc Biochemistry/ II B.Sc Physics</b>	<b>Total Hours</b>	<b>: 39</b>

#### Objectives

##### To enable the students

- Estimate the chemical substance using Quantitative Analysis.
- Acquire the Skills in Quantitative Analysis.

#### Volumetric Analysis

1. Estimation of sodium hydroxide using standard sodium carbonate
2. Estimation of HCl using standard oxalic acid
3. Estimation of oxalic acid by KMnO<sub>4</sub> using standard oxalic acid
4. Estimation of borax using standard sodium carbonate
5. Estimation of Ferrous sulphate using standard Mohrs salt
6. Estimation of zinc using EDTA

#### Reference Books

- Thomas.A.O, *Practical chemistry*, 2nd edition, Scientific Book Center, Cannanore, 2006.
- Venkateswaran.V, Veerasawamy.R & Kulandaivelu.A.R, *Basic Principles of practical Chemistry*, 2<sup>nd</sup> edition, S. Chand & Sons Publications, New Delhi, 2008.

### III and IV Evaluation Component of CIA

Semester	Course Code	Course Title	Component-III	Component-IV
III	UCHM305	General Chemistry –III	Assignment	Seminar
	UCHM306	Separation & Purification Techniques	Poster Presentation	Seminar
IV	UCHM405	General Chemistry –IV	Assignment	Seminar
	UCHM406	Instrumental Methods of Analysis	Poster Presentation	Seminar
	UCHM507	Dairy and its products	Assignment	Preparation of milk product
	UCHA402/UCHA403	Chemistry for Physics	Assignment	Seminar
	UCHR404/UCHR405	Semi micro Qualitative Inorganic Analysis	DPA	Viva Voce
	UCHR104/ UCHR404	Volumetric Analysis	DPA	Viva Voce

## PROGRAMME PROFILE M.Sc. (Chemistry)

**PSO1:** Development of the skills in handling various chemicals, apparatus and instruments.

**PSO2:** Application of the principles of thermodynamics and chemical kinetics in chemical reactions

**PSO3:** Acquiring the knowledge on heterocyclic compounds and natural products

**PSO4:** Ability to apply the basic principles of various spectroscopic, electro and thermo analytical methods to characterize the compounds

**PSO5:** Industrial insights on polymers, textile dyes, fibre and medicinal chemistry.

Semester	Category	Course Code	Course Title	Contact Hrs/Week	Credits	
					Min	Max
I	Core-I	PCHM107/PCHM111	Organic Chemistry-I	5	4	4
	Core-II	PCHM108/PCHM112	Inorganic Chemistry-I	5	4	4
	Core-III	PCHM109	Physical Chemistry-I	5	4	4
	Core-IV	PCHM110	Nano Science and Nano Materials	5	4	4
	Core Practical-I	PCHR203	Organic Practical	5	-	-
	Core Practical-II	PCHR204	Inorganic Practical	5	-	-
<b>Total</b>				<b>30</b>	<b>16</b>	<b>16</b>
II	Core-V	PCHM204	Organic Chemistry-II	5	4	4
	Core-VI	PCHM205	Inorganic Chemistry-II	5	4	4
	Core-VII	PCHM206	Physical Chemistry-II	5	4	4
	Core Practical-I	PCHR203	Organic Practical	5	5	5
	Core Practical-II	PCHR204	Inorganic Practical	5	5	5
	Non-Major Elective			5	4	4
	Service Learning	PCHX201	Vermicomposting	-	1	1
<b>Total</b>				<b>30</b>	<b>27</b>	<b>27</b>
III	Core-VIII	PCHM306	Organic Chemistry-III	6	5	5
	Core-IX	PCHM307	Inorganic Chemistry-III	6	4	4
	Core -X	PCHM308	Physical Chemistry-III	6	4	4
	Core-XI	PPHI301/PCHI301	Sustainable Materials and Technologies	5	5	5
	Core Practical – III	PCHR401	Physical Chemistry Practical	5	-	-
	Core XVI	PCHP401	Project	2	-	-
<b>Total</b>				<b>30</b>	<b>18</b>	<b>18</b>
IV	Core-XII	PCHM404	Organic Chemistry-IV	6	5	5
	Core-XIII	PCHM408	Inorganic Chemistry-IV	5	4	4
	Core-XIV	PCHM409	Physical Chemistry-IV	5	4	4
	Core-XV	PCHM410	Research Methodology	5	4	4
	Core Practical – III	PCHR401	Physical Chemistry Practical	5	6	6
	Core XVI	PCHP401	Project	4	6	6
<b>Total</b>				<b>30</b>	<b>29</b>	<b>29</b>
<b>Total</b>				<b>120</b>	<b>90</b>	<b>90</b>

## PCHM306 ORGANIC CHEMISTRY- III

Semester	: III	Credit	: 5
Category	: Core VIII	Hours/Week	: 6
Class & Major	: II M.Sc. chemistry	Total Hours	: 78

### Objectives

#### To enable the students

- Understand the various spectroscopic methods to interpret the structure of the compounds
- Apply the gained knowledge from Alkaloids to extract it from natural products.

### UNIT-I HETEROCYCLIC COMPOUNDS 18 Hrs

Nomenclature of heterocyclic compounds. Preparation, Properties and uses - Pyrazole, Oxazole, Pyridazine, Pyrimidine, Pyrazines and Thiozole.

**Alkaloids:** Classification and isolation of alkaloids - General methods of Structural elucidation. Structural elucidation of Papaverine, Cocaine.

### UNIT-II UV AND IR SPECTROSCOPY 15 Hrs

**UV-Visible spectroscopy:** Frank-condon principle, Types of electronic transitions, Chromophores & Auxochromes, absorption and intensity shifts, Factors influencing positions & intensity of absorption bands, Absorption spectra of dienes, polyenes & unsaturated carbonyl compounds, Woodward – Fieser rules.

**IR spectroscopy** – Principle, vibrational frequencies & factors affecting them, identification of functional groups, Finger Print Region, Significance of Far IR region.

### UNIT-III MASS SPECTROMETRY 15 Hrs

Principle - EI, CI & FAB – Base peak, isotopic peaks, metastable peak, parent peak, Fragmentation–Nitrogen, even electron rule and pattern, McLafferty rearrangement, Retro - Diel's Alder reaction fragmentation pattern of hydrocarbons, alcohols, aldehydes and ketones.

### UNIT-IV NMR SPECTROSCOPY 18 Hrs

Basic principles of NMR experiments – CW & FT NMR –  $^1\text{H}$  NMR – Chemical Shift & Coupling constant – Factors influencing Proton Chemical Shift & Proton – Proton Coupling constant, AX & AB spin system – Spin decoupling – Nuclear Overhaust effect – Chemical exchange.  $^{13}\text{C}$  NMR chemical shift & factor affecting  $^{13}\text{C}$  Chemical shift.

### UNIT-V IDENTIFICATION OF ORGANIC COMPOUNDS: 12 Hrs

Identification of organic molecules using UV, IR, NMR and Mass spectroscopic techniques.

### Text Books

- Finar .I.L, *Organic Chemistry*, Vol-I&II, Fifth Edition, ELBS Publication, 2006.
- Sharma. Y.R, *Elementary Organic Spectroscopy*, Fifth Edition, S. Chand Publication, 2013.
- Jag mohan, *Organic Spectroscopy: Principles and Applications*, Second Edition, Alpha Science International Ltd., Harrow, U.K.

## Reference Books

- Dyer.J, *Applications of Organic Spectroscopy*, Prentice & Hall of India Pvt Ltd., New Delhi, 1980.
- Mukerjee.S.M & Singh.S.P, *Organic Reaction Mechanism*, McMillan India Ltd., Chennai, 1990.
- Gurdeep R. Chatwal, *Organic chemistry of Natural products*, Volume I & II Himalaya Publishing House , New Delhi, 2009.
- Kemp. W, *Organic Spectroscopy*, Mcmillan Lid., 2001.
- Silverstein.R.M, G.D.Bassler & Monson, *Spectrometric Identification of Organic Compounds*, John Wiley & Sons, New York , 2004.

## e- Books

- <https://www.k-state.edu/bmb/labs/jc/teaching/bioch590/bioch590-6-NMR.pdf>
- <https://www.weizmann.ac.il/plants/aharoni/sites/plants.aharoni/files/uploads/june192007.pdf>
- <http://chemistry.syr.edu/totah/che575/support/3a1/3-1.MS.pdf>

## PCHM307 INORGANIC CHEMISTRY- III

Semester	: III	Credit	: 4
Category	: Core IX	Hours/Week	: 6
Class & Major	: II M.Sc. chemistry	Total Hours	: 78

### Objectives

#### To enable the students

- Know about the application of Nuclear Chemistry in various fields
- Understand the properties & applications of f-block elements.
- Interpret the spectra for Inorganic compounds.

### UNIT-I CHEMISTRY OF LANTHANIDES AND ACTINIDES

15 Hrs

Lanthanides and actinides - Occurrence, isolation Position in the periodic table, lanthanide contraction, oxidation state, color, spectral, magnetic characteristics, coordination numbers, stereochemistry, nuclear and non-nuclear applications.

### UNIT-II NUCLEAR CHEMISTRY-I

16 Hrs

Subatomic particle, isotope, isotone, isobar, nuclear forces, meson theory of nuclear forces, stability of the nucleons-N/P ratio and stability belt, liquid drop model, shell and combined model of the nucleus. Mass defects and Binding energy. Natural and artificial radioactivity. Radioactivity disintegration, Group displacement law, radioactive series, Trans uranium element.

### UNIT-III NUCLEAR CHEMISTRY-II

16 Hrs

Nuclear transmutation, classification of nuclear reactions- elastic, inelastic, spallation, capture, fission and fusion reaction, Q-value of nuclear fission, mechanism and fission bomb. Nuclear fusion-Mechanism, stellar energy and Hydrogen bomb. Modes of radioactive decay –

detection and determination of activity by Cloud Chamber and Geiger Muller Counter. Nuclear reactors – Fast Breeder reactors, particle accelerators, Cyclotron and Synchrotron. Neutron Activation Analysis, isotopic dilution analysis, Dosimetry.

#### **UNIT– IV ORGANO METALLIC CHEMISTRY -I**

**15 Hrs**

Carbon donors: Alkyls and aryls metallation, Chain and cyclic donors, olefines, acetylene, and allyl system.

Reactions: Association, substitution, addition and elimination reactions, ligand protonation, electrophilic and nucleophilic attack on ligands. Carbonylation, decarboxylation, oxidative addition and fluxionality.

#### **UNIT- V ORGANO METALLIC CHEMISTRY -II**

**16 Hrs**

Catalysis: Hydrogenation of olefins(Wilkinson’s catalyst), hydroformylation of olefins using cobalt or rhodium catalysts (Oxo process), oxidation of olefins to aldehydes and ketones (Wacker process) polymerization (Zeigler-Natta catalyst): cyclo oligomerisation of acetylene using Nickel catalyst(Reppé’s catalyst), polymer bound catalysts.

#### **Text Books**

- Arniker .H.J, *Nuclear chemistry*, wiley Eastern Co, II Edition , 2000.
- Wahid U.Malik, G.D.Tuli & R.D.Madan, *Selected Topics in Inorganic Chemistry*, S.Chand & Company Ltd., New Delhi, 2010.

#### **Reference Books**

- Maheshwar Sharma & Madhuri Sharma, *Nuclear chemistry*, Ane Books Pvt. Ltd, 2009.
- Singh. G, *Chemistry of Lanthanides and Actinides*, Discovery publishing, 2008.
- J.E.Huheey, E.A. Keiter and R.L. Keiter , *Inorganic Chemistry*; 4th ed.; Harper and Row: NewYork, 1983.

#### **e-Books**

- [https://www.alchemyst.co.uk/pdf/Inorganic/lanthanides\\_and\\_actinides.pdf](https://www.alchemyst.co.uk/pdf/Inorganic/lanthanides_and_actinides.pdf)
- <http://chemistry.bd.psu.edu/jircitano/Wilkinsons13.pdf>
- <https://nptel.ac.in/courses/104101006/downloads/lecture-notes/mod3/lec4.pdf>

### **PCHM308 PHYSICAL CHEMISTRY-III**

<b>Semester</b>	<b>: III</b>	<b>Credit</b>	<b>: 4</b>
<b>Category</b>	<b>: Core X</b>	<b>Hours/Week</b>	<b>: 6</b>
<b>Class &amp; Major</b>	<b>: II M.Sc Chemistry</b>	<b>Total Hours</b>	<b>: 78</b>

#### **Objectives**

##### **To enable the students**

- Acquire the fundamental knowledge in the colloidal system
- Know about the function of the catalysts and its surface action and apply it for research work.

## **UNIT – I COLLOIDAL STATE**

**15 Hrs**

Colloidal system-classification, Preparation of lyophobic colloidal solutions-Dispersion methods and Condensation methods-Purification of colloidal solutions-general properties of colloidal systems. properties of hydrophobic colloidal systems-Electrical properties and electro kinetics properties. Determination of size of colloidal particles

## **UNIT-II SURFACE CHEMISTRY**

**16 Hrs**

Kinetics of surface reactions: Physical and chemical adsorption–adsorption isotherms–types of adsorption isotherms–Langmuir adsorption isotherm. B.E.T theory for multilayer adsorption – measurement of surface area – Mechanism of heterogeneous catalytic unimolecular and bimolecular reactions. Adsorption coefficient and its significance.

## **UNIT-III CATALYSIS**

**16 Hrs**

Acid Base catalysis – mechanism of Langmuir - Hinshelwood and Eley Rideal – Bronsted catalytic law - Catalysis by enzymes – effects of substrate concentration, pH and temperature on enzyme catalyzed reactions – reversible and irreversible enzyme inhibition mechanism.

## **UNIT–IV KINETICS OF REACTIONS IN SOLUTION AND FAST REACTION 15 Hrs**

Kinetics of reaction in solution – Diffusion controlled reactions in solutions- influence of ionic strength on rates of reactions – primary and secondary salt effect, dielectric constant.

Kinetics of fast reaction – relaxation method - temperature and pressure jump methods- flash photolysis.

## **UNIT–V CORROSION**

**16 Hrs**

Corrosion – definition – costs of corrosion – economic losses –human life and safety – types of corrosion- dry corrosion – wet corrosion –mechanisms - galvanic corrosion – concentration cell corrosion – atmospheric corrosion – soil corrosion – pitting corrosion - inter-granular corrosion-water line corrosion – stress corrosion – microbial corrosion.

Overvoltage and evolution of oxygen and hydrogen at different pH. Symmetry factors vs transfer coefficients. Corrosion and passivation of metals - Pourbiax and Evan's diagrams. Corrosion control methods. Inhibitor – types and theory

### **Text Books**

- D. R. Crow, *Principles and applications of electrochemistry*, 4th edition, Chapman & Hall/CRC, 2014.
- Atkins .P and J. de Paula, *Physical Chemistry*, 7th ed., Oxford University Press, Oxford, 2002.

### **Reference Books**

- Gabor A. Somorjai Yimin Li, *Introduction to Surface chemistry and Catalysis*, 2<sup>nd</sup> ed., John Wiley & Sons, 2010
- Puri , Sharma and Pathania, *Principle of Physical chemistry*, 46<sup>th</sup> Edition, Vishal publication, 2013.
- K.J. Laidler, *Chemical Kinetics*, Third Edition, Pearson Education India, 2008.

### **e-Books**

- <https://nptel.ac.in/courses/113108051/module1/lecture1.pdf>
- [http://www.uobabylon.edu.iq/eprints/publication\\_12\\_18276\\_228.pdf](http://www.uobabylon.edu.iq/eprints/publication_12_18276_228.pdf)

- [https://chem.libretexts.org/Courses/University\\_of\\_California\\_Davis/UCD\\_Chem\\_107B%3A\\_Physical\\_Chemistry\\_for\\_Life\\_Scientists/Chapters/2%3A\\_Chemical\\_Kinetics/2.10%3A\\_Fast\\_Reactions\\_in\\_Solution](https://chem.libretexts.org/Courses/University_of_California_Davis/UCD_Chem_107B%3A_Physical_Chemistry_for_Life_Scientists/Chapters/2%3A_Chemical_Kinetics/2.10%3A_Fast_Reactions_in_Solution)

## **PPHI301/PCHI301 SUSTAINABLE MATERIALS AND TECHNOLOGIES**

<b>Semester</b>	: III	<b>Credit</b>	: 5
<b>Category</b>	: Core XI	<b>Hours/week</b>	: 5
<b>Class &amp; Major:</b>	II - M.Sc Chemistry & Physics	<b>Total Hours</b>	: 65

### **Objectives**

#### **To enable the students**

- Understand the concept of sustainable materials
- Learn about green chemistry strategies for designing the chemical synthesis.
- Explore the theoretical understanding of various physical and chemical properties of nanomaterials.

### **UNIT– I INTRODUCTION TO MATERIALS**

**13 Hrs**

Concept of Sustainable materials, Classification of materials: Crystalline & amorphous materials, high T<sub>c</sub> superconductors, alloys & composites, semiconductors, solar energy materials, luminescent and optoelectronic materials, Polymer, Liquid crystals and quasi crystals, Ceramics.

### **UNIT– II GREEN CHEMISTRY**

**14 Hrs**

Introduction: Prospects and future of Green Chemistry - Twelve guiding principles of green chemistry - Concept of atom economy - Green starting materials, Green reagents, Green solvents and reaction conditions, Green synthesis - Real world cases (Traditional Vs. Green processes) Synthesis of Ibuprofen, Adipic acid - Biomimetic, multifunctional reagents; Combinatorial green chemistry; Non-covalent derivatization.

### **UNIT– III GREEN TECHNOLOGIES**

**13Hrs**

Green Solvents: Enhancement of selectivity, efficiency, and industrial applicability - Ionic liquids-Supercritical fluids - Solvent free neat reactions in liquid phase - Fluorous phase reactions  
Green Catalysis: Heterogeneous catalysis: Use of zeolites, silica, alumina, clay, polymers, cyclodextrins, and biocatalysts.

### **UNIT– IV CHARACTERIZATION TECHNIQUES RELATED TO NANOMATERIALS**

**13 Hrs**

Electron Microscopy techniques: Scanning Electron Microscope, Transmission Electron Microscope, Field emission scanning electron microscopy, Atomic Force Microscopy, X-ray photoelectron spectroscopy, (XPS), Energy Dispersive X-Ray Analysis (EDX).

## UNIT– V APPLICATION OF NANOMATERIALS

12 Hrs

Overview of nanomaterials properties and their applications, Molecular Electronics and Nanoelectronics – Nanobots- Biological Applications – Quantum Devices – Nanomechanics – Photovoltaic cells- Nano structures as single electron transistor.

### Reference Books

- K. Barriham, D.D. Vvedensky, *Low Dimensional Semiconductor Structures: Fundamental and Device Applications*, Cambridge University Press, 2001.
- V.K. Ahluwalia, *Methods and Reagents of Green Chemistry: An Introduction by Green Chemistry*, Ane Books India, 2006.
- Bontempi, Elza, *Raw Materials Substitution Sustainability*, Springer International Publishing, 2017.
- G. Cao, *Nanostructures & Nanomaterials: Synthesis, Properties & Applications*, Imperial College Press, 2004.

### Text Books

- J.George, Marcel Dekker, *Preparation of Thin Films*, Inc., New York. 2005.
- Rashmi Sanghi & M. M. Srivastava, *Green Chemistry – Environment Friendly Alternatives*, Narora Publishing House, 2003.
- Elson Longo, Felipe de Almeida La Porta, *Recent Advances in Complex Functional Materials*, Springer, 2017.

### e-Books

- [https://asdlb.org/onlineArticles/ecourseware/Bullen/SPMModule\\_BasicTheoryAFM.pdf](https://asdlb.org/onlineArticles/ecourseware/Bullen/SPMModule_BasicTheoryAFM.pdf)
- [http://etsf.ehu.es/files/nanorobots\\_work.pdf](http://etsf.ehu.es/files/nanorobots_work.pdf)
- <http://www.me.nchu.edu.tw/lab/CIM/www/courses/Manufacturing%20Processes/Ch07-Ceramics-Wiley.pdf>

## PCHR401 PHYSICAL CHEMISTRY PRACTICAL-I

**Semester : III & IV**  
**Category :Core Practical -III**  
**Class & Major: II M.Sc Chemistry**

**Credit : 6**  
**Hours/Week : 5+5**  
**Total Hours : 130**

### Objectives

#### To enable the students

- Understand some theoretical concepts by experimental methods
- Interpret the results in accurate manner

### Phase rule

- Binary system of Naphthalene & Biphenyl
- Binary system of Naphthalene & M-dinitrobenzene
- Three component System( $\text{CH}_3\text{COOH}$ ,  $\text{H}_2\text{O}$  &  $\text{CHCl}_3$ )

### Kinetics

- Hydrolysis of Ester
- KI Vs  $\text{K}_2\text{S}_2\text{O}_8$
- $\text{I}_2$  Vs  $\text{CH}_3\text{COCH}_3$  (By Calorimetric method)
- Comparison of Strength of two Acids.

**Partition Co-efficient**

- Instability constant ( $KI_3 = KI + I_2$ )
- Strength of KI

**Potentiometry**

- Mixture of acids Vs Strong base
- FAS Vs  $K_2Cr_2O_7$
- Determination of dissociation constant of weak acid
- Sparingly soluble salts  $BaSO_4$  (concentration cell)

**Conductometric**

- Mixture of acids Vs NaOH
- Verification of Onsager's theory
- Degree of dissociation & dissociation constant of a weak electrolyte
- Determination of solubility of a sparingly soluble salts

**Polarimeter**

- Inversion of Sucrose

**Text book**

- Alexander Findlay and Kitcher. J.A, "Practical physical chemistry", Longmans, Green, 2010.

**Reference book**

- Shoemaker .D.P and Garland .C.W, "Experiment physical chemistry", 8<sup>th</sup> ed., Mc Graw- Hill, New York, 2009.

**PCHM404 ORGANIC CHEMISTRY- IV**

<b>Semester</b>	<b>: IV</b>	<b>Credits</b>	<b>: 5</b>
<b>Category</b>	<b>: Core XI</b>	<b>Hours/Week</b>	<b>: 6</b>
<b>Class &amp; Major</b>	<b>: II-M. Sc., Chemistry</b>	<b>Total Hours</b>	<b>: 78</b>

**Objectives****To enable the students**

- Understand the principles to differentiate the Photochemical and Pericyclic reactions.
- Apply the chemistry concepts to categorize the different reagents and rearrangements in organic synthesis.
- Expose the mechanism of writing skill in Retro synthesis reactions.

**UNIT - I PHOTOCHEMISTRY****18 Hrs**

Absorption of Electromagnetic Radiation-Excited state, Types - Quantum yield - Jablonski diagram : Phosphorescence & Fluorescence - Energy transfer and Photo sensitization- Inter system crossing - photochemical reactions - photoreduction, photo enolisation, cis - trans isomerisation, photo oxidation, photo addition, photoreactions of ketones - Norrish type I & II reactions and Di-Pi methane rearrangement.

**UNIT - II PERICYCLIC CHEMISTRY****15 Hrs**

Introduction of pericyclic reactions - Conservation of molecular orbital Symmetry - Methods to explain Pericyclic reactions - Electrocyclic reactions (FMO Approach) -

Cycloaddition - Cheletropic reactions - Sigmatropic Rearrangement - Correlation Diagram method

### UNIT - III MOLECULAR REARRANGEMENT

15 Hrs

Introductory concept of rearrangements, migrating aptitude, memory effect. Pinacol - Pinacolone, Wager- Meerwein, , Favorski, Baeyer - Villiger, Wolf, Stevens ( in cyclic systems) Von Richter rearrangements, Hoffman, Curtius, Lossen, Schmidt, Beckman, Benzil-Benzilic, Benzidine , Fries and cope rearrangement.

### UNIT - IV MORDERN REAGENTS FOR ORGANIC SYNTHESIS

12 Hrs

CrO<sub>3</sub>, peracids, Osmiumtetroxide, DDQ, Seleniumdioxide, DCC, DMSO, aluminium triisopropoxide, Diazomethane, LAH, NaBH<sub>4</sub>, organoboranes, , NBS, LTA, Wittig reagent. Pd compounds- heck & Suzuki coupling.

### UNIT - V RETROSYNTHESIS

18Hrs

An introduction to retero synthesis - Synthon, Synthetic equivalent, Umpolung-Target molecule, Functional group interconversion, Disconnection approach - One group disconnection - Disconnection of alcohols, olefins and ketones - Logical and illogical disconnection, Two group disconnection- 1,2 - 1,3 - 1,4 - 1,5 and - Deoxygenated skeletons and dicarbonyls. Retero Diels Alder reaction, Reterosynthesis .

#### Text books

- Jonathanclayden, Nick Greeves and Warrner Stuart, Organic Chemistry, Oxford University Press, Oxford, UK, 2012.
- Jerry March, *Advanced Organic Chemistry*, 6<sup>th</sup> edition, John Wiley & Sons. New York, 2007.
- Ahluwalia .V.K, *Organic Reaction Mechanism*, 4<sup>th</sup> edition, Narosa Publishers, 2011.

#### Reference books

- Coyle .J.D, *Organic Photo Chemistry*-Wiley, 2004
- Aggarwal. O.P, “ *Reaction and Reagents in organic chemistry*”, 4<sup>th</sup> edition, Goyle publications, 2004.
- Gaikwad .N.J, Chaudari R. Y, Patil V.R., *Retrosynthetic analysis and synthesis of drugs*, Nirali prakashan Publication, 2006.

#### e-Books

- <https://www.massey.ac.nz/~gjrowlan/chem312/lct1.pdf>
- <http://diposit.ub.edu/dspace/bitstream/2445/61063/25/5.%20Organic%20Synthesis.%20Introduction%20to%20Retrosynthetic%20Analysis.pdf>
- <https://www.massey.ac.nz/~gjrowlan/chem312/tutorial.pdf>

## PCHM408 INORGANIC CHEMISTRY – IV

Semester	: IV	Credit	: 4
Category	: Core XIII	Hours/Week	: 5
Class & Major	: II M.Sc. chemistry	Total Hours	: 65

#### Objectives

##### To enable the students

- Understand the basic concept of supramolecular and green chemistry
- Acquire skill to interpret the spectra of NMR, EPR and NQR for inorganic compounds.

**UNIT – I INORGANIC CHAINS, RINGS, CAGES AND CLUSTERS****15 Hrs**

Silicate minerals – ortho-, pyro-, and meta-silicates – pyroxene, amphiboles– two-dimensional silicates – talc, mica and three dimensional aluminosilicates, feldspar, ultramarine – Polymeric sulphur nitride, phosphonitrilic compounds-trimers and tetramers - homocyclic inorganic ring systems – Concept of multi-centered bond – structure of  $B_2H_6$ ,  $B_4H_{10}$ ,  $[B_{12}H_{12}]^{2-}$ ,  $B_6H_{10}$ ,  $B_8H_{12}$ ,  $B_{10}H_{14}$  – Wade’s rules, closo, nido, arachno boranes and carboranes – The “styx” code.

**UNIT – II EPR SPECTROSCOPY****12 Hrs**

Electron spin resonance: theory, g value– factors affecting the magnitude of g- values , hyperfine structure, ESR of organic free radicals, ESR of inorganic ions, ESR of simple free radicals in solutions, zero field splitting and Kramer’s degeneracy.

**UNIT-III APPLICATIONS OF NQR AND MOSSBAUER SPECTROSCOPY****14 Hrs**

NQR Spectra of transition metal complexes, metal hyperfine anisotropic spectra. Zero-field splitting, applications. Mossbauer-Principles, isomer shift, quadrupole effect of magnetic field, Magnetic hyperfine interactions, Applications of the technique to the studies of (i) bonding and structures of  $Fe^{2+}$  and  $Fe^{3+}$  compounds including those of intermediate spin, (ii)  $Sn^{+2}$  and  $Sn^{+4}$  compounds, nature of M-L bond, coordination number, structure and (iii) detection of oxidation state.

**UNIT-IV SUPRAMOLECULAR CHEMISTRY****12Hrs**

Metallocenes- Electronic structure and bonding in ferrocene- synthesis – physical and spectroscopic properties of metallocenes- reactions and applications of metallocenes- multiple decker sandwich complexes- application of metallocenes in polymers- non-linear optics- medicine- molecular recognition– catalysis.

**UNIT-V GREEN CHEMISTRY****12 Hrs**

The Twelve principles, atom economy for addition, elimination, substitution reactions and its calculation, green starting materials, green reagents, green catalysts, green solvents and green reactions.

**Text Books**

- Parish. R. V, *NMR, NQR, EPR and Mossbauer Spectroscopy in Inorganic Chemistry*, EllisHorwood, New York, 1990.
- Ahluwalia .V.K and Varma, *Text book of Green Chemistry*, 3<sup>rd</sup> ed., Ane Books Pvt. Ltd, 2013

**Reference Books**

- Gokel. W, “*Advances in Supramolecular Chemistry*”, Vol.7, Jai press INC, 2000.
- J.E.Huheey, E.A. Keiter and R.L. Keiter , *Inorganic Chemistry*; 4th ed.; Harper and Row: NewYork, 1983.

**e-Books**

- <https://www.rsc.org/Education/Teachers/Resources/Inspirational/resources/6.4.4.pdf>
- <https://nptel.ac.in/courses/104108062/module6.pdf>
- <http://www.anilmishra.name/notes/nqr1.pdf>

## PCHM409 PHYSICAL CHEMISTRY-IV

<b>Semester</b>	<b>: IV</b>	<b>Credit</b>	<b>: 4</b>
<b>Category</b>	<b>: Core XIV</b>	<b>Hours/Week</b>	<b>: 5</b>
<b>Class &amp; Major</b>	<b>: II M.Sc. chemistry</b>	<b>Total Hours</b>	<b>: 65</b>

### Objectives

#### To enable the students

- Understand the principles of Magnetic, Quadruple and Electron resonance spectroscopy.
- Analyse the samples using different analytical techniques like SEM, TEM, AFM, STM, Polarography and cyclic voltammetry.
- Differentiate cells by using photo analytical techniques.

### UNIT– I ROTATIONAL AND VIBRATIONAL SPECTROSCOPY 15 Hrs

The rotation of molecules, rotational spectra-rigid diatomic molecule, intensity of spectral lines, selection rules, effect of isotopic substitution. Diatomic molecules as non-rigid rotors. Polyatomic molecules-linear, symmetric and asymmetric top molecule. Stark effect.

Vibrating diatomic molecule: energy of diatomic molecules as simple harmonic oscillator-energy levels, vibrational transitions, selection rules; anharmonic oscillator-energy levels, selection rules, vibrational transitions. - Diatomic vibrating rotator: Born-Oppenheimer approximation, vibration of polyatomic molecules-fundamental vibrations, linear molecules, symmetric top and asymmetric top molecules.

### UNIT - II MICROSCOPY TECHNIQUES 12 Hrs

Principle, theory, Instrumentation and Application of Optical microscopy - Scanning electron microscope (SEM) - Transmission electron microscope (TEM)- Atomic force microscope (AFM) - Surface Tunneling microscope (STM) - Energy dispersive X-ray spectroscopy (EDX).

### UNIT – III MACROMOLECULES 13 Hrs

Polymerization in homogeneous and heterogeneous phases - Kinetics of polymerization (Ionic and Addition)-kinetics of copolymerization - Mechanism of Polymerization - Chain Initiation- Propagation - Termination-Transfer -Inhibition and Retardation. Properties of polymers : Molecular weight of polymers - Mw, Mn determination - Light Scattering, Ultra centrifuge - Gel Permeation Chromatography.

### UNIT- IV PHOTO and Radiation Chemistry 10 Hrs

Photovoltaic and photogalvanic cells, photoelectrochemical cells, photo assisted electrolytes of water, aspects of solar energy conversion. Radiation chemistry-Interaction of high energy radiation with matter-primary and secondary processes-G value- radiolysis of water-hydrated electron.

### UNIT - V ELECTRO ANALYTICAL TECHNIQUES 15 Hrs

Polarography – theory, DME, diffusion, Kinetic and catalytic currents, current-voltage curves for reversible and irreversible systems, Qualitative and quantitative application to

inorganic systems. Amperometric titrations- theory, types of titration curves, Cyclic Voltammetry - theory, instrumentation, differential pulse Voltammetry - principle and instrumentation.

#### **Text Books**

- Banwell .C. N and McCash .E. M, *Fundamentals of Molecular Spectroscopy*, 4th ed., Tata McGraw Hill, New Delhi, 2007.
- Drago. R. S, *Physical Methods in Chemistry*; Saunders: Philadelphia, 2008.
- Allen J. Bard and Israel Rubinstein, *Electroanalytical chemistry*, vol.22, Marcel Dekker, 2004.

#### **Reference Books**

- Atkins. P and J. de Paula, *Physical Chemistry*, 7th ed., Oxford University Press, Oxford, 2002.
- Raman .K. V, Gopalan .R and Raghavan .P. S, *Molecular Spectroscopy*, Thomson and Vijay Nicole, Singapore, 2004.
- Weil .J. A, Bolton .J. R and Wertz .J. E, *Electron Paramagnetic Resonance*; Wiley Interscience, 2005.

#### **e-Books**

- [https://pubweb.eng.utah.edu/~lzung/images/Lecture\\_6\\_STM.pdf](https://pubweb.eng.utah.edu/~lzung/images/Lecture_6_STM.pdf)
- [https://gcep.stanford.edu/pdfs/assessments/solar\\_assessment.pdf](https://gcep.stanford.edu/pdfs/assessments/solar_assessment.pdf)
- [https://shodhganga.inflibnet.ac.in/bitstream/10603/88264/10/10\\_chapter%201.pdf](https://shodhganga.inflibnet.ac.in/bitstream/10603/88264/10/10_chapter%201.pdf)

### **PCHM410 RESEARCH METHODOLOGY**

<b>Semester</b>	<b>: IV</b>	<b>Credits</b>	<b>: 4</b>
<b>Category</b>	<b>: Core XV</b>	<b>Hours/Week</b>	<b>: 5</b>
<b>Class &amp; Major</b>	<b>: II M.Sc. Chemistry</b>	<b>Total hours</b>	<b>: 65</b>

#### **Objectives**

##### **To enable the students**

- Identify the research problems
- Analysis of data using software.
- Draft research reports efficiently

#### **UNIT - I LITERATURE SURVEY**

**13 Hrs**

Nature and importance of research - aims, objective, principles and problems - selection of research problem - survey of scientific literature - primary and secondary sources -citation index for scientific papers and journals - patents.

#### **UNIT - II PROCESSING OF DATA**

**13 Hrs**

Editing ,Coding, Tabulation-Problems-use of computers in social research-Analysis of data-statistical analysis- Diagramatic and graphic representation-interpretation of research.

#### **UNIT - III STATISTICAL TREATMENT OF ANALYTICAL DATA**

**13 Hrs**

Sampling –Definition, need and types-Sampling errors - Statistical treatment of finite samples - the students test and F test Criteria for rejection of an observation - the Q test, significant figures and computation rules - data plotting - least square analysis.

**UNIT-IV SCIENTIFIC WRITING****15 Hrs**

Internet source- e Books, e- Journals, Thesis writing, Website- Information and retrieving Chemical compound search - Conventions of writing - the general format - page and chapter format - Revising editing and evaluating the final product - proof reading - Meanings and examples of commonly used abbreviations.

**UNIT – V PROPOSAL WRITING AND PLAGIARISM****11 Hrs**

Patent and project proposal – writing – knowledge of various funding agencies. Plagiarism – definition, classification and their limitations

**Text Books**

- Kothari. C.R, *Research Methodology- Methods and techniques*, New Wiley Eastern Ltd., New Delhi, 2009.
- Paneerselvam, *Research Methodology*, R. Prentice hall of India, New Delhi, 2004.

**Reference Books**

- Anderson. J, Durston .H.M and Poole. M, “*Thesis and assignment writing*”: Wiley Eastern Ltd., 2007.
- Suresh Chandra, Mohit kr. Sharma, “*Research Methodology*”, Alpha science, Oxford, 2013.

**e-Books**

- <http://www.library.auckland.ac.nz/docs/helpsheets/Bibliometrics.pdf>
- <https://www.researchgate.net/...plagiarism...plagiarizing.../The-Effect-of-Anti- plagiaris...>

**III and IV Evaluation Component of CIA**

Semester	Course Code	Course Title	Component-III	Component-IV
III	PCHM306	Organic Chemistry-III	Mechanism writing	Seminar
	PCHM307	Inorganic Chemistry-III	Assignment	Seminar
	PCHM308	Physical Chemistry-III	Assignment	Seminar
	PCHI301	Sustainable Materials and Technologies	Poster Presentation	Seminar
IV	PCHM404	Organic Chemistry- IV	Mechanism writing	Seminar
	PCHM408	Inorganic Chemistry – IV	Assignment	Seminar
	PCHM409	Physical Chemistry-IV	Problem Solving	Seminar
	PCHM410	Research Methodology	Assignment	Seminar
	PCHR401	Physical Chemistry Practical-I	DPA	Viva Voce