

**VINAYAKA MISSION'S RESEARCH FOUNDATION**

**(Deemed to be University)**

**FACULTY OF ARTS & SCIENCE**



**CURRICULUM AND SYLLABUS FOR**

**MASTER OF SCIENCE IN CHEMISTRY  
(Regular)**

**Learning Outcome Based Curriculum Framework  
(LOCF-2022)**

**(For the Academic year-2022-2023 onwards)**

Semester	Compulsory Core Courses (CC) Theory	Compulsory Core Courses (CC) Practical	Discipline Specific Elective (DSE/Inter Disciplinary/Generic Electives)	Ability Enhancement Compulsory Courses (AEC)	Skill Enhancement Course (SEC)	Total Credits
Sem I	CC (I,II,III) (3 x 4 credits =12 credits)	CC(P) (I,II) (2 x 3 credits =6 credits)	DSE - I (1 x 4 credits =4 credits)		SEC - I (1 X 3 = 3 Credits)	25
Sem II	CC (IV,V,VI) (3 x 4 credits =12 credits)	CC(P) (III,IV) (2 x 3 credits =6 credits)	DSE - II (1 x 4 credits =4 credits)		SEC - II (1 X 3 = 3 Credits)	25
Sem III	CC (VII,VIII,IX) (3 x 4 credits =12 credits)	CC(P) (V,VI) (2 x 3 credits =6 credits)	DSE - III (1 x 4 credits =4 credits)	AEC - I (1 x 4 credits =4 credits)	---	26
Sem IV	CC (X) (1 x 4 credits =4 credits)  Core Project work (1 x 8 credits =8 credits)		DSE -IV, V (2 x 4 credits =8 credits)	AEC - II (1 x 4 credits =4 credits)		24
<b>Total</b>	<b>48</b>	<b>18</b>	<b>20</b>	<b>8</b>	<b>6</b>	<b>100</b>

Name	No of Courses	No of Credits	Total
Core Course Theory (CCT)	10	4	40
Core Course Practical (CCP)	6	3	18
Discipline Specific Elective Course (DSE)	5	4	20
Ability Enhancement Compulsory Course (AEC)	2	4	8
Skill Enhancement Course (SEC)	2	3	6
Core Project Work (CPW)	1	8	8
<b>Total Credits</b>			<b>100</b>

Sem	Component	Course Title	Theory / Practical	Credits
<b>First Semester</b>	Compulsory Core Course Theory-I	CCT – I: Inorganic Chemistry-I	Theory	4
	Compulsory Core Course Theory-II	CCT – II: Physical Chemistry-I	Theory	4
	Compulsory Core Course Theory-III	CCT – III: Organic Chemistry-I	Theory	4
	Compulsory Core Course Practical-I	CCP – I: Inorganic Chemistry Practical-I	Practical	3
	Compulsory Core Course Practical-II	CCP – II: Physical Chemistry Practical-I	Practical	3
	Discipline Specific Elective Course - I	DSE - I: (Any one selected from the list)	Theory	4
	Skill Enhancement Course - I	SEC - I: (Any one selected from the list)	Theory	3
	<b>Total Credits</b>			<b>25</b>
<b>Second Semester</b>	Compulsory Core Course Theory-IV	CCT – IV: Inorganic Chemistry-II	Theory	4
	Compulsory Core Course Theory-V	CCT – V: Physical Chemistry-II	Theory	4
	Compulsory Core Course Theory-VI	CCT – VI: Organic Chemistry-II	Theory	4
	Compulsory Core Course Practical-III	CCP – III: Organic Chemistry Practical-I	Practical	3
	Compulsory Core Course Practical-IV	CCP – IV: Inorganic Chemistry Practical-II	Practical	3
	Discipline Specific Elective Course - II	DSE - II: (Any one selected from the list)	Theory	4
	Skill Enhancement Course - II	SEC - II: (Any one selected from the list)	Theory	3
	<b>Total Credits</b>			<b>25</b>
<b>Third Semester</b>	Compulsory Core Course Theory-VII	CCT – VII: Inorganic Chemistry-III	Theory	4
	Compulsory Core Course Theory-VIII	CCT – VIII: Physical Chemistry-III	Theory	4
	Compulsory Core Course Theory-IX	CCT – IX: Organic Chemistry-III	Theory	4
	Compulsory Core Course Practical-V	CCP – V: Organic Chemistry Practical-II	Practical	3
	Compulsory Core Course Practical-VI	CCP – VI: Physical Chemistry Practical-II	Practical	3
	Discipline Specific Elective Course - III	DSE – III: (Any one selected from the list)	Theory	4
	Ability Enhancement Compulsory Course - I	AEC – I: Human Rights	Theory	4
	<b>Total Credits</b>			<b>26</b>
<b>Fourth Semester</b>	Compulsory Core Course Theory-X	CCT – X: Organic Chemistry-IV	Theory	4
	Discipline Specific Elective Course - IV	DSE – IV: (Any one selected from the list)	Theory	4
	Discipline Specific Elective Course - V	DSE – V: (Any one selected from the list)	Theory	4
	Ability Enhancement Compulsory Course - II	AEC – II: Analytical Techniques	Theory	4
	Core Project Work	CPW: Core Project Work	Project	8
<b>Total Credits</b>			<b>24</b>	
<b>Total (Four Semesters Credits)</b>				<b>100</b>

## Syllabus

<b>Compulsory Core Courses - Theory (CCT)</b>			
<b>Component</b>	<b>Course Title</b>	<b>Theory / Practical</b>	<b>Credits</b>
Compulsory Core Course Theory-I	CCT – I: Inorganic Chemistry-I	Theory	4
Compulsory Core Course Theory-II	CCT – II: Physical Chemistry-I	Theory	4
Compulsory Core Course Theory-III	CCT – III: Organic Chemistry-I	Theory	4
Compulsory Core Course Theory-IV	CCT – IV: Inorganic Chemistry-II	Theory	4
Compulsory Core Course Theory-V	CCT – V: Physical Chemistry-II	Theory	4
Compulsory Core Course Theory-VI	CCT – VI: Organic Chemistry-II	Theory	4
Compulsory Core Course Theory-VII	CCT – VII: Inorganic Chemistry-III	Theory	4
Compulsory Core Course Theory-VIII	CCT – VIII: Physical Chemistry-III	Theory	4
Compulsory Core Course Theory-IX	CCT – IX: Organic Chemistry-III	Theory	4
Compulsory Core Course Theory-X	CCT – X: Organic Chemistry-IV	Theory	4

<b>Compulsory Core Courses - Practical (CCP) / Project Work (CPW)</b>			
<b>Component</b>	<b>Course Title</b>	<b>Practical / Project</b>	<b>Credits</b>
Compulsory Core Course Practical-I	CCP – I: Inorganic Chemistry Practical-I	Practical	3
Compulsory Core Course Practical-II	CCP – II: Physical Chemistry Practical-I	Practical	3
Compulsory Core Course Practical-III	CCP – III: Organic Chemistry Practical-I	Practical	3
Compulsory Core Course Practical-IV	CCP – IV: Inorganic Chemistry Practical-II	Practical	3
Compulsory Core Course Practical-V	CCP – V: Organic Chemistry Practical-II	Practical	3
Compulsory Core Course Practical-VI	CCP – VI: Physical Chemistry Practical-II	Practical	3
Core Project Work	CPW: Core Project Work	Project	8

<b>Discipline Specific Elective Courses (DSE)</b>			
<b>Component</b>	<b>Course Title</b>	<b>Theory / Practical</b>	<b>Credits</b>
Discipline Specific Elective Course - I	DSE - I: (Any one selected from the list)	Theory	4
Discipline Specific Elective Course - II	DSE - II: (Any one selected from the list)	Theory	4
Discipline Specific Elective Course - III	DSE – III: (Any one selected from the list)	Theory	4
Discipline Specific Elective Course - IV	DSE – IV: (Any one selected from the list)	Theory	4
Discipline Specific Elective Course - V	DSE – V: (Any one selected from the list)	Theory	4

**List of Discipline Specific Elective Courses (DSE)**

1. Theories of molecular structure
2. Bioorganic Chemistry
3. Pharmaceutical Chemistry
4. Selected Topics in Inorganic and Physical Chemistry- I
5. Selected Topics in Chemistry
6. Nano Science and Technology
7. Computational Chemistry and Numerical Analysis
8. Solid State and bioinorganic compounds
9. Research methodology

<b>Skill Enhancement Courses (SEC)</b>			
<b>Component</b>	<b>Course Title</b>	<b>Theory / Practical</b>	<b>Credits</b>
Skill Enhancement Course - I	SEC - I: (Any one selected from the list)	Theory	3
Skill Enhancement Course - II	SEC - II: (Any one selected from the list)	Theory	3

**List of Skill Enhancement Courses**

1. Selected Topics in Organic Chemistry
2. Industrial Products
3. Health Science
4. Herbal Technology
5. Medical Biotechnology
6. Food Technology

<b>Ability Enhancement Compulsory Courses (AEC)</b>			
<b>Component</b>	<b>Course Title</b>	<b>Theory / Practical</b>	<b>Credits</b>
Ability Enhancement Compulsory Course - I	AEC – I: Human Rights	Theory	4
Ability Enhancement Compulsory Course - II	AEC – II: Analytical Techniques	Theory	4

Semester	Course code	Title of the Course	Hours	Credits
I		<b>CORE-1: INORGANIC CHEMISTRY - I</b>	5	4

CO. No.	CO-Statements	Cognitive Levels (K-Level)
	On successful completion of this course, students will be able to	
CO-1	Identify the catalytic and magnetic properties of transition elements.	K1
CO-2	Understand the structures of selected complexes.	K2
CO-3	Apply the fundamental aspects of nuclear chemistry.	K3
CO-4	Compare and contrast the properties of lanthanides and actinides.	K4
CO-5	Interpret and elaborate various structure-property relations of transition metal complexes.	K5 & K6

### Unit-I Transition Elements (18 Hours)

Transition elements - general characteristics - atomic, ionic radii - variation along the period and group - variable valency, colour, magnetic properties, non-stoichiometry, catalytic property, formation of alloys, complexing tendency - stabilization of unusual oxidation states.

### Unit-II Inner Transition Elements (18 Hours)

Inner transition elements - position in the periodic table - electronic configuration, oxidation states, solubility, colour and spectra, magnetic properties - separation of lanthanides - lanthanide contraction: causes and consequences - gadolinium break, shift reagents - extraction of thorium and uranium- comparison of actinides and lanthanides.

### Unit-III Selected Compounds of *d*-block and basics of Nuclear Chemistry (18 Hours)

**Selected compounds of *d*-block elements:** (Structure only): chromium (II) acetate, manganese (III) acetate, manganese (III) oxalate,  $[\text{Re}_2\text{Cl}_8]^{2-}$ ,  $[\text{Nb}_6\text{Cl}_{12}]^{2+}$ ,  $[\text{Mo}_6\text{Br}_8]^{4+}$ , Prussian blue, Turnbull's blue,  $[\text{Ni}(\text{DMG})_2]$ ,  $[\text{Zn}(\text{EDTA})]$ .

**Fundamentals of Nuclear Chemistry:** Subatomic particles and their properties - nuclear binding energy - nuclear structure - liquid drop model and nuclear shell model - *n/p* ratio - nuclear forces - modes of radioactive decay - alpha, beta and gamma decay - orbital electron capture - nuclear isomerism - internal conversion.

### Unit -IV Instrumental Techniques in Nuclear Chemistry (18 Hours)

Q-value of nuclear reaction, coulombic barrier, nuclear cross section, threshold energy and excitation function - different types of nuclear reactions: fragmentation, nuclear fission, nuclear fusion and spallation - proportional counter, Geiger-Muller counter, scintillation counter and Cherankov counter-linear accelerators - cyclotron, synchrotron.

### Unit - V Applications of Fission, Fusion and Trace Elements (18 Hours)

Characteristics of fission reactions - product distribution, theories of fission - fissile and fertile isotopes - nuclear fusion and stellar energy- nuclear wastes - nuclear reprocessing - radiation hazards and prevention - applications of isotopes - neutron activation analysis -



isotopic dilution analysis - uses of tracers in structural and mechanistic studies, agriculture, medicine and industry - radio carbon dating - hot atom chemistry - atomic power projects in India.

### Books for Study

- Huheey J E, Keiter E A and Keiter R L, *Inorganic Chemistry Principles of Structure and Reactivity*, 4<sup>th</sup> Edition, Harper Collins College Publishers, New York, 1993.  
**Unit I and II Chapter 14**
- Lee J D, *Concise Inorganic Chemistry*, 5<sup>th</sup> Edition, ELBS, London, 1998.  
**Unit I Chapter 18                      Unit II Chapter 29 and 30**
- Glasstone S, *Source Book on Atomic Energy*, Affiliated East West Press Pvt. Ltd. New Delhi, 1967.  
**Unit III Chapter 1 and 5      Unit IV Chapter 6      Unit V Chapter 13-18**

### Books for Reference

- Cotton F A and Wilkinson G, *Inorganic Chemistry A Comprehensive Text*, 3<sup>rd</sup> Edition, Inter Science Publishers, New York, 1972.
- Shriver D, Weller M, Overton T, Rourke J and Armstrong F, *Inorganic Chemistry*, 6<sup>th</sup> Edition, W H Freeman and Company, New York, 2014.
- Housecroft C E and Sharpe A G, *Inorganic Chemistry*, 4<sup>th</sup> Edition, Pearson Education Limited, Essex, 2012.
- Friedlander G, Macias E S, Kennedy J W and Miller J M, *Nuclear and Radiochemistry*, 3<sup>rd</sup> Edition, John Wiley and Sons Inc., London, 1981.
- Arniker H J, *Essentials of Nuclear Chemistry*, New Age International Publishers, New Delhi, 2005.

### Web Resources



Radioactivity



Nuclear Fission



Nuclear Reactions



Reactor System



Periodic Table Properties

Semester	Course code	Title of the Course									Hours	Credits
I	21PCH1CC01	CORE-1: INORGANIC CHEMISTRY - I									5	4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO-1	3	2	2	2	2	3	2	2	2	2	2.2	
CO-2	3	2	2	2	2	3	2	2	2	2	2.2	
CO-3	3	3	2	2	2	2	3	2	2	2	2.3	
CO-4	3	2	2	2	2	2	3	2	2	2	2.2	
CO-5	3	2	2	2	2	3	3	2	2	2	2.3	
<b>Mean overall Score</b>											<b>2.24 (High)</b>	

Semester	Course Code	Title of the Course	Hours	Credits
I		<b>CORE-2: PHYSICAL CHEMISTRY-I</b>	5	4

CO. No.	CO-Statements	Cognitive Levels (K level)
	On successful completion of this course, students will be able to	
CO-1	Describe the concepts of classical mechanics.	K1
CO-2	Understand the fundamentals of statistical thermodynamics.	K2
CO-3	Apply mathematical relations in quantum chemistry.	K3
CO-4	Correlate the Schrodinger equation with simple systems.	K4
CO-5	Interpret and validate the concepts of statistical thermodynamics in various thermodynamic functions.	K5 & K6

### Unit-I Classical Mechanics (21 Hours)

Conservation principles- conservation of linear momentum, angular momentum and energy- equations of motion - Newtonian, Lagrangian and Hamiltonian- failure of classical mechanics - black body radiation- photoelectric effect - heat capacity of substances- hydrogen atomic spectrum- wave particle dualism- de-Broglie equation- Compton effect - uncertainty principle and its applications - conversion of classical wave equation into Schrodinger wave equation.

### Unit-II Mathematics for Quantum Chemistry (21 Hours)

Functions - definition- classification- linearly dependent and independent functions- odd and even functions- inner product- normalization- orthogonality- orthonormal functions- Kronecker delta -proper function - Eigen functions - need for normalization- review of vectors and vector spaces- operators - linear and non-linear operators- commutation relationship- Construction of operators-linear momentum- angular momentum and energy operators- commutation relation among angular momentum operators- Hermitian operators and their properties- anti Hermitian - postulates of quantum mechanics.

### Unit-III Basic Quantum Chemistry (21 Hours)

Solution of the Schrodinger equation for exactly solvable problems - particle in 1D and 3D boxes - harmonic oscillator and rigid rotor- tunneling - one dimensional potential barrier and wells - solution of Schrodinger equation for hydrogen atom - radial and angular probability distributions - atomic orbital and electron spin - Pauli's exclusion principle.

### Unit-IV Fundamentals of Statistical Thermodynamics (21 Hours)

Statistical method - microstates- macro states - permutations and combinations - combinatory rule - probability theorems - ensembles - phase space - thermodynamic probability - statistical equilibrium - Maxwell Boltzmann statistics - derivation of M.B. statistics - relationship between entropy and probability - heat capacity of solids - Einstein and Debye models - statistical meaning of third law of thermodynamics.

### Unit-V Applications of Statistical Thermodynamics (21 Hours)

Partition functions - molar- translational- rotational and vibrational partition functions of diatomic and polyatomic molecules - separation of partition function according to forms of energy-partition function and vibrational energy - total partition function - electronic partition function-derivation of thermodynamic quantities E, S, A, H, G, K and  $C_p$ ,  $C_v$  using partition function-Sackur-Tetrode equation - Bose - Einstein statistics - Fermi - Dirac statistics -

electronic heat capacity of gases - equipartition of energy - classical and quantum statistical theory of heat capacities - heat capacities for diatomic molecule - rotational heat capacity of hydrogen molecule - nuclear spin statistics - nuclear spin entropy- quantum statistics.

### Books for Study

1. Prasad R K, *Quantum Chemistry*, 5<sup>th</sup> Edition, Wiley Eastern Ltd, New Delhi, 1992.  
**Unit I, II and III Chapters 1- 7**
2. Anderson J M, *Mathematics of Quantum Chemistry*, 1<sup>st</sup> Edition, W.A. Benjamin Inc., Massachusetts, 2005. **Unit II Chapter 1 and 2**
3. McQuarrie D A, *Quantum Chemistry*, 1<sup>st</sup> Indian Edition, Viva Books Private Ltd., New Delhi, 2007. **Unit I, II and III Chapter: 1-6**
4. Kuriakose J C and Rajaram J C, *Thermodynamics*, Shoban Lal Co., Jalandar, 1996.  
**Unit IV and V Chapter 7 and 8**

### Books for Reference

1. Levine I N, *Quantum Chemistry*, 6<sup>th</sup> Edition, Prentice Hall of India, Pvt. Ltd., 2009.
2. Atkins P and Ronald Friedman, *Molecular Quantum Mechanics*, 5<sup>th</sup> Edition, Oxford University Press, New York, 2011.
3. Gupta M C, *Statistical Thermodynamics*, 2<sup>nd</sup> Edition, New Age International Publishers, Chennai, 1998.
4. McQuarrie D A, *Statistical Thermodynamics*, Indian Edition, Viva Books Private Ltd., New Delhi, 2003.

### Web Resources



Wave  
Duality



Postulates-Part-I



Particle in a Box



Statistical  
Thermodynamics



Microstates

Semester	Course code	Title of the Course									Hours	Credits
I	21PCH1CC02	CORE-2: PHYSICAL CHEMISTRY-I									5	4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO-1	3	3	2	2	1	3	3	2	2	1	2.2	
CO-2	2	2	2	3	1	2	2	2	3	1	2.0	
CO-3	3	2	2	2	2	3	2	2	2	2	2.2	
CO-4	2	3	2	2	2	2	3	2	2	2	2.2	
CO-5	3	3	3	2	2	3	3	3	2	2	2.6	
Mean overall Score											2.24 (High)	

Semester	Course Code	Title of the Course	Hours	Credits
I		CORE 3 ORGANIC CHEMISTRY - I	5	4

CO No.	CO-Statements	Cognitive Levels (K - level)
	On successful completion of this course, students will be able to	
CO-1	Understand the concepts of stereochemistry and write the configurational nomenclature.	K1
CO-2	Examine the mechanisms of nucleophilic substitution reactions and describe nucleophilic substitution on aromatic rings.	K2
CO-3	Compose multiple ways for addition-elimination reactions and predict the stereochemistry of elimination mechanisms.	K3
CO-4	Assess the concept of aromaticity and classify the reactions on aromatic rings.	K4
CO-5	Identify the types of intermediates and their role in identifying organic mechanisms.	K5

### Unit -I Stereochemistry (15 Hours)

**Configuration:** Double bonds - cyclic systems - tetrahedral atoms with multiple stereogenic centres - other types of stereogenic centres - axial chirality - biphenyls, allenes, spiranes - assigning *R/S* - chirality and symmetry concept of atropisomerism - helicity and chirality - Topocity and prostereoisomerism - topocity of ligands and faces - enantiotopic ligands and faces - diastereotopic ligands and faces - configuration at prochiral centers.

**Conformation:** Mono and disubstituted three-, four-, five- and six- membered ring systems and their optical activity - conformations of decalin - Newmann projection of cyclohexane and decalins - chirality in molecules with non-carbons stereocenters (*N*, *S* and *P*).

### Unit-II Nucleophilic Substitutions (15 Hours)

**Mechanisms of nucleophilic substitution:** Ionization mechanism:  $S_N1$  and direct displacement mechanism:  $S_N2$  - borderline mechanism - stereochemistry and mechanism - substitution in aryldiazonium ions - structural and solvation effects on reactivity - nucleophilicity - solvation -leaving group ability - steric and strain effects - effect of conjugation on reactivity - neighbouring group participation (NGP) - substitution at vinylic and allylic carbons and reactivity - ambient nucleophiles and substrates - hydrolysis of esters - mechanisms - phase transfer catalysis (PTC) - crown ethers.

**Nucleophilic substitutions on aromatic rings:**  $S_NAr$  mechanism -  $S_N1$  (Aromatic) mechanism with evidences - Benzyne mechanism - effect of substrate structure, leaving group, attacking nucleophile and solvent.

### Unit - III Aromatic Substitution Reactions (15 Hours)

**Aromaticity:** Huckel's theory of aromaticity: Huckel Molecular Orbital (HMO) energies for conjugated planar ring systems of 3-9 carbon atoms - annulenes - cyclobutadiene - benzene - cyclooctatetraene - [10-18] and larger annulenes - aromaticity in charged rings - cations and anions - homoaromaticity - fused ring systems - polycyclic aromatic compounds - hydrocarbons incorporating exocyclic bonds - heteroaromatic systems.

**Electrophilic substitution reactions:** Active electrophiles - generalized mechanism - structure - reactivity relationships for substituted benzenes - mechanistic interpretation of the relationship - reactivity of polycyclic and heteroaromatic compounds - nitration - halogenation

- protonation and hydrogen exchange - alkylation and acylation - substitution by diazonium ions - substitution of groups other than hydrogen.

#### **Unit-IV Addition and Elimination Reactions (15 Hours)**

**Addition reactions:** Introduction - addition of HX to alkenes - acid catalyzed hydration and related reactions - addition of halogens - sulfenylation and selenylation - addition reaction involving epoxides - solvomercuration - argentation - hydroboration - reactions of organoboranes - enantioselective hydroboration - addition to alkynes and allenes.

**Elimination reactions:** E1, E2 and E1CB mechanisms - spectrum of E1, E2 and E1CB mechanisms, regioselectivity - stereochemistry of E2 reactions - dehydration of alcohols - dehalogenation - Chugav reaction - Hofmann exhaustive methylation - elimination and its regioselectivity - Cope elimination - Shapiro reaction - extrusion reactions.

#### **Unit-V Reactive Intermediates (15 Hours)**

**Carbocations:** Structure and stability - direct observation of carbocations - competing reactions - rearrangement of carbocations - non-classical carbocations.

**Carbenes:** Reactivity - generation - addition and insertion reactions - generation and reactions of ylides by carbenoid decomposition - rearrangement reactions: ring expansion of cycloalkanones - Wolff - aldehyde to alkyne elongation *via* carbene and carbenoid.

**Nitrenes:** Generation - rearrangements to electron deficient nitrogen.

**Free radicals:** Sources of radicals - addition reactions of radicals with substituted alkenes - cyclization - addition to C=N bonds - Tandem radical cyclizations and alkylations - fragmentation and rearrangements - intramolecular functionalization by radical reactions.

#### **Books for Study**

1. Carey F A, Sundberg R J, *Advanced Organic Chemistry, Part A: Structure and mechanisms*, 5<sup>th</sup> Edition, Springer (India) Pvt. Ltd. New Delhi, 2007.

**Unit I** Chapter 2

**Unit II** Chapter 4

**Unit III** Chapter 8 & 9

**Unit IV** Chapter 5

2. Carey F A, Sundberg R J, *Advanced Organic Chemistry, Part B: Structure and Mechanisms*, 5<sup>th</sup> Edition, Springer (India) Pvt. Ltd. New Delhi, 2007.

**Unit III** Chapter 11

**Unit IV** Chapter 4

**Unit V** Chapter 10

#### **Books for Reference**

1. Eliel E L, *Stereochemistry of Carbon Compounds*, Tata-McGraw Hill Publishing Company, New Delhi, 1998.

2. Nasipuri D, *Stereochemistry of Carbon Compounds*, 2<sup>nd</sup> Edition, New-Age International Publishers, New Delhi, 1996.

3. Bruckner R, *Organic Mechanisms - Reactions, Stereochemistry and Synthesis*, Springer-Verlag, Berlin, Heidelberg, 2010.

4. Clayden J, Greeves N, and Warren S, *Organic Chemistry*, 2<sup>nd</sup> Edition, Oxford University Press, New York, 2012.

5. Gould E S, *Mechanism and Structure in Organic Chemistry*, Holt-Reinhart and Winston, New York, 1959.

6. Smith M B, and March J, *March's Advanced Organic Chemistry*, 6<sup>th</sup> Edition, John-Wiley and Sons, New York, 2007.

## Web Resources



Stereochemistry



Substitution Reaction



Carbocations

Semester	Course Code	Title of the Course									Hours	Credits
I	21PCH1ES01A	DSE -I: ORGANIC CHEMISTRY - I									5	4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean scores of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO-1	2	2	3	2	3	3	2	2	3	2	2.4	
CO-2	3	2	2	3	2	2	2	2	3	2	2.3	
CO-3	2	2	2	3	1	3	1	2	2	3	2.1	
CO-4	3	2	2	3	2	2	3	2	2	3	2.4	
CO-5	3	2	2	2	2	1	2	3	3	2	2.2	
	<b>Mean Overall Score</b>										<b>2.28 (High)</b>	

Semester	Course Code	Title of the Course	Hours	Credits
I		<b>Core Practical-1: INORGANIC CHEMISTRY PRACTICAL-I</b>	4	3

CO No.	CO-Statement	Cognitive Level (K-Level)
	On completion of the course, the postgraduates will be able to	
CO-1	Understand the basics of semimicro inorganic analysis.	K1
CO-2	Explain the classification of metal cations into different groups.	K2
CO-3	Examine a given inorganic mixture and find out the different groups of cations in it.	K3
CO-4	Investigate the presence of trace metal ions using colorimetry.	K4
CO-5	Assess and improve the water quality by eliminating the environmental pollutants.	K5 & K6

**Unit-I Introduction to Inorganic Semimicro Analysis (5 Hours)**

Introduction to the semi-micro method - apparatus and procedures - reaction vessels - reagent bottles - the dropper pipette - stirrers - spatula - generators for hydrogen sulphide - heating devices- centrifuge - evaporation - testing for gaseous products

**Unit-II Classification of Cations into Groups (5 Hours)**

Classification of cations into groups - analysis of group I - separation of copper and tin groups - analysis of groups IIA and IIB - analysis of group III - analysis of group IV - analysis of group V - analysis of group VI

**Unit-III Systematic Semi-micro Analysis of Inorganic Mixtures Containing Two Common and Two Less Common (rare) Cations (30 Hours)**

Systematic semi-micro analysis of any five inorganic mixtures.

**Unit-IV Introduction to Colorimetric Analysis (5 Hours)**

Basic principles of colorimetry - Lambert's law - Beer's law -Beer-Lambert law - applications of Beer's law - deviations from Beer's law - classification of methods of color measurement - the standard series method - photoelectric photometric method - spectrophotometric method.

**Unit-V Experimental Colorimetric Determinations (15 Hours)**

Some general remarks on colorimetric determinations - general procedure for colorimetric determinations - colorimetric estimation of iron as its thiocyanate complex - colorimetric estimation of copper by its reaction with ferrocyanide - colorimetric estimation of nickel as its dimethyl glyoxime complex.

### Books for Study

1. *Inorganic Laboratory Manual*, Department of Chemistry, St. Joseph's College (Autonomous), Tiruchirappalli-2. **Unit III** and **Unit-V**
2. Ramanujam V V, *Inorganic Semi Micro Qualitative Analysis*, 3<sup>rd</sup> Edition, National Publishing Company, Chennai, 1990.  
**Unit-I** Chapter 1 and 2      **Unit-II** Chapter 3 and 4
3. Jeffery G H, Bassett J, Mendham J and Denney R C, *Vogel's Textbook of Quantitative Chemical Analysis*, 5<sup>th</sup> Edition, Longman Scientific & Technical, Essex, England, 1989.  
**Unit-IV** Chapter 17      **Unit-V** Chapter 17

### Books for Reference

1. Svehla G, *Vogel's Qualitative Inorganic Analysis*, 7<sup>th</sup> Edition, Longmann, London, 1996.
2. Metz C and Castellion M E, *Chemistry: Inorganic Qualitative Analysis in the Laboratory*, Academic Press, New York, 1980.
3. Skoog D A, West D M, Holler F J, and Crouch S R, *Fundamentals of Analytical Chemistry*, 9<sup>th</sup> Edition, Brooks/Cole Cengage Learning, Belmont, USA, 2014.

### Web Resources



Colorimeter



Gravimetry-Virtual Lab

Semester	Course code	Title of the Course	Hours	Credits							
I		<b>INORGANIC CHEMISTRY PRACTICAL-I</b>	<b>4</b>	<b>3</b>							
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
<b>CO-1</b>	2	2	3	2	2	2	2	3	2	2	<b>2.2</b>
<b>CO-2</b>	1	3	2	2	3	2	3	2	2	3	<b>2.3</b>
<b>CO-3</b>	3	2	3	2	1	3	2	3	2	1	<b>2.4</b>
<b>CO-4</b>	2	1	2	2	2	2	1	2	2	2	<b>2.0</b>
<b>CO-5</b>	2	2	2	2	1	2	2	2	2	1	<b>1.8</b>
<b>Mean overall Score</b>											<b>2.14 (Medium)</b>



## SCHEME OF VALUATION

### INTERNAL

<b>CIA</b>		<b>100 Marks</b>
	Cumulative mark of regular practical classes	40 Marks
	Record	10 Marks
	Two CIA tests	50 Marks
<b>For Each CIA Test</b>	<b>100 marks</b>	
	Test	10 Marks
	Results	90 Marks (60 Marks for Analysis & 30 Marks for colorimetry)

#### *Scheme of valuation*

##### *Inorganic Analysis*

15 marks for each radical

Only 10 marks for group identification

##### *Colorimetry*

<5% Error	30 Marks
10%	20 Marks
>10%	10 Marks

### EXTERNAL

<b>Total</b>	<b>100 Marks</b>
	<i>Viva voce</i> 10 Marks
	Results 90 Marks (60 Marks for Analysis & 30 Marks for colorimetry)

#### *Scheme of valuation*

##### *Inorganic Analysis*

15 marks for each radical

Only 10 marks for group identification

##### *Colorimetry*

<5% Error	30 Marks
10%	20 Marks
>10%	10 Marks

Semester	Course Code	Title of the Course	Hours	Credits
I		Core Practical-2: PHYSICAL CHEMISTRY PRACTICAL- I	4	3

CO. No.	CO-Statement	Cognitive Level (K-Level)
	On successful completion of this course, students will be able to	
CO-1	Learn concepts of kinetics of chemical reaction and adsorption isotherm.	K1
CO-2	Understand the effect of ionic strength on the rate constant.	K2
CO-3	Analyze the phase transformations.	K3
CO-4	Experiment the concepts of surface catalysis and adsorption.	K4
CO-5	Justify the concepts of phase rule in different component systems.	K5

**Unit – I Principle Behind Experiments (8 Hours)**

Kinetics of reaction between iodide and persulphate- iodination of acetone- hydrolysis of ester- phase diagram (simple and compound forming systems)- adsorption isotherm- heat of solution- polarimetry.

**Unit -II Preparation of Solutions (4 Hours)**

Preparation and standardization of HCl, NaOH, iodine, potassium persulphate, oxalic acid, sucrose.

**Unit -III Cycle I (16 Hours)**

Neutral salt effect - kinetics of reaction between iodide and persulphate - effect of ionic strength on rate constant.

1. Kinetics of iodination of acetone.
2. Kinetics of hydrolysis of ester - comparison of acid strengths.

**Unit – IV Cycle II (16 Hours)**

1. Phase diagram of naphthalene - *m*-dinitrobenzene system. (Simple eutectic system).
2. Freundlich's adsorption isotherm - adsorption of acetic acid by charcoal.
3. Phase diagram of two-component system forming a compound.

**Unit -V Cycle II (16 Hours)**

1. Determination of Arrhenius parameters - Hydrolysis of methyl acetate by acid
2. Heat of solution of oxalic acid by solubility.
3. Polarimetry - Inversion of Cane sugar.

**Books for Study**

1. *Lab Manual*, Department of Chemistry, St. Joseph's College (Autonomous), Tiruchirappalli.
2. Venkateswaran V, Veeraswamy R and Kulandaivelu A R, *Basic Principles of Practical Chemistry*, 2<sup>nd</sup> Edition, Sultan Chand & sons, New Delhi, 1997.
3. Daniels, Mathews F, Howard J and John Warren W, *Experimental Physical Chemistry*, 7<sup>th</sup> Edition, Mc Graw Hill, New York, 1970.
4. Findlay A, *Practical Physical Chemistry*, 7<sup>th</sup> Edition, Longman, London, 1959.

## Web Resources

Phase diagram of naphthalene -



Freundlich's adsorption isotherm



*M*-dinitrobenzene system.

Semester	Course code	Title of the Course					Hours	Credits			
I		PHYSICAL CHEMISTRY PRACTICAL- I					4	3			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of Cos
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO-1	3	2	2	2	2	3	2	2	2	2	2.2
CO-2	3	3	2	2	1	3	3	2	2	1	2.2
CO-3	3	3	3	3	2	3	3	3	3	2	2.8
CO-4	3	2	3	2	1	3	3	2	2	2	2.3
CO-5	2	3	3	2	2	2	3	3	2	2	2.4
<b>Mean overall Score</b>											<b>2.38</b>

**SCHEME OF VALUATION  
INTERNAL**

<b>CIA</b>		<b>100 Marks</b>
	Cumulative mark of Regular Practical Classes	50 Marks
	Two CIA tests	50 Marks

<b>For Each CIA Test</b>	<b>100 marks</b>
Procedure	10 Marks
Record	10 Marks
Viva	10 Marks
Results	70 Marks
	Table-10marks
	Calculation-10 marks
	Graph - 10 marks Results-
	40 marks <b>Scheme of</b>
	<b>valuation</b>
	<2% Error 40 Marks
	3% 30 Marks
	4% 20 Marks
	>4% 10 Marks

<b>Total</b>	<b>100 Marks</b>
Procedure	10 Marks
Viva	10 Marks
Results/Analysis	80 Marks
Table-10marks	

**EXTERNAL**

Calculation-10 marks	Graph - 10 marks	Results -50 marks	<b>Scheme of valuation</b>
	<2% Error	50 Marks	
	3%	40 Marks	
	4%	30 Marks	
	>4%	20 Marks	

Semester	Course Code	Title of the Course	Hours	Credits
II		CORE-4: INORGANIC CHEMISTRY - II	5	4

CO. No.	CO-Statement	Cognitive Level (K-Level)
	On successful completion of this course, students will be able to	
CO-1	Understand the concept of ionic bonding.	K1
CO-2	Summarize the concepts of acids and bases.	K2
CO-3	Discuss the chemistry of halogens and noble gases.	K2
CO-4	Apply the VSEPR theory to predict the structures.	K3
CO-5	Summarize the nature of inorganic chains, rings, cages and clusters.	K5

### Unit-I Ionic Bonding (12 Hours)

Effective nuclear charge - shielding - Slater's rule - Born - Lande equation - Born Haber cycle and its applications - radius ratio - polarization- Fajan's rule - results of polarization. electronegativity - determination - methods of estimating charges, electronegativity equalization - types of chemical forces - Van der Waals forces - hydrogen bonding - effects of chemical forces - melting and boiling points, solubility and hardness.

### Unit-II Covalent Bonding (12 Hours)

Octet rule - valence bond theory - resonance - conditions of resonance - formal charge - hybridization - molecular orbital theory - symmetry and overlap - molecular orbital in homonuclear diatomic molecules: O<sub>2</sub>, B<sub>2</sub>, N<sub>2</sub> and C<sub>2</sub> - MO treatment of hetero nuclear diatomic molecules: CO and HCl - VSEPR theory: methane, ammonia, water, PCl<sub>3</sub>F<sub>2</sub> (Bent's rule), SF<sub>4</sub>, BrF<sub>3</sub>, TeF<sub>5</sub><sup>-</sup>, ICl<sub>2</sub><sup>-</sup>, ICl<sub>4</sub><sup>-</sup>, XeF<sub>2</sub>, XeF<sub>4</sub>, XeF<sub>6</sub>, XeO<sub>3</sub>, XeO<sub>4</sub>, XeO<sub>2</sub>F<sub>2</sub>, XeOF<sub>4</sub>, phosphorus trihalides, ammonia and NX<sub>3</sub> dipole moments, OF<sub>2</sub> and COF<sub>2</sub> - bond angle - s, p character relationship - energetics of hybridization.

### Unit-III Acids and Bases (12 Hours)

Electrode potentials and electromotive forces - applications - acid-base concepts: Bronsted-Lowry, Lux-Flood, Usanovich, Lewis, solvent system and generalized acid base concepts - measures of acid-base strength - steric effect and solvation effects F-strain and B-strain - hard and soft acids and bases - acid base strength - hardness and softness - symbiosis - theoretical basis of hardness and softness, electronegativity and hardness and softness - types of solvents, types of reactions - autoionisation, neutralisation, precipitation, solvation, solvolysis and complex formation. Liq. NH<sub>3</sub>, liq. SO<sub>2</sub>, HF and H<sub>2</sub>SO<sub>4</sub> as solvents - alkali metals in liq. NH<sub>3</sub>.

### Unit-IV Periodicity and the Chemistry of Halogens and Noble Gases (12 Hours)

Periodicity: The use of p-orbitals in pi-bonding - pπ-pπ bonding in phosphine complexes and π bonding - comparison of pπ-dπ non-metals - the use of d orbitals by non-metals - experimental evidence of p oxides - experimental evidences for d-orbital contraction and participation Chemistry of halogens and noble gases: Interhalogen compounds - polyhalide ions - oxyacids of heavier halogens -structure and reactivity of noble gas fluorides.

**Unit - V Inorganic Chains, Rings, Cages and Clusters (12 Hours)**

Silicate minerals - ortho, pyro, and meta silicates - pyroxene, amphiboles - two-dimensional silicates - talc, mica and three dimensional aluminosilicates, feldspar, zeolites, ultramarine - silicones-preparation, properties and uses-polymeric sulphur nitride, phosphonitric 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.

**Books for Study**

- Huheey J E, Keiter E A and Keiter R L, *Inorganic Chemistry Principles of Structure and Reactivity*, 4<sup>th</sup> Edition, Pearson Education, India, 2008.

**Unit I** Chapter 4**Unit II** Chapter 5**Unit III** Chapter 8**Unit IV** Chapter 10 & 12**Unit V** Chapter 11**Books for Reference**

- Cotton F A and Wilkinson G, *Inorganic Chemistry A Comprehensive Text*, 3<sup>rd</sup> Edition, Inter Science Publishers, New York, 1972.
- Shriver D, Weller M, Overton T, Rourke J and Armstrong F, *Inorganic Chemistry*, 6<sup>th</sup> Edition, W H Freeman and Company, New York, 2014.
- Housecroft C E and Sharpe A G, *Inorganic Chemistry*, 4<sup>th</sup> Edition, Pearson Education Limited, Essex, 2012.

**Web Resources**

Ionic Vs Covalent



Acid and Base



Metal Clusters

Semester	Course code	Title of the Course									Hours	Credits
II		CORE-4: INORGANIC CHEMISTRY - II									5	4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of Cos	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO-1	3	3	2	2	1	3	2	2	2	1	2.1	
CO-2	2	2	2	2	1	2	2	2	2	2	2.0	
CO-3	2	2	2	2	1	2	2	2	2	2	2.0	
CO-4	3	2	2	2	1	3	2	2	2	1	2.0	
CO-5	2	3	2	2	2	2	3	2	2	2	2.2	
<b>Mean overall Score</b>											<b>2.0</b>	
											<b>(Medium)</b>	

Semester	Course Code	Title of the Course	Hours	Credits
II		<b>CORE-05: PHYSICAL CHEMISTRY II</b>	5	4

CO. No.	CO-Statements	Cognitive Levels (K Level)
	On successful completion of this course, students will be able to	
CO-1	Memorize and retain the basics of various concepts of kinetics, solution kinetics catalysis and electrodictics.	K1
CO-2	Understand the underlying principles of kinetics and electrodictics.	K2
CO-3	apply the underlying concepts in day to day inventions and application.	K3
CO-4	Analyze the intricacies of electrical double layer and evaluate its implications in real life.	K4 & K5
CO-5	Create new electrochemical cells and newer electrodes for application.	K6

### **Unit- I Theories of Reaction Rate (18 Hours)**

Theories of reaction rates and reaction mechanism - Arrhenius equation - potential energy surfaces and reaction coordinates - collision theory - ARRT(thermodynamic treatment only) - application of ARRT to unimolecular, bimolecular and termolecular reactions - kinetic isotope effect- isokinetic relation and temperature - theories of unimolecular reactions - Lindemann and Rice-Ramsperger-Kassel - principle of microscopic reversibility and detailed balancing.

### **Unit-II Application of ARRT to Solution Kinetics and Catalysis (18 Hours)**

Application of ARRT to solution kinetics - factors affecting reaction rate in solution-internal pressure - solvent dielectric constant - ionic strength - reactions - Van't Hoff equation and volume of activation - catalysis- characteristics of a catalyst -factors affecting catalytic reactions - types of catalysis - homogeneous catalysis - acid - base catalysis - Van't Hoff and Arrhenius intermediates -mechanism - protolytic and prototropic catalysis laws - acidity functions -Hammett-Zucker hypothesis - catalysis in biological systems- Michaelis-Menten equation - Lineweaver-Burk and Eadie-Hofstee plots - influence of substrate concentration- pH- and temperature on rate - influence of substituent's on reaction rates - Hammett and Taft equations - linear free energy relations.

### **Unit-III Surface Chemistry and Heterogeneous Catalysis (18 Hours)**

Surface phenomenon - physical and chemical adsorption - adsorption and free energy relations at interface - Langmuir adsorption isotherm - Gibbs adsorption isotherm - BET isotherm - measurement of surface area - heterogeneous catalysis - mechanism - Langmuir Hinshelwood mechanism - Langmuir-Rideal bimolecular mechanism - role of surface in catalysis.

### **Unit-IV Debye-Huckel Theory and its Applications (18 Hours)**

Debye Huckel theory - radius of ionic atmosphere - calculations of thickness of ionic atmosphere - evidences of ionic atmosphere - asymmetry effect -electrophoretic effect - Debye Falkenhagen effect - Wien effect - Debye-Huckel Onsager equation - modification and

verification of the equation - Debye-Huckel limiting law - modification and verification - finite ion size model - Huckel-Bronsted equation - calculation of activity coefficient - determination of ion size parameter - solubility - solubility product of sparingly soluble salt - common ion effect - neutral salt effect and solubility - determination of solubility and solubility product.

### Unit-V Electrode Kinetics

(18 Hours)

Theories of electrical double layer - electric double layer at the electrode -electrolyte interface - Helmholtz model of double layer - law of electrical neutrality - Gouy - Chapman diffused charged model - desorption theory of double layer - Stern's model, triple-layer theory- electro capillary phenomenon - electrocapillary curves for solutions containing anions, cations and molecular substances - electrocapillary maximum - Lipmann equations and potential - experimental measurement and its calculation - capillary electrometer and contact angle method - electro kinetic phenomena - classification electro-osmosis and electrophoresis - streaming potential and sedimentation potential - kinetics of electrode process - equilibrium and non-equilibrium process - concentration and activation polarization - theory of electrochemical over potential - derivation and verification of the equations - Butler-Volmer equation - Tafel equation.

### Books for Study

1. Laidler K J, *Chemical Kinetics*, 3<sup>rd</sup> Edition, New Delhi TATA McGraw Hill Co. 1984.  
**Unit I and II** Chapters 2 and 3
2. Kuriacose J C and Rajaram J, *Kinetics and Mechanism of Chemical Transformation*, Macmillan & Co, Delhi, 1993. **Unit I-III** Chapters 5 -10
3. Glasstone S, *An Introduction to Electrochemistry*, New Delhi, East West Press Pvt. Ltd, 1956. **Unit IV and V** Chapter 3,4,15 and 16

### Books for Reference

1. Castellan G W, *Physical Chemistry*, 4<sup>th</sup> Edition, Narosa, New Delhi, 2004.
2. Kapoor K L, *A Textbook of Physical Chemistry*, Vol. 3 Macmillan, India Ltd, 2013.
3. Huges G, *Radation Chemistry*, Oxford series, 1973.
4. Antorpov L, *Theoretical Electrochemistry*, 2<sup>nd</sup> Edition, Mir Publishers, Moscow, 1977.
5. Bockris J O'M and Reddy A K N, *Modern Electrochemistry*, Vol. 1 & 2, 2<sup>nd</sup> Edition, Plenum Press, New York, 1998.

### Web Resources



Electrical Double Layer



Gibbs Adsorption Isotherm



Semester	Course code	Title of the Course					Hours	Credits				
II		CORE- 05: PHYSICAL CHEMISTRY II					5	4				
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO-1	1	3	1	1	3	2	2	3	3	1	2	
CO-2	2	3	2	3	2	1	2	3	1	3	2.2	
CO-3	1	3	1	3	2	2	3	2	1	2	2	
CO-4	2	1	3	3	2	2	3	2	2	3	2.3	
CO-5	2	3	2	3	2	2	3	2	3	3	2.5	
<b>Mean overall Score</b>											<b>2.2 (High)</b>	

Semester	Course Code	Title of the Course	Hours	Credits
II		CORE-06: ORGANIC CHEMISTRY - II	5	4

CO. No.	CO-Statements	Cognitive Levels (K -Level)
	On successful completion of this course, students will be able to	
CO-1	Define the techniques of determining the mechanisms of reactions.	K1
CO-2	Understand the synthetic applications of enolates.	K2
CO-3	Utilize the synthetic applications carbon nucleophiles in synthesis.	K3
CO-4	Categorize the reduction reactions and their mechanism.	K4
CO-5	Determine and design the multiple ways for using oxidation reactions in synthesis.	K5 & K6

### Unit - I Methods of Determining Reaction Mechanism (15 Hours)

**Non-kinetic methods:** Product analysis and its importance- intermediates and transition states - trapping, testing and detection of intermediates - cross-over experiments - isotopic labeling - stereochemical studies.

**Kinetic methods:** isotope effects-primary, secondary and solvent isotope effect-correlation analysis-linear free energy relationships - Hammett equation-significances of  $\sigma$  and  $\rho$ - applications of Hammett equation - Taft equation and its applications.

**Catalysis:** By acids and bases - Bronsted catalysis law - acidity functions- $pH$  profile rates - Lewis acid catalysis - solvent effects: bulk solvent effects - specific solvent effects - acidity of hydrocarbons:  $pK_a$  values of weakly acidic hydrocarbons.

### Unit - II Oxidations (15 Hours)

Oxidation of alcohols to aldehydes, ketones, and carboxylic acids - transition metal oxidants - addition of oxygen to  $C=C$ - transition metal oxidants - epoxides from alkenes and peroxide reagents-subsequent transformations of epoxides - allylic oxidations - transition metal oxidants - reactions of alkenes with singlet oxygen - oxidative cleavage of  $C=C$ -transition metal oxidants - oxidation of ketones and aldehydes by oxygen-and periodic compounds - oxidation with other reagents - selective oxidative cleavages at functional groups - cleavage of glycols-oxidative decarboxylations - oxidations at unfunctionalized carbon.

### Unit - III Reductions (15 Hours)

**C-C multiple bonds:** Hydrogenation using heterogeneous and homogeneous catalysts - enantioselective hydrogenation - partial reduction of alkynes - hydrogen transfer from diimide.

**Carbonyl groups:** Group III hydride donor reagents - comparative reactivity of common hydride donors - stereoselectivity of hydride reduction - enantioselective reduction of carbonyl compounds-reduction of other functional groups - Group IV hydride donors - silicon hydrides - hydride transfer for carbon-reduction reactions involving hydrogen atom donors-dissolving metal reductions-addition of hydrogen - reductive removal of functional groups-reductive coupling of carbonyl compounds - reductive deoxygenation of carbonyl groups to methylene - reduction of carbonyl compounds to alkenes-reductive elimination and fragmentation.

### Unit - IV Reactions of Enolates (15 Hours)

Generation of enolates - regioselective and stereoselective enolate formation-solvent effects on enolate structure and reactivity - alkylation of highly stabilized and ketone enolates -

alkylation of aldehydes, esters, acids, amides and nitriles-alkylation of dianions - intramolecular alkylation of enolates - enantioselectivity in alkylation reactions - enamines and imine anions - conjugate addition of enolates - conjugate addition with tandem alkylations - conjugate addition by enolate equivalents - facial selectivity - addition of organometallic reagents and cyanide ions.

### Unit - V Reactions of Carbon Nucleophiles

(15 Hours)

Aldol addition and condensation reactions - regio and stereoselectivity in aldol reactions of aldehydes and ketones-aldol addition reactions of enolates of ester and other carbonyl derivatives - Mukaiyama aldol condensation - facial selectivity - intramolecular aldol condensation - Robinson annulation - Mannich reaction - additions to *N*-acyl iminium ions - amine catalyzed condensation reactions - Claisen and Dieckmann reactions - Wittig reaction - reactions of alpha-trimethylsilylcarbanions with carbonyl compounds - Julia olefination-reactions involving sulfur ylides and related nucleophiles - nucleophilic addition - cyclization of alpha-haloesters.

### Books for Study

1. Francis Carey A, Richard J. Sundberg, *Advanced Organic Chemistry, Part B: Structure and Mechanisms*, 5<sup>th</sup> Edition, Springer (India) Pvt Ltd., New Delhi, India, 2007.

**Unit-II Chapter 12 Unit-III Chapter 5 Unit IV Chapters 1 & 2**

**Unit V Chapter 2**

2. Michael Smith B and Jerry March, *March's Advanced Organic Chemistry*, 6<sup>th</sup> Edition, John-Wiley and Sons, New York, 2007. **Unit-I Chapter 6**
3. Reinhard Bruckner, *Organic Mechanisms - Reactions, Stereochemistry and Synthesis*, Springer-Verlag, Berlin, Heidelberg, 2010. **Unit V Chapter 5**

### Books for References

1. Peter Sykes, *Guide Book to Mechanism in Organic Chemistry*, 6<sup>th</sup> Edition, ELBS with Longmann, 1997.
2. Jonathan Clayden, Nick Greeves, and Stuart Warren, *Organic Chemistry*, Oxford University Press, New York, 2012.
3. Stanley Pine H, *Organic Chemistry*, 5<sup>th</sup> Edition, Tata-Mcgraw Hill, New Delhi, 2006.

### Web Resources



Reaction Mechanism



Oxidation Reactions



Enolate Reactions



Nucleophilic Addition

Semester	Course code	Title of the Course									Hours	Credits
II		CORE-6: ORGANIC CHEMISTRY - II									5	4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	2.2	
CO-1	2	3	3	2	2	3	2	2	2	1	2.0	
CO-2	2	2	2	2	1	2	2	2	2	2	2.2	
CO-3	2	3	2	2	2	2	3	2	2	2	2.0	
CO-4	2	2	2	2	1	2	2	2	2	2	2.0	
CO-5	3	2	2	2	1	3	2	2	2	1	2.0	
<b>Mean overall Score</b>												

Semester	Course Code	Title of the Course	Hours	Credits
II		Core practical-3 ORGANIC CHEMISTRY PRACTICAL-I	4	3

CO. No.	CO-Statement	Cognitive Levels (K -Level)
On successful completion of this course, students will be able to		
CO-1	Choose appropriate solvent for the separation of organic binary mixtures.	K1
CO-2	Infer the functional group of the compounds based on characteristic reactions.	K2
CO-3	Apply the skills of micro level analysis to identify the nature of organic compounds	K3
CO-4	Categorize the micro level analysis to identify the functional groups of organic compounds	K4
CO-5	Confirm the functional group by preparing a solid derivative	K5

**Unit-I Micro Qualitative Analysis of an organic binary mixture (12 Hours)**

Pilot separation -Ether separation, Bicarbonate separation, Alkali separation and Acid separation, Bulk separation, Preliminary tests- Colour and appearance - solubility tests - acidic/basic/neutral nature - tests for aliphatic and aromatic compounds - tests for saturation/unsaturation.

**Unit-II Tests for Characteristic elements in organic compounds (12 Hours)**

Preparation of sodium fusion extract -chemistry of converting organic N/S/halogens into inorganic ion in sodium fusion extract - tests for Nitrogen - tests for sulphur - tests for halogens such as chlorine, bromine and iodine - need for blank test.

**Unit-III Analysis of Functional groups-1 (12 Hours)**

Tests for carbonyl functional groups - mono- & dicarboxylic acids, esters, aldehydes and ketones, phenol, sulphanic acid, alcohol and hydrocarbon

**Unit-III Analysis of Functional groups-1** Primary and secondary amines, amide, diamide, anilide, and nitro compounds

**Unit-V: Preparation of Derivatives (12 Hours)**

Confirmation of the functional groups by preparation of solid derivatives/characteristic colour reactions for the functional groups - scientific reporting

**Books for Reference**

1. Ganapragasm N S and Ramamurthy C, *Organic Chemistry Lab Manual*, 2<sup>nd</sup> Edition, Vishwanathan S Printers and Publishers (P) Ltd., Chennai, 2015.
2. Furniss B S, Hannaford A J, Smith P W G, and Tatchell A R, *Vogel's Textbook of Practical Organic Chemistry*, 5<sup>th</sup> Edition, Pearson publication.

3. Venkateswaran V, Veeraswamy R, Kulandaivelu A R, *Basic Principles of Practical Chemistry*, 2<sup>nd</sup> Edition, Sultan Chand and Sons, New Delhi, 1997.
4. *Organic Chemistry Lab Manual for Micro Qualitative Analysis*, Department of Chemistry, St. Joseph's College, Tiruchirappalli-620 002. (Private circulation).

#### Web Resource



Organic Analysis-I



Organic Analysis-II



Separation of mixtures

#### Scheme of valuation

##### Organic Chemistry Practical-I

##### Organic Analysis + TLC Preparation

#### INTERNAL

<b>CIA</b>		<b>100 Marks</b>
	Cumulative mark of Regular Practical Classes	40 Marks
	Record	10 Marks
	Two CIA tests	50 Marks
<b>For Each CIA Test</b>		<b>100 marks</b>
	Solvent for separation	10 Marks
	Viva/Test	10 Marks
	Results	80 Marks (40 marks for each compound)
<b>Organic Analysis</b>		
	Solubility	5 Marks
	Saturation/unsaturation	5 Marks
	Aromatic/Aliphatic	5 Marks
	Elements	10 marks
	Functional Group	10 Marks
	Derivative	5 marks

#### EXTERNAL

<b>Total</b>		<b>100 Marks</b>
	Solvent for separation	10 Marks
	Test	10 Marks
	Results	80 Marks (40 marks for each compound)
<b>Organic Analysis</b>		
	Solubility	5 Marks
	Saturation/unsaturation	5 Marks
	Aromatic/Aliphatic	5 Marks
	Elements	10 marks
	Functional Group	10 Marks
	Derivative	5 marks

Semester	Course code	Title of the Course									Hours	Credits
II		ORGANIC CHEMISTRY PRACTICAL- I									4	3
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of Cos	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO-1	2	1	2	3	1	2	3	2	3	3	2.2	
CO-2	3	2	1	3	2	3	1	3	3	3	2.4	
CO-3	2	3	2	3	2	2	3	2	2	2	2.3	
CO-4	3	2	3	3	2	2	3	1	2	3	2.4	
CO-5	1	3	2	2	3	2	2	3	3	1	2.2	
<b>Mean overall Score</b>											<b>2.3 (High)</b>	

Semester	Course Code	Title of the Course	Hours	Credits
II		Core Practical 4: INORGANIC CHEMISTRY PRACTICAL-II	4	3

CO No.	CO-Statements	Cognitive Levels (K-Level)
	On completion of the course, the graduates will be able to	
CO-1	Discuss the basics of titrimetric analysis.	K2
CO-2	Discuss the methods of preparation of complexes.	K2
CO-3	Illustrate various methods of characterization of complexes.	K3
CO-4	Identify the components of a binary inorganic mixture.	K4
CO-5	Recommend a suitable thermal method for the quantification of metal cations.	K5

**Unit-I Basic Principles of Titrimetric Analysis (5 Hours)**

Titrimetric analysis - classifications of reactions in titrimetric analysis - Standard solutions - Equivalents, normality and oxidation numbers - Preparation of standard solutions - Primary and secondary standards - redox titrations - complexation titrations.

**Unit-II Basic Principles of Gravimetric and Thermo Gravimetric Analyses (5 Hours)**

Introduction to gravimetric analysis - precipitation methods - the colloidal state - supersaturation and precipitate formation - the purity of the precipitate: co-precipitation - of the precipitate: thermogravimetric method of analysis.

**Unit-III Methods of preparation and characterization of complexes (5 Hours)**

Preparatory methods of coordination complexes - characterization methods - conductance measurements - magnetic measurements - potentiometric measurements - polarimetry - UV-Visible spectra

**Unit-IV Estimations of Metal Ions in a Binary Mixture (30 Hours)**

- Quantitative analysis of a mixture of iron (volumetry) and copper (gravimetry)
- Quantitative analysis of a mixture of copper (volumetry) and nickel (gravimetry)
- Quantitative analysis of a mixture of calcium (volumetry) and magnesium (gravimetry)
- Quantitative analysis of a mixture of calcium and magnesium (both by volumetry)
- Quantitative analysis of a mixture of iron (volumetry) and zinc (gravimetry)
- Quantitative analysis of a mixture of copper (volumetric) and zinc (gravimetry)

**Unit-V Preparation and Characterization of Selected Complexes (15 Hours)**

- Preparation and characterization of hexamminecobalt(III) chloride
- Preparation of tetramminecopper(II) sulphate
- Preparation of *tris*-(thiourea)copper(I) chloride
- Preparation of potassium *tris*-(oxalato)chromate(III) trihydrate



### Books for Study

1. *Inorganic Laboratory Manual*, Department of Chemistry, St. Joseph's College (Autonomous), Tiruchirappalli-2

#### Unit IV and Unit V

2. Jeffery G H, Bassett J, Mendham J and Denney R C, *Vogel's Textbook of Quantitative Chemical Analysis*, 5<sup>th</sup> Edition, Longman Scientific & Technical, Essex, England, 1989.

#### Unit I Chapter 10 Unit II Chapter 11

3. Pass G and Sutcliffe H, *Practical Inorganic Chemistry*, 2<sup>nd</sup> Edition, Chapman and Hall, London, 1974.

#### Unit III Chapter 18, 20, 21 and 22

#### Unit V Chapters 6 and 9

### Books for Reference

1. Skoog D A, West D M, Holler F J, and Crouch S R, *Fundamentals of Analytical Chemistry*, 9<sup>th</sup> Edition, Brooks/Cole Cengage Learning, Belmont, CA 94002-3098, USA, 2014

### Web Resources



Coordination Chemistry



Gravimetric Analysis

Semester	Course Code	Title of the Course	Hours	Credits							
II		INORGANIC CHEMISTRY PRACTICAL-II	4	3							
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO-1	2	2	3	2	1	2	2	3	2	1	2.0
CO-2	3	2	2	2	3	3	2	2	2	3	2.3
CO-3	2	2	3	3	2	2	2	3	3	2	2.4
CO-4	3	2	2	1	2	3	2	2	1	2	2.0
CO-5	2	3	2	2	2	2	3	2	2	2	2.2
Mean overall Score											2.18 (Medium)

## SCHEME OF VALUATION

### INTERNAL

<b>CIA</b>		<b>100 Marks</b>
	Cumulative mark of Regular Practical Classes	40 Marks
	Record	10 Marks
	Two CIA tests	50 Marks
<b>For Each CIA Test</b>	<b>100 marks</b>	
	Test	10 Marks
	Results	90 Marks (60 Marks for Estimations & 30 Marks for Preparation)

#### *Scheme of valuation*

##### *Inorganic Estimations*

Thirty Marks each for the volumetric and gravimetric estimations

##### *Gravimetry*

<2% Error	30 Marks
3%	25 Marks
4%	20 Marks
>4%	15 Marks

##### *Volumetry*

<1% Error	30 Marks
2%	25 Marks
3%	20 Marks
4% and above	15 Marks

##### *Preparation*

Fifteen marks each for the crude and re-crystallized samples

### EXTERNAL

<b>Total</b>	<b>100 Marks</b>	
	Test	10 Marks
	Results	90 Marks (60 Marks for Estimations & 30 Marks for Preparation)

#### *Scheme of valuation*

##### *Inorganic Estimations*

Thirty Marks each for the volumetric and gravimetric estimations

##### *Gravimetry*

<2% Error	30 Marks
3%	25 Marks
4%	20 Marks
>4%	15 Marks

##### *Volumetry*

<1% Error	30 Marks
2%	25 Marks
3%	20 Marks
4% and above	15 Marks

##### *Preparation*

Fifteen marks each for the crude and re-crystallized samples

Semester	Course code	Title of the Course	Hours	Credits
III		CORE-7: INORGANIC CHEMISTRY- III	5	4

CO No	CO-Statement	Cognitive level (K Level)
	On successful completion of this course, students will be able to	
CO-1	Understand the stability of the complexes.	K1
CO-2	Know the organometallic complexes and draw their structures.	K2
CO-3	Analyze the electronic spectra of the complexes.	K4
CO-4	Predict mechanisms of reactions of complexes.	K5
CO-5	Predict the structure of the complexes utilizing spectral techniques.	K5

### Unit-I Theories of Coordination Chemistry (15 Hours)

Crystal field theory - splitting pattern of octahedral, tetrahedral, square planar, trigonal bipyramidal and square pyramidal complexes - magnetic properties, CFSE, high spin-low spin cross over - limitations - structural and thermodynamic effects of inner orbital splitting, Jahn-Teller effect (static, dynamic, elongation and flattening) - ligand field theory - evidences for M-L overlap, spin-orbit coupling constant and Racah parameters - MO theory of octahedral complexes (sigma and pi bonding), tetrahedral and square planar complexes.

### Unit-II Basics of Organometallics (15 Hours)

Hapticity- 16 and 18 electron rules - applications and limitations - carbonyls- bonding - terminal, doubly, triply bridged carbonyls - structure of carbonyls - CO stretching frequencies of carbonyls and mixed carbonyls - carbonyl hydrides - nitrosyls-terminal, bridging and bent - *pi* complexes with olefins - ferrocene and benzenoid metal complexes - non-benzenoid aromatics as ligands and carbene complexes - fluxional molecules.

### Unit-III Reaction Kinetics in Coordination Chemistry (15 Hours)

Inert and labile complexes - Stepwise, overall stability constants -Chelate effect-mechanisms of substitutions in octahedral complexes-dissociative (*D*), associative (*A*), and interchange (*I*) mechanisms - Aquation (acid hydrolysis) and anation - conjugate base mechanism of base hydrolysis - Substitution reactions in square planar complexes - Trans effect-theories and applications - electron transfer reactions - inner and outer sphere mechanisms- excited state outer sphere electron transfer - mixed valence complexes.

### Unit-IV Physical Methods in Coordination Chemistry-I (15 Hours)

Types of magnetic behaviour - magnetic susceptibility measurements - Gouy's method-orbital contribution-spin-orbit coupling and its effects on magnetic properties - Temperature independent paramagnetism (TIP) - spin-crossover phenomena - electronic spectra of complexes-band width and intensity-Sugano-Tanabe and Orgel Diagrams - charge transfer spectra - infrared spectra of Coordination complexes-characteristic frequencies-mode of coordination and interpretation of IR spectra of complexes containing CO, SO<sub>2</sub>, carboxylate, ester, amine, amide, DMSO ligands.

## Unit-V Physical Methods in Coordination Chemistry-II (15 Hours)

NMR - Applications of NMR to inorganic compounds - NMR of metal hydrides ( $^1\text{H}$  NMR), metal carbonyls ( $^{13}\text{C}$  NMR),  $^{19}\text{F}$  and  $^{31}\text{P}$  NMR -Applications of NQR spectroscopy to the study of complexes-ESR-zero- field splitting - Kramer's degeneracy - pattern for number of lines of complexes having  $d^1$ - $d^9$  systems -bis(salicylaldimine) Cu(II), Mn(II) complexes - Mossbauer spectroscopy - quadrupole interactions - magnetic interactions -  $\text{FeSO}_4$ ,  $\text{FeCl}_3$ , ferro-and ferricyanides, nitroprusside,  $\text{FeC}_2\text{O}_4$ ,  $\text{Fe}_3(\text{CO})_{12}$ .

### Books for Study

1. Huheey J E, Keiter E A Keiter R L, and Medhi O K, *Inorganic Chemistry - Principles of Structure and Reactivity*, 4<sup>th</sup> Edition, Harper Collins College Publishers, New York, 1993.

**Unit I** Chapter 14

**Unit II** Chapter 18,6

**Unit III** Chapter 16, 17

**Unit IV** Chapter 15 Appendix-G

2. Drago R S, *Physical Methods in Inorganic Chemistry*, Affiliated East-West Press Private Limited, New Delhi, 1965 (Reprint).

**Unit I** Chapter-3

**Unit IV** Chapter-6,7 & Appendix-A

**Unit V** Chapter-8, 9, 10, 11

### Books for Reference

1. Cotton F A and Wilkinson G, *Inorganic Chemistry A Comprehensive Text*, 3<sup>rd</sup> dition, Interscience Publishers, New York, 1972.
2. Purcell K F and Kotz J C, *Inorganic Chemistry*, WB Saunders Company, Philadelphia, 1977.
3. Weller M, Overton T, Rourke J and Armstrong F, *Inorganic Chemistry*, 6<sup>th</sup> Edition, W H Freeman and Company, New York, 2014.
4. Miessler G L, Fischer P J and Tarr D A, *Inorganic Chemistry*, 5<sup>th</sup> Edition, Pearson Education, Inc., New York, 2014.
5. Housecroft C E and Sharpe A G, *Inorganic Chemistry* 4<sup>th</sup> Edition, Pearson Education Limited, Essex, 2012.
6. Lee JD, *Concise Inorganic Chemistry*, 6<sup>th</sup> Edition, ELBS, London, 1998.
7. Lewis J and Wilkins RG, *Modern Coordination Chemistry*, Interscience Publishers, Inc., New York, 1960.
8. Basalo F and Pearson RG, *Mechanisms of Inorganic Reactions*, John- Wiley and Sons Inc., New York, 1960.
9. Crabtree RH, *The Organometallic Chemistry of the Transition Metals*, 6<sup>th</sup> Edition, John-Wiley and Sons Inc., New York, 2014.
10. Kazuo Nakamota, *Infrared and Raman Spectra of Inorganic and Coordination Compounds*, Part A and B, 6<sup>th</sup> Edition, John-Wiley and Sons, Inc. New York, 2009.

### Web resources



Fluxionality in Organic  
Chemistry



Magnetic Resonance



Crystal field Theory

Semester	Course code	Title of the Course					Hours	Credits				
III		CORE-7: INORGANIC CHEMISTRY- III					5	4				
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO-1	2	2	3	2	1	2	2	3	2	1	2.0	
CO-2	3	2	2	2	3	3	2	2	2	3	2.3	
CO-3	2	2	3	3	2	2	2	3	3	2	2.4	
CO-4	2	3	2	2	2	3	2	2	2	2	2.2	
CO-5	3	2	2	1	2	2	3	2	1	2	2.0	
<b>Mean overall Score</b>											<b>2.18 (Medium)</b>	

Semester	Course Code	Title of the Course	Hours	Credits
III		CORE-8: PHYSICAL CHEMISTRY-III	5	4

CO. No.	CO-Statements	Cognitive Levels (K-Level)
	On successful completion of this course, students will be able to	
CO-1	Recall and understand the concept of sensors and apply to real life examples	K1 & K2
CO-2	Imbibe and apply the concepts of polarography and cyclic voltametry	K3
CO-3	Examine the applications of quantum chemistry	K4
CO-4	Interpret the concepts of molecular orbital theory to evaluate few organic molecular systems	K5
CO-5	Elaborate the concepts and instrumentation of amperometry and electrogravimetry	K6

#### Unit-I Electrochemical and Biosensors (12 Hours)

Basic sensor technology - sensor systems - sensor characteristics - system characteristics - instrument selection - data acquisition and readout introduction - FET & MOSFET - chemical sensor - biosensors - ion exchange membrane electrodes - electrolytic sensors - electrochemical sensors.

#### Unit-II Electroanalytical Techniques - I (12 Hours)

Polarography - experimental setup - advantages of dropping mercury electrode - supporting electrolyte - polarographic peak maxima - types of peak maxima - polarographic peak maxima suppressor - residual current - migration current - diffusion current - polarogram - half wave potential - Ilkovic equation (derivation is not required) - outline of applications (Polarogram of  $Zn^{2+}$  and  $Cd^{2+}$ ) - cyclic voltametry, principle, experimental set up - cyclic voltammogram of  $Fe^{2+}$  in  $H_2SO_4$  - anodic peak current - cathodic peak current - electrochemically reversible couple - cathodic peak potential - anodic peak potential - electrochemically irreversible couple - outline of applications.

#### Unit-III Electro Analytical Techniques II (12 Hours)

Amperometry - principle of amperometric titration - different types of current voltage curves - amperometric titration between  $Pb^{2+}$  vs  $K_2Cr_2O_7$ ,  $Pb^{2+}$  vs  $SO_4^{2-}$ ,  $SO_4^{2-}$  vs  $Pb^{2+}$ ,  $Ni^{2+}$  vs DMG- Electrogravimetry - principle - experimental set up - physical characteristics of metal deposits - separation of Cu & Ni - Coulometry - principle, experimental set up - controlled potential coulometric analysis and application - experimental set up for constant current coulometry - coulometric - titration of Fe(II) with Cerium(III).

#### Unit-IV Applications of Quantum Chemistry I (12 Hours)

Approximation methods - need for approximation - perturbation theory - time independent perturbation - first order and second order perturbation theory - application of perturbation theory to particle in one dimensional box - anharmonic oscillator and helium atom - principle of variation and its proof - trial function and secular determinant- variation methods and its applications to hydrogen and helium atoms - particle in one dimensional box.

## Unit-V Applications of Quantum Chemistry II

(12 Hours)

The Born - Oppenheimer approximation- VB theory of hydrogen molecule and MO theory of hydrogen molecular ion ( $H_2^+$ ) - coulomb integral- exchange integral and overlap integral- detailed calculation of energy and overlaps- construction of  $sp$ ,  $sp^2$  and  $sp^3$  hybrid orbitals- Huckel molecular orbital theory - principles and applications to ethylene, butadiene, benzene, cyclobutadiene, trimethylamine, bicyclobutadiene and allyl systems- Hartree - Fock method- self consistent field method and Roothan equations.





### Books for Study

1. Willard, Merit, Dean and Settle, *Instrumental Methods of Analysis*, 7<sup>th</sup> Edition, CBS Publication New Delhi, 2004. **Unit II Chapter XVI**  
**Unit III Chapter XVII & XV**
2. Kaur, H. *Instrumental Methods of Chemical Analysis*, Revised 4<sup>th</sup> Edition, Pragati Prakashan Educational Publishers, 2010.  
**Unit II Chapter 37** **Unit-III Chapter 3, 36 & 40**
3. Anatharaman R, *Fundamentals of Quantum Chemistry*, McMillan, New Delhi, 2001.  
**Unit IV and V Chapter 5 - 7**
4. Prasad R K, *Quantum Chemistry*, Revised 4<sup>th</sup> Edition, New age international (P) Ltd., New Delhi, 2008. **Unit IV and V Chapter 5&6**
5. *Department Study Material*, Department of Chemistry, St. Joseph's College (Autonomous), Tiruchirapalli. **Unit I**

### Books for Reference

1. Vogel A I, *Text book of Quantitative Inorganic Analysis*, ELBS, 1978.
2. McQuarrie D A, *Quantum Chemistry*, 2<sup>nd</sup> Indian Edition, Viva Books Private Ltd., 2008.
3. Levine I N, *Quantum Chemistry*, 6<sup>th</sup> Edition, PHI Learning Private Limited, 2009.
4. Noel M and Vasu K I, *Cyclic Voltammetry and the Frontiers of Electrochemistry*, Oxford and IBH, 1990.
5. Kissinger P T and Heinman, *Laboratory Techniques in Electroanalytical Chemistry*, Editors, Marcel, Dekker, Inc., New York, 1984.
6. Puri Sharma and Pathania, *Principles of Physical Chemistry*, Vishal Publishing Co., 47<sup>th</sup> Edition, 2017.

### Web resources

			
Polarography	Cyclic voltammetry-I	Cyclic voltammetry-II	Coulometry

Semester	Course code						Hours	Credits			
III		<b>CORE-8: PHYSICAL CHEMISTRY-III</b>					5	4			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
<b>CO-1</b>	3	3	2	2	2	3	2	2	2	1	2.2
<b>CO-2</b>	2	2	2	2	2	2	2	2	2	1	1.9
<b>CO-3</b>	3	2	2	2	2	3	2	2	2	1	2.1
<b>CO-4</b>	2	3	2	2	2	2	3	2	2	2	2.2
<b>CO-5</b>	2	2	2	2	2	2	2	2	2	1	1.9
<b>Mean overall Score</b>											<b>2.06 (Medium)</b>



Semester	Course Code	Title of the Course	Hours	Credits
III		<b>CORE-9: ORGANIC CHEMISTRY-III</b>	5	4

CO. No.	CO-Statements	Cognitive levels (K-Level)
	On successful completion of the course, students will be able to	
CO-1	Acquire the knowledge and applications of <sup>1</sup> H NMR.	K1
CO-2	Comprehend the basics of pericyclic reaction.	K2
CO-3	learn the principles, techniques and applications of <sup>13</sup> C NMR and ESR.	K3
CO-4	Deduce the instrumentation, ionization techniques in mass spectrometry.	K4
CO-5	Recognize the mechanisms of rearrangements.	K5

### Unit -I <sup>1</sup>H NMR Spectroscopy (18 Hours)

**<sup>1</sup>H NMR:** Nuclear spin states - mechanism of absorption - chemical shift and shielding - NMR spectrometer continuous wave and FT instrument - chemical equivalence - integrals and integration - chemical environment and chemical shift - local diamagnetic shielding: electronegativity and hybridization effects - acidic exchangeable protons - deuterium exchange and peak broadening-tautomerism - protons on N: amines and amides-magnetic anisotropy -spin-spin splitting (n+1) rule - coupling constants - symbols - spectra of diastereotopic systems - measuring coupling constants - spin system notation: A<sub>2</sub>, AB, AX, AB<sub>2</sub>, AX<sub>2</sub>, A<sub>2</sub>B<sub>2</sub>, A<sub>2</sub>X<sub>2</sub> spin systems -heteronuclear coupling: <sup>1</sup>H-<sup>19</sup>F and <sup>1</sup>H-<sup>31</sup>P - PMR absorptions by hydrocarbons and functional groups-Chemical shift reagents-chiral resolving agents - problem solving.

### Unit -II <sup>13</sup>C NMR and ESR Spectroscopy (18 Hours)

**<sup>13</sup>C NMR:** <sup>13</sup>C nucleus-chemical shifts - correlation charts - proton coupled and decoupled <sup>13</sup>C spectra - nuclear overhauser effect - off resonance decoupling - DEPT experiments. Two dimensional spectroscopic methods: COSY, HETCOR and NOESY experiments - Magnetic resonance imaging - problem solving.

**ESR spectroscopy** - basic principle - predicting number of ESR lines for simple organic free radicals such as methyl, ethyl, phenyl and naphthalene radicals.

### Unit - III Mass Spectrometry (18 Hours)

Basic principles - instrumentation - sampling techniques - ionization methods: EI, CI, desorption ionization techniques (SIMS, FAB, and MALDI), ESI - Mass analysis: magnetic, double focusing, quadrupole and ToF mass analysers - detection and quantization - determination of molecular weight - molecular ion peak - base and meta stable peaks - calculation of molecular formula - fragmentation and structural analysis - fundamental fragmentation processes -Stevenson's rule -  $\alpha$ -cleavage-inductive cleavage - two bond cleavage - *retro* Diels-Alder cleavage - McLafferty rearrangements -fragmentation of hydrocarbons - alcohols, phenols, thiols - ethers and sulfides - carbonyl compounds - amines - and nitrogen compounds - halides.

Combined applications of UV-Visible, IR, NMR and Mass spectral techniques for the structural elucidation of organic molecules.

#### Unit- IV Pericyclic Reactions

(18 Hours)

Characteristics and types of pericyclic reactions

Cycloaddition reactions: stereochemistry of Diels-Alder reactions - substituent effects on reactivity, regioselectivity and stereochemistry -catalysis by Lewis acid - synthetic applications - enantioselectivity-synthetic applications - diastereoselective using chiral auxiliaries - 1,3-dipolar additions - relative reactivity - regioselectivity - stereoselectivity - transition structures - applications - [2+2] cycloaddition reactions of ketenes and alkenes.

Electrocyclic reactions: overview - orbital basis for stereospecificity - FMO and MO correlation diagram methods - thermal and photochemical reactions - Woodward-Hoffman rules - electrocyclic reactions of charged species - electrocyclization of heteroatomic trienes - rules for electrocyclic reactions.

#### Unit-V Sigmatropic rearrangements

(18 Hours)

Types shifts of hydrogen and alkyl groups - [3,3]sigmatropic rearrangement - oxidation of tertiary allylic alcohols - Cope, oxy-cope, anionic cope rearrangements - Claisen rearrangements-ortho ester Claisen, Ireland-Claisen, Ester enolate Claisen and Claisen rearrangement of N,N-dialkylketene - [2,3]-sigmatropic rearrangements - allylic sulfoxides, selenoxides and amine oxides-allylic sulfonium and ammonium ylides - thermal and photochemical - [1,n] H sigmatropic shifts.

#### Books for Study

1. Pavia D L, Lampman G M, Kriz G S and Vyvyan J R, *Introduction to Spectroscopy*, 5<sup>th</sup> Edition, Cengage Learning, Delhi, 2015.
2. **Unit I & II Chapter 5-9**                      **Unit III Chapter 3-4**
3. Carey F A, and Sundberg R J, *Advanced Organic Chemistry, Part A: Structure and mechanisms*, 5<sup>th</sup> Edition, Springer (India) Pvt Ltd., New Delhi, 2007.  
**Unit IV Chapter 10**                      **Unit V Chapter 10**
4. Carey F A, and Sundberg R J, *Advanced Organic Chemistry, Part B: Structure and Mechanisms*, 5<sup>th</sup> Edition, Springer (India) Pvt Ltd., New Delhi, 2007.  
**Unit IV Chapter 6**                      **Unit V Chapter 6**
5. Bruchner R, *Organic Mechanisms - Reactions, Stereochemistry and Synthesis*, Springer-Verlag, Berlin, Heidelberg, 2010.                      **Unit V Chapter 12**

#### Books for Reference

1. Silverstein R M and Bassler G C, *Spectrometric Identification of Organic Compounds*, 4<sup>th</sup> Edition, John- Wiley and Sons, New York, 1993.
2. Kemp W, *Organic Spectroscopy*, 3<sup>rd</sup> Edition, ELBS, London, 1987.
3. Fleming I, *Spectroscopic Methods in Organic Chemistry*, 4<sup>th</sup> Edition, Tata-McGraw Hill Publishing Company, New Delhi, 1988.
4. Smith M B, and March J, *March's Advanced Organic Chemistry*, 6<sup>th</sup> Edition, John-Wiley and Sons, New York, 2007.
5. Clayden J, Greeves N, and Warren S, *Organic Chemistry*, Oxford University Press, New York, 2012.
6. Bruchner R, *Organic Mechanisms - Reactions, Stereochemistry and Synthesis*, Springer-Verlag, Berlin, Heidelberg, 2010.

## Web Resources



Electromagnetic Spectrum



ESR - Instrumentation



Mass Spectroscopy

Semester	Course code	Title of the Course									Hours	Credits
III		<b>CORE-9: ORGANIC CHEMISTRY-III</b>									5	4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of Cos	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO-1	3	2	2	1	2	2	3	2	3	1	2.1	
CO-2	1	2	3	3	2	2	3	1	2	3	2.2	
CO-3	2	3	2	2	1	3	2	2	1	2	2.0	
CO-4	2	3	2	3	2	2	3	2	1	1	2.1	
CO-5	2	3	1	2	3	2	2	3	3	2	2.3	
<b>Mean overall Score</b>											<b>2.14 (Medium)</b>	

Semester	Course Code	Title of the Course	Hours	Credits
III		Core Practical 5: ORGANIC CHEMISTRY PRACTICAL- II	4	3

CO. No.	CO-Statements	Cognitive Levels (K -Level)
	On successful completion of this course, students will be able to	
CO-1	describe the principles of quantitative analysis in organic chemistry	K1
CO-2	understand the procedure for estimation of organic compounds	K2
CO-3	analyze the amount of oils, proteins and dyes	K3
CO-4	estimate the phenol, Aniline and Glucose	K5
CO-5	prepare organic compounds <i>via</i> single and double stage method	K6

**Unit- I Quantitative Analysis Organic Compounds (12 Hours)**

1. Determination of saponification value of edible oil.
2. Estimation of iodine value of oil.
3. Estimation of phenol
4. Estimation of aniline.

**Unit- II Quantitative Analysis Organic Compounds (12 Hours)**

1. Estimation of ketone.
2. Estimation of glucose.
3. Estimation of ascorbic acid.

**Unit - III Preparation of Organic Compounds (Single-Stage) (12 Hours)**

1. Preparation of acetanilide from aniline
2. Preparation of *p*-nitroaniline from acetanilide
3. Preparation of *p*-bromoaniline from acetanilide
4. Preparation of methyl nitrobenzoate from methyl benzoate

**Unit - IV Preparation of Organic Compounds (Two-stage) (12 Hours)**

1. Preparation of orange-II dye
2. Preparation of *p*-nitroaniline
3. Preparation of methyl orange dye
4. Preparation of *p*-bromoaniline

**Unit - V Preparation of Organic Compounds (Two-stage) (12 Hours)**

1. Preparation of 1,3,5-tribromobenzene
2. Preparation of acetyl salicylic acid (aspirin)
3. Preparation of methyl red

**Book of References**

1. Ganapragasm N S and Ramamurthy C, *Organic Chemistry Lab Manual*, 2<sup>nd</sup> Edition, Vishwanathan S Printers and Publishers (P) Ltd., Chennai, 2015.
2. Furniss B S, Hannaford A J, Smith P W G, and Tatchell A R, *Vogel's Textbook of Practical Organic Chemistry*, 5<sup>th</sup> Edition, Pearson publication.
3. Venkateswaran V, Veeraswamy R, Kulandaivelu A R, *Basic Principles of Practical Chemistry*, 2<sup>nd</sup> Edition, Sultan Chand and Sons, New Delhi, 1997.

4. *Organic Chemistry Lab Manual for Micro Qualitative Analysis*, Department of Chemistry, St. Joseph's College, Tiruchirappalli-620 002, (Private circulation).

### Web Resources



Estimation of Phenol



Preparation of Orange II Dye

### Scheme of Valuation

<b>Organic Chemistry Practical-II</b>		<b>Estimation and preparation</b>
<b>INTERNAL</b>		
<b>CIA</b>		<b>100 Marks</b>
	Cumulative mark of Regular Practical Classes	40 Marks
	Record	10 Marks
	Two CIA tests	50 Marks
<b>For Each CIA Test</b>	<b>100 marks</b>	
	Procedure	10 Marks
	Test/Viva	10 Marks
	Results	80 Marks (60 marks for estimation and 20 marks for preparation)
<b>Organic Estimations</b>		
<1% Error	60 Marks	
2%	50 Marks	
3%	40 Marks	
4%	30 Marks	
>4%	20 marks	
<b>Preparation</b>		
10 marks each for the crude and recrystallized samples		
<b>EXTERNAL</b>		
<b>Total</b>		<b>100 Marks</b>
	Procedure	10 Marks
	Test	10 Marks
	Results	80 Marks (60 marks for estimation and 20 marks for preparation)
<b>Organic Estimations</b>		
<1% Error	60 Marks	
2%	50 Marks	
3%	40 Marks	
4%	30 Marks	
>4%	20 marks	
<b>Preparation</b>		
10 marks each for the crude and recrystallized samples		

Semester	Course code	Title of the Course					Hours	Credits			
III		Core Practical 5: ORGANIC CHEMISTRY PRACTICAL- II					4	3			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO-1	2	1	2	3	3	2	3	2	3	3	2.4
CO-2	1	2	3	3	2	3	3	3	3	3	2.6
CO-3	2	3	2	3	2	2	3	2	2	2	2.3
CO-4	3	2	3	3	2	2	3	1	2	3	2.4
CO-5	2	3	2	2	3	2	2	3	3	1	2.3
<b>Mean overall Score</b>											<b>2.4 (High)</b>

Semester	Course Code	Title of the Course	Hours	Credits
III		<b>Core Practical 6: PHYSICAL CHEMISTRY PRACTICAL- II</b>	4	3

CO. No.	CO-Statements	Cognitive Levels (K-Level)
	On successful completion of this course, students will be able to	
CO-1	Describe the concept electrode potential.	K1
CO-2	Understand the concept of salting out constant.	K2
CO-3	Learn the concepts and measurement of equivalent conductance.	K2
CO-4	Apply the concepts of potentiometric titrations.	K3
CO-5	Experiment the concepts of conductometric titrations.	K4

### Unit –I Principle Behind Experiments (8 Hours)

Standard electrode potential - dissociation constant -conductometric acid-base and precipitation titrations- saponification of ethyl acetate by conductivity- potentiometric acid-base, precipitation and redox titrations - effect of NaCl on solubility of benzoic acid- solubility of sparingly soluble salt- equivalent conductance of a strong electrolyte at infinite dilution.

### Unit -II Preparation of Solutions (4 Hours)

Preparation and standardization of HCl, CH<sub>3</sub>COOH, NaOH, KCl, KI, AgNO<sub>3</sub> and NaCl.

### Unit - III Cycle I (16 Hours)

1. Conductometric acid-base titration - mixture of acids.
2. Conductometric precipitation titration - iodide and chloride mixture.
3. Determination of second-order rate constant for saponification of ethyl acetate by conductivity.

### Unit - IV Cycle II (16 Hours)

1. Potentiometric acid-base titration - mixture of acids.
2. Potentiometric precipitation titration - iodide and chloride mixture.
3. Salting out constant - effect of NaCl on solubility of benzoic acid.
4. Determination of standard electrode potential of zinc and copper.

### Unit - V Cycle III (16 Hours)

1. Potentiometric redox titration
2. Solubility of sparingly soluble salt by (i) Conductivity and (ii) Potentiometry
3. Determination of equivalent conductance of a strong electrolyte at infinite dilution.
4. Dissociation constant of weak acid by conductivity method.

### Books for Study

1. *Lab Manual*, Department of Chemistry, St. Joseph's College (Autonomous), Tiruchirappalli.
2. Venkateswaran V, Veeraswamy R and Kulandaivelu A R., *Basic Principles of Practical Chemistry*, 2<sup>nd</sup> Edition, Sultan Chand & sons, New Delhi, 1997.
3. Daniels, Mathews F, Howard J and John Warren W, *Experimental Physical Chemistry*, 7<sup>th</sup> Edition, Mc Graw Hill, New York, 1970.
4. Findlay A, *Practical Physical Chemistry*, 7<sup>th</sup> Edition, Longman, London, 1959.

Web Resources



Conductometric precipitation titration

Saponification of ethyl acetate by conductivity

Semester	Course code	Title of the Course					Hours	Credits			
III		Core Practical 6: PHYSICAL CHEMISTRY PRACTICAL- II					4	3			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of Cos
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO-1	3	3	2	2	1	3	3	2	2	1	2.2
CO-2	3	2	2	2	2	3	2	2	2	2	2.2
CO-3	3	3	3	3	2	3	3	3	3	2	2.8
CO-4	3	3	2	2	2	3	2	2	2	2	2.3
CO-5	3	2	3	2	1	3	3	2	2	3	2.4
<b>Mean overall Score</b>											<b>2.38 (High)</b>



**SCHEME OF VALUATION  
INTERNAL**

<b>CIA</b>	<b>100</b>	<b>Marks</b>
Cumulative mark of Regular Practical Classes	50 Marks	
Two CIA tests	50 Marks	
<b><i>For Each CIA Test</i></b>	<b><i>100 marks</i></b>	
Procedure	10 Marks	
Record	10 Marks	
Viva	10 Marks	
<b>Results</b>	<b>70 Marks</b>	
Table	10marks	
Calculation	10 marks	
Graph	10 marks	
Results	40 marks	

**EXTERNAL**

***Scheme of valuation***

<2% Error	40 Marks
3%	30 Marks
4%	20 Marks
>4%	10 Marks

<b>Total</b>	<b>100 Marks</b>
Procedure	10 Marks
Viva	10 Marks
<b>Results</b>	<b>80 Marks</b>
Table	10marks
Calculation	10 marks
Graph	10 marks
Results	50 marks

***Scheme of valuation***

<2% Error	50 Marks
3%	40 Marks
4%	30 Marks
>4%	20 Marks

Semester	Course Code	Title of the Course	Hours	Credits
IV		CORE-10: ORGANIC CHEMISTRY-IV	5	4

CO. No.	CO-Statements	Cognitive Levels (K-Level)
	On successful completion of this course, students will be able to	
CO-1	Name the synthesis and application of organometallic reagents.	K1
CO-2	Overview of modern name reactions.	K2
CO-3	Get familiarized with the selectivity in reactions and control them.	K3
CO-4	Analyze and explain the methods of synthesizing target molecules.	K4 & K5
CO-5	Understand and design the methods of asymmetric synthesis.	K6

### Unit-I Retro-synthetic analysis

(15 Hours)

Synthons and synthetic equivalents - types of synthons: donor and acceptor synthons - umpolung reactions - typical examples. Functional Group Interconversion (FGI), Functional Group Addition (FGA) - monofunctional disconnection: alcohol disconnection - alkene disconnection - ketone disconnection - acid and their derivatives disconnection - alkane disconnection - amine disconnection - bifunctional 1,2-, 1,3-, 1,4-, 1,5-, and 1,6- disconnections.

#### Multistep Synthesis:

Illustrative synthesis of Juvabion from 4-methoxyacetophenone and from 4-methoxybenzaldehyde

### Unit - II Selectivity in Organic Synthesis

(15 Hours)

#### Chemoselectivity:

Chemo-, region-, and stereoselectivity - reactivity of carbonyl groups towards nucleophiles - selectivity of hydrides in reduction - selectivity in oxidations - Protecting groups - hydroxyl, amino, carbonyl and carboxylic acid protecting groups

**Regioselectivity:** Regioselectivity in electrophilic and nucleophilic aromatic substitution, regioselectivity in elimination reactions, electrophilic attack on alkenes, regioselectivity in radical reactions, nucleophilic attack on allylic compounds, electrophilic attack on conjugated dienes and conjugate addition.

### Unit - III Asymmetric Synthesis

(15 Hours)

Chiral auxiliaries - alkylation of chiral enolates - enantiomeric excess-optical purity - chiral reagents and chiral catalysis - asymmetric hydrogenation - asymmetric epoxidation - asymmetric dihydroxylation

**Diastereoselectivity:** prochirality, Cram's rule and chelation effect, diastereoselectivity in aldol reaction, diastereoselective epoxidation.

### Unit - IV Organometallic Reagents

(15 Hours)

Preparation of organometallics: oxidative insertion, deprotonation of alkyne, ortholithiation of functionalized benzene rings, halogen metal exchange, transmetallation - preparation and properties and synthetic applications of organolithium, organomagnesium, organocopper reagents and intermediates - synthesis, features and reactions of organosilicon compounds - reactions involving organopalladium intermediates - Heck reaction - cross coupling reactions

- Suzuki coupling, Stille coupling, Fukuyama coupling - Negishi coupling, Kumada coupling- Sonogashira reaction-carbonylation reactions - olefin metathesis reactions.

### Unit - V Name Reactions

(15 Hours)

Chan-Lam coupling, Hiyama coupling - Corey-Fuchs Reaction, Baylis-Hillman reaction - Biginelli reaction - Mukaiyama aldol reaction - Prins reaction, Mitsunobu reaction - Weinreb ketone synthesis Henry reaction - Hosomi-Sakurai reaction - Norrish Type I and II reactions - Paterno-Buchi and its regioselectivity - Barton reaction - Hofmann - Loeffler-Freytag reaction.

### Books for Study

1. Carey F A, Sundberg R J, *Advanced Organic Chemistry, Part A: Structure and mechanisms*, 5<sup>th</sup> Ed., Springer (India) Pvt Ltd. New Delhi, India, 2007.

**Unit I** Chapter

2. Carey F A, Sundberg R J, *Advanced Organic Chemistry, Part B: Structure and Mechanisms*, 5<sup>th</sup> Ed., Springer (India) Pvt Ltd. New Delhi, India, 2007.

**Unit I** Chapter 13

**Unit II** Chapter 3

**Unit IV** Chapter 7-9

3. Clayden J, Greeves N, and Warren S, *Organic Chemistry*, Oxford University Press, New York, 2012.

**Unit I** Chapter 28

**Unit II** Chapter 23

**Unit III** Chapter 41

**Unit IV** Chapter 40

**Unit V** Chapter 48

### Books for Reference

1. Warren S, *Designing Organic synthesis: The Disconnection Approach*, Wiley, New Delhi, 1984.
2. Bruchner R, *Organic Mechanisms - Reactions, Stereochemistry and Synthesis*, Springer-Verlag, Berlin, Heidelberg, 2010.
3. Richard O. Norman.C, Coxon J M, *Principles of Organic Synthesis*, 3<sup>rd</sup> Ed., CRC Press, Boca Raton, Florida, USA, 1993 .

### Web Resources



Retrosynthesis



Chemoselective



Asymmetric synthesis

Semester	Course code	Title of the Course									Hours	Credits
IV		<b>Core 10: ORGANIC CHEMISTRY-IV</b>									5	5
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of Cos	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO-1	3	2	3	2	2	2	3	2	2	3	2.4	
CO-2	2	3	1	2	3	2	2	3	3	2	2.3	
CO-3	3	2	2	2	1	3	2	2	1	2	2.0	
CO-4	3	2	2	2	1	2	3	2	3	1	2.1	
CO-5	2	3	2	3	2	2	3	2	1	3	2.3	
<b>Mean overall Score</b>											<b>2.22 (High)</b>	

Semester	Course Code	Title of the Course	Hours	Credits
IV		PROJECT WORK AND VIVA VOCE		8

CO. No.	CO-Statement	Cognitive Level (K - level)
	On successful completion of this course, students will be able to	
CO-1	Relate and understand the basic aspects of research.	K1 & K2
CO-2	Identify current chemical literature and other search engines judiciously.	K3
CO-3	Discover synthetic skills in carrying out research problem.	K4
CO-4	Appraise scientific writing and presentation skill for preparing project reports.	K5
CO-5	Design new research problems and carry out systematically.	K6

**Unit-I Introduction and Fundamentals of Research (5 hours)**

**Research:** Definition - search for knowledge - role of theory-research hypothesis and null hypothesis - populations and sampling - purposes of research - types of educational research: fundamental research - applied research - action research - descriptive research, assessment, and evaluation.

**Unit-II Problem identification and Research Design (5 hours)**

**Scientific research problem:** Definition, objectives, purposes and components of research problem-ethics in research.

**Unit-III Chemical Literature Survey (5 hours)**

Introduction to the chemical literature-non-patent primary literature: communications, articles, reviews, conference papers, reports, abstracts and preprints-chemical patents. Searching using text: beyond web search engines-searching by structure and substructure.

**Unit-IV Project Work-Lab (70 hours)**

Identification of research problem - collection of materials -preliminary analysis - finalizing the methodology - execution of the research work - collection of data and evidences - finalizing the results.

**Unit-V Compilation of Report (5 hours)**

**Scientific Writing and Effective Presentation:** Requirement of scientific communications: eliminating wordiness and jargon-tautology, redundancy, imprecise words, superfluous phrases - style of writing-footnotes and end notes- referencing styles-bibliography-journal abbreviations (CAS source index) -abbreviations used in scientific writing-Effective presentation: slide presentation and poster presentation- Report preparation:



Semester	Course code	Title of the Course					Hours	Credits				
IV		PROJECT WORK AND VIVA VOCE					6	8				
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of Cos	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO-1	3	3	2	2	3	3	3	2	2	2	2.5	
CO-2	2	2	2	2	3	2	3	2	2	3	2.3	
CO-3	3	2	2	2	3	3	3	2	2	3	2.5	
CO-4	2	3	2	2	3	2	3	2	2	3	2.3	
CO-5	3	3	2	3	3	3	3	2	3	3	2.8	
<b>Mean overall Score</b>											<b>2.48 (High)</b>	

### Scheme of Evaluation

<b>Internal examination</b>	<b>100 marks</b>
Review of literature	15 marks
Experimental work	30 marks
Manuscript preparation	30 marks
Common <i>viva-voce</i> examination	25 marks

<b>External examination</b>	<b>100 marks</b>
<b>External examiner</b>	<b>(75 marks)</b>
Review of literature	10 marks
Experimental work	20 marks
Manuscript preparation	20 marks
<i>Viva voce</i> examination	25 marks
<b>Internal examiner</b>	<b>(25 marks)</b>
<i>Viva voce</i> examination	25 marks

### **Discipline Specific Elective Courses (DSE)**

<b>Component</b>	<b>Course Title</b>	<b>Theory / Practical</b>	<b>Credits</b>
Discipline Specific Elective Course - I	DSE - I: (Any one selected from the list)	Theory	4
Discipline Specific Elective Course - II	DSE - II: (Any one selected from the list)	Theory	4
Discipline Specific Elective Course - III	DSE – III: (Any one selected from the list)	Theory	4
Discipline Specific Elective Course - IV	DSE – IV: (Any one selected from the list)	Theory	4
Discipline Specific Elective Course - V	DSE – V: (Any one selected from the list)	Theory	4

#### **List of Discipline Specific Elective Courses (DSE)**

Theories of molecular structure

Bioorganic Chemistry

Pharmaceutical Chemistry

Selected Topics in Inorganic and Physical Chemistry- I

Selected Topics in Chemistry

Nano Science and Technology

Computational Chemistry and Numerical Analysis

Solid State and bioinorganic compounds

Research methodology

Semester	Course code	Title of the Course	Credits
I		THEORIES OF MOLECULAR STRUCTURE	4

CO. No.	CO-Statements	Cognitive levels (K - level)
	On successful completion of the course, students will be able to	
CO-1	Describe the concept of rotational and vibrational spectroscopy	K1
CO-2	Learn the concepts of Raman, NMR, ESR, electronic and Mossbauer spectroscopy	K2
CO-3	Apply the concept of group theory in constructing character table	K3
CO-4	Correlate the concept of group theory	K4
CO-5	Predict the structures of simple compounds	K5

### Unit-I Rotational and Vibrational Spectroscopy (12 Hours)

Basic aspects of spectroscopy - characterization of electromagnetic radiation - quantization of energy- microwave spectroscopy - rotation of molecules and selection rules - diatomic molecules - rigid and non-rigid rotator - rotational constant and centrifugal distortion - techniques and instrumentation - vibrational spectroscopy - diatomic molecules, harmonic and anharmonic oscillators - zero point energy - force constant - fundamental absorption and overtones (hot bands, Fermi resonance) - polyatomic molecules - techniques and instrumentation of FT-IR.

### Unit-II Raman, NMR, and Mossbauer Spectroscopy (12 Hours)

Raman spectroscopy - Raman and Rayleigh scattering - quantum and classical theories of Raman effect - Stokes and anti-stokes lines - pure rotational Raman spectra - vibrational Raman spectra - mutual exclusion rule - polarized and depolarized Raman lines - techniques and instrumentation- NMR - hydrogen nuclei - chemical shift and spin-spin splitting - coupling constant - splitting with and without chemical exchange - interaction between spin and magnetic field - gyro magnetic ratio - instrumentation of NMR - FT NMR- applications of 2D NMR techniques like COSY, NOESY - applications of <sup>13</sup>C NMR spectroscopy - Mossbauer spectroscopy - principles of Mossbauer spectroscopy- Doppler shift - recoil energy- isomer shift- quadrupole splitting - applications to various compounds.

### Unit-III ESR Spectroscopy and Electronic Spectroscopy (12 Hours)

ESR - principle - position of ESR absorptions - g value - hyperfine splitting - zero field splitting - ESR spectrum of free radicals and copper salicylaldehyde complexes - electronic spectra - Electronic spectra of diatomic molecules - Born-Oppenheimer approximation - vibrational coarse structure - Franck-Condon principle - dissociation energy and dissociation products - rotational fine structure of electronic vibration - vibration transition - Fortrat diagram- electronic angular momentum in diatomic molecules - spectrum of molecular hydrogen - molecular photoelectron spectroscopy - UV photoelectron spectroscopy and X-ray photoelectron spectroscopy.

### Unit-IV Rudiments of Group Theory (12 Hours)

Principles of group theory - symmetry elements - symmetry operations - properties of group - abelian, non - abelian and cyclic groups - multiplication tables - classes - subgroups -



molecular point groups - Schoenflies symbols - optical activity and dipole moment on the basis of point groups matrices for symmetry operations - reducible and irreducible representations - statement of great orthogonality theorem - construction of character table - explanation of a character table.

### **Unit-V Applications of Group Theory (12 Hours)**

Applications of group theory - standard reduction formula relating reducible and irreducible representations - hybridization schemes for atoms in molecules of different geometry - AB<sub>4</sub> tetrahedral, AB<sub>3</sub> triangular planar and AB (linear)- symmetries of vibrational modes in non-linear molecules (H<sub>2</sub>O, NH<sub>3</sub> and BF<sub>3</sub>) - integration method - selection rules in spectroscopy - IR & Raman active - vibration modes -mutual exclusion rule - symmetry in crystals - Hermann - Mauguin symbols - space groups of crystals -translational elements of symmetry - comparison of crystal symmetry with molecular symmetry.

### **Books for Study**

1. Banwell C N, *Molecular Spectroscopy*, 2<sup>nd</sup> Edition, TATA McGraw Hill Co., New Delhi, 2010.  
**Unit I -III Chapter 2,3,4,5, & 6**
2. Raman K V, *Group Theory and its Applications to Chemistry*, Tata Mc Graw-Hill Publishing Company, New Delhi, 1990.  
**Unit IV Chapter 1,2,3 & 4                      Unit V Chapter 5,6,7 & 8**

### **Book for References**

1. Drago R S, *Physical Methods in Inorganic Chemistry*, East West Press Ltd, New Delhi, 1971.
2. Chang R, *Basic Principles of Spectroscopy*, Englewood Cliffs, New Jersey, 1978.
3. Straughan B P and Walker S, *Spectroscopy*, Volume 1,2,3, Chapman and Hall, A Halstet Press Book, John Wiley & Sons Ins., New York, London, 1975.
4. Barrow G M, *Introduction to Molecular Spectroscopy*, Tata McGraw - Hill, New Delhi, 1993.
5. Chatwal G R and Anand S K, *Spectroscopy*, Himalaya Publishing House, Mumbai, 2009.
6. Albert Cotton F, *Chemical applications of Group Theory*, 3<sup>rd</sup> Edition, Wiley India (P) Ltd., New Delhi, 2010.

### **Web Resources**



Principles of Organic Chemistry



NPTEL-Online Course

Semester	Course code	Title of the Course					Hours	Credits			
I		THEORIES OF MOLECULAR STRUCTURE						4			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of Cos
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO-1	3	3	2	2	1	3	2	3	2	1	2.2
CO-2	3	3	2	2	1	3	2	3	2	2	2.3
CO-3	3	3	3	2	2	3	3	2	2	2	2.5
CO-4	3	2	3	2	1	3	2	2	2	1	2.1
CO-5	2	2	2	2	2	2	2	2	2	2	2.0
<b>Mean overall Score</b>											<b>2.22 (High)</b>

Semester	Course Code	Title of the Course	Hours	Credits
I		BIOORGANIC CHEMISTRY		4

CO. No.	CO – Statements	Cognitive Levels (K Level)
	On successful completion of course, students will be able to	
CO-1	Understand the reactivity of heterocycles.	K1
CO-2	Outline the structure and functions of DNA and RNA.	K2
CO-3	Apply the separation concepts on aminoacids.	K3
CO-4	Identify the mechanism of preparation and reactions of heterocycles.	K4
CO-5	Compare the organic reaction mechanism with enzyme mechanism.	K5

### Unit-I Heterocycles 1 (12 Hours)

Hantzsch pyridine synthesis - electrophilic aromatic substitution in pyridine and activated pyridine - nucleophilic substitution in pyridine - pyridone in nucleophilic substitutions - pyridine as catalyst and reagent - pyrones - structures of triazoles, and tetrazole and their tautomers - quinoline and isoquinoline - electrophilic and nucleophilic substitution reactions.

### Unit-II Heterocycles 2 (12 Hours)

Preparation of imidazole- only the structures, numbering and naming of diazins (pyrazine, pyrimidine and pyrazine), azines (oxazine and azepine)-electrophilic aromatic substitution reactions in five membered heterocycles - pyrrole, furan, thiophene and indole - electrophilic addition in furan - lithiation in furan and thiophene - five membered heterocycles in Diels-Alder reactions.

### Unit-III Nucleic Acids (12 Hours)

Structures and names of nucleosides and nucleotides - ATP - carrier of chemical energy - phosphoryl transfer reaction-mechanisms for phosphoryl transfer reactions - structures of dinucleotides - NAD<sup>+</sup>, NADP<sup>+</sup>, NADH, NADPH and GTP - Nucleic acids - DNA and RNA - primary and double helical structures - base pair - replication - transcription - ribosomal RNA - transfer RNA - translation -base sequencing of DNA - DNA fingerprinting - AZT drug in HIV treatment.

### Unit-IV Carbohydrates and Amino Acids (12 Hours)

**Carbohydrates:** The reactions of monosaccharides in basic solutions - oxidation and reduction reactions of monosaccharides - the Wohl degradation - measuring the blood glucose level in diabetes - anomeric effect in glucose.

**Amino acids:** Separation of amino acids - electrophoresis - TLC - Ion exchange chromatography - Synthesis of amino acids - HVZ reaction - *N*-Phthalimidomalonic ester synthesis - Resolution of racemic mixtures of amino acids - Peptide bonds and disulfide bonds.

### Unit-V Enzyme Catalysis and Lipids (12 Hours)

**Enzyme Catalysis:** Types of enzymes - names - Active site - molecular recognition - lock and key model - mechanism of carboxypeptidase A.

**Lipids:** Fatty acids - omega fatty acids - waxes - fats and oils - PUFA - phospholipids -- prostaglandins - biosynthesis of prostaglandins, thromboxanes, and prostacyclins.

### Books for Study

1. Clayden J, Greeves N and Warren S, *Organic Chemistry*, 2<sup>nd</sup> Edition, Oxford University Press, New York, 2012.  
**Unit I** Chapter 29  
**Unit II** Chapter 8
2. Bruice P Y, *Organic Chemistry*, 4<sup>th</sup> Edition, Pearson Education, New Delhi, 2012.  
**Unit III** Chapter 27  
**Unit IV** Chapter 22  
**Unit V** Chapter 24

### Books for Reference

1. Rodwell D, Bender D and Botham K, *Harper's Illustrated Biochemistry*, 31<sup>st</sup> Edition, McGraw Hill Professional, New York, 2018.
2. Stryer L, Berg J M, Tymoczko J L and Gatto G, *Biochemistry*, 9<sup>th</sup> Edition, W. H. Freeman and Company, New York, 2019.

### Web Resources



Nucleic Acids



Carbohydrates

Semester	Course code	Title of the Course									Hours	Credits
I		DSE-2: BIOORGANIC CHEMISTRY									5	4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO-1	3	2	3	2	2	2	3	3	3	2	2.5	
CO-2	2	2	2	2	2	3	2	2	2	2	2.1	
CO-3	3	3	3	2	2	3	3	3	2	2	2.6	
CO-4	3	2	3	3	2	2	3	2	3	2	2.5	
CO-5	2	2	2	3	2	2	3	2	2	2	2.2	
Mean overall Score											2.38 (High)	

Semester	Course Code	Title of the Course	Hours	Credits
II		PHARMACEUTICAL CHEMISTRY		4

CO. No.	CO – Statements	Cognitive Levels (K Level)
	On successful completion of course, students will be able to	
CO-1	Recall the chemistry of bioregulatory drugs.	K1
CO-2	Understand the therapeutic uses of drugs containing heterocycles.	K2
CO-3	Identify the common diseases and their treatments employed.	K3
CO-4	Classify drugs based on their biological, chemical characteristics.	K4
CO-5	Apply the concept of chemical reactions in designing the drugs.	K6

**Unit-I: Introduction to Chemistry of Drugs (12 Hours)**

Drugs - definition- sources- study of drugs -classification (biological, chemical, commercial and utility)-nomenclature of drugs- biotransformation-drug design - factors affecting the stability of drugs- encapsulation - drug delivery systems and sustained release of drugs.

**Unit-II: Drugs Containing Heterocycles (12 Hours)**

Structures and their therapeutic uses of drugs containing pyridine: nikethamide, isoniazid, mepyramine and niacin-thiazole: niridazole, thiabendazole and sulfathiazole - imidazole: azomycin, metronidazole and clotrimazole - indole: seratonine, reserpine, ergotamine and indomethacin- quinoline: chinofon, chloroquine and primaquine.

**Unit-III: Common Diseases and their Treatment (12 hours)**

Insect borne diseases - Treatment using drugs - Air borne diseases-Treatment using drugs - water borne diseases- Treatment using drugs-Digestive disorders - treatment- diseases of respiratory system- treatment-diseases of nervous system - treatment - other common diseases- treatment.

**Unit-IV: Name Reactions in Drug Synthesis (12 hours)**

Mechanism and uses of Beckmann rearrangement- Fries rearrangement- Schmidt reaction- MPV reduction- Clemmensen Reduction-Birch Reduction-Darzen's reaction-Reiley Reaction-Mannich reaction-Michael reaction.

**Unit-V: Bioregulatory Drugs (12 hours)**

Cardiovascular drugs - Cardiac glycosides - anti arrhythmic drugs -antihypertensive agents - antianginal agents. Diabetes and Hypoglycaemic drugs - two types of diabetes - Diabetes insipidus and diabetes mellitus -Control of diabetes - Insulin -Hypoglycaemic agents. Anticonvulsants -Cancer and antineoplastic drugs - Common causes - antimetabolites.

## Books for Study

1. Clayden J, Greeves N and Warren S, *Organic Chemistry*, 2<sup>nd</sup> Edition, Oxford University Press, New York, 2012.

Unit I Chapter 29

Unit II Chapter 8

2. Gosh J, *Text Book of Pharmaceutical Chemistry*, 3<sup>rd</sup> Edition, S. Chand & Chand Publications,

New Delhi, 1997.

Unit I Chapter 2

Unit III Chapter 6

Unit V Chapter 10

3. George M and Joseph L, *Text Book of Pharmaceutical Chemistry*, Viva Books, New Delhi, 2009.

Unit II

Chapter 3

## Books for Reference

1. Srivastava, S K, *A Complete Text Book of Medical Pharmacology*, Volume I, 2<sup>nd</sup> Edition, Avichal Publishing Company, Kolkatta, 2012.
2. Srivastava, S K, *A Complete Text Book of Medical Pharmacology*, Volume II, 2<sup>nd</sup> Edition, Avichal Publishing Company, Kolkatta, 2012.
3. Deb A C, *Fundamentals of Biochemistry*, New Central Book Agency, Calcutta, 1994.
4. Satake M and Mido Y, *Chemistry for Health Science*, Discovery Publishing House, New Delhi, 2003.
5. Kar A, *Medicinal Chemistry*, Wiley Easterns Limited, New Delhi, 1993.

## Web Resources



Medicinal Chemistry



Common Diseases



Base Catalyzed Reaction

Semester	Course code	Title of the Course									Hours	Credits
II		PHARMACEUTICAL CHEMISTRY										4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of Cos	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO-1	3	3	2	2	2	3	3	2	3	2	2.5	
CO-2	3	3	3	2	2	3	3	2	3	2	2.6	
CO-3	3	3	2	2	2	3	3	2	2	2	2.4	
CO-4	3	3	3	3	2	3	2	2	3	2	2.6	
CO-5	2	2	2	2	2	2	2	2	3	2	2.1	
Mean overall Score											2.44 (High)	

Semester	Course Code	Title of the Course	Hours	Credits
II		SELECTED TOPICS IN INORGANIC AND PHYSICAL CHEMISTRY- I		4

CO. No.	CO-Statements	Cognitive Levels (K -Level)
	On successful completion of this course, students will be able to	
CO-1	Know the different types of organometallic reactions	K1
CO-2	Discuss the role of organometallic complexes in catalytic processes	K2
CO-3	Illustrate the industrial importance of compounds of main group elements	K3
CO-4	Identify the importance of partial molar properties	K4
CO-5	Explain the concepts of fugacity and activity	K5 & K6

**Unit-I Types of organometallic reactions (12 Hours)**

Oxidative addition - addition of H-H, C-H, C-C, X-X and R-X bonds. Reductive elimination - cis-elimination, C-H elimination and dinuclear reductive eliminations. Insertion and deinsertion - 1, 1-insertion (carbonyl insertion or alkyl migration), 1,2-insertion (beta-elimination), insertion into M-H, M-C bonds. Nucleophilic addition to the ligand - addition to CO, carbene and pi-ligands. Metathesis reactions.

**Unit-II Homogeneous catalysis by transition metal complexes (12 Hours)**

Key steps in homogeneous catalysis - catalyst activation, substrate coordination, oxidative addition, reductive elimination, nucleophilic attack on substrate and product dissociation. The hydroformylation reaction - Co and Rh catalyzed hydroformylation reactions. The Wacker-Smith synthesis of acetaldehyde, Hydrogenation of alkenes, carbonylation of methanol, Pd catalyzed C-C bond forming reactions, Reduction of Carbon Monoxide (Fischer-Tropsch Synthesis), oligomerization and polymerization reactions.

**Unit-III Chemistry of the main group elements (12 Hours)**

Allotropy, synthesis, structure and bonding, industrial importance of the compounds of the *s* and *p* block elements.

**Unit-IV Chemical Thermodynamics I (12 Hours)**

Partial molar properties - molarity and mole fraction - partial molar quantities - methods of determination of partial molar volume - chemical potential - Gibbs-Duhem equation - chemical potential of mixture of gases - chemical potential in terms of U, H - variation of chemical potential with temperature and pressure - determination of partial molar properties from apparent molar properties - free energy of mixing - entropy of mixing and volume of mixing- fugacity - definition - methods of determination - variation of fugacity with temperature, pressure and composition - Duhem-Margules equation - fugacity of solids, liquids and mixture of gases - determination of fugacity in gas mixtures (Lewis-Randall Rule).

**Unit-V Chemical Thermodynamics II****(12 Hours)**

Activity and activity coefficients - definition - standard state- reference state- choice of standard state for gases, liquids and solids, liquid solvent and solute - dependence of activity on temperature and pressure - determination of activity coefficient of non-electrolyte - mean ionic activity - determination of activity coefficient of electrolytes by freezing point method.

**Books for Study**

1. Miessler G L, Fischer P J and Tarr D A, *Inorganic Chemistry*, 5<sup>th</sup> Edition, Pearson Education, New York, 2014.  
**Unit-I Chapter 14                      Unit-II Chapters 14                      Unit-III Chapters 8**
2. Kuriakose J C and Rajaram J C, *Thermodynamics*, Shoban Lal Co., Jalandar, 1999.  
**Unit IV and V Chapter 8 and 10**

**Books for Reference**

1. Weller M, Overton T, Rourke J and Armstrong F, *Inorganic Chemistry*, 7<sup>th</sup> Edition, Oxford University Press, London, 2018.
2. Spessard G O and Miessler G L, *Organometallic Chemistry*, 2<sup>nd</sup> Edition, Oxford University Press, New York, 2010.
3. Gupta M C, *Statistical Thermodynamics*, 2<sup>nd</sup> Edition, New Age International Publishers, Chennai, 1998.
4. McQuarrie D A, *Statistical Thermodynamics*, 1<sup>st</sup> Indian Edition, Viva Books Private Ltd., New Delhi, 2003.

**Web resources**

Organometallic Chemistry



Applications

Semester	Course Code					Title of the Course					Hours	Credits
II						SELECTED TOPICS IN INORGANIC AND PHYSICAL CHEMISTRY- I						4
Course Outcomes (COs)	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)					Mean Scores of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO-1	3	3	2	2	2	3	3	2	2	2	2.4	
CO-2	3	2	2	2	1	3	2	2	2	1	2.0	
CO-3	2	2	2	2	2	2	2	2	2	2	2.0	
CO-4	2	2	2	2	3	2	2	2	2	3	2.2	
CO-5	2	3	2	2	2	2	3	2	2	2	2.2	
<b>Mean Overall Score</b>											<b>2.16</b> <b>( Medium)</b>	



Semester	Course Code	Title of the Course	Hours	Credits
III		SELECTED TOPICS IN CHEMISTRY		4

CO. No.	CO-Statements	Cognitive Levels (K- Level)
	On successful completion of this course, students will be able to	
CO-1	Know the different types of measurements and instrumentation	K1
CO-2	Understand the importance of operational amplifiers	K2
CO-3	Understand the basics of non- equilibrium thermodynamics	K2
CO-4	Apply the concepts of non-equilibrium thermodynamics	K3
CO-5	Explain the basics of digital electronics	K4

### Unit-I Measurement and Instrumentation (12 Hours)

Introduction - the nature of a measurement - choice of a method of measurement - control of variables - basic design patterns - general properties of modules - propagation of uncertainty - single channel design- limit of detection and amplification - automatic operation and computer control

### Unit-II Operational Amplifiers (12 Hours)

The operational amplifier - limitations on amplifier performance -mathematical operations - differentiation - integration - measurement of current and voltage - precise control of current and voltage

### Unit-III Digital Electronics (12 Hours)

Binary logic concepts - logic gates - multivibrators - counters - wave shaping - analog to digital converters - instruments and digital computers

### Unit-IV Non-equilibrium Thermodynamics-I (12 Hours)

Introduction to non-equilibrium thermodynamics - methods of study of non-equilibrium thermodynamics - mass conversion de-Donder equation - energy conservation - entropy production in systems involving heat transfer - entropy production in chemical reactions - affinity and equilibrium constant - affinity and Gibbs free energy - affinity and rate derivations - coupled and non-coupled reaction systems - entropy production and entropy flow in open system - Onsager theory -phenomenological relations - an introduction - characteristics of direct and cross coefficients - rate expression using Onsager equation - kinetic approach - thermodynamic approach - derivation of Onsager reciprocity relation using a cyclic coupled reaction (Proof of  $L_{12} = L_{21}$ ).

### Unit-V Non-equilibrium Thermodynamics-II (12 Hours)

Linear law - condition for coupled and non-coupled reactions with reference to cross coefficients - decomposition of cyclohexane and linear law - non coupled reaction - isomerization of xylene - coupled reaction - reaction taking place in liver - experimental verification of Onsager's reciprocity relation - thermoelectricity - Seebeck effect - Peltier effect - electro kinetic effect - thermo molecular pressure difference -  $L_{12} = L_{21}$  by transference number method - irreversible thermodynamics and biological systems.

### Books for Study

1. Strobel H A, *Chemical Instrumentation: A systematic Approach*, 2<sup>nd</sup> Edition, AddisonWesley Publishing Company, London, 1973  
**Unit I Chapter 1 Unit II Chapter 7 Unit III Chapter 9**
2. Kuriakose J C and Rajaram J C, *Thermodynamics*, Shoban Lal Co., Jalandar, 1999.  
**Unit IV and V Chapter Appendix A & B**

### Books for Reference

1. Skoog D A, Holler J F and Crouch S R, *Principles of Instrumental Analysis*, 7<sup>th</sup> Edition, Boston, 2018.
2. Skoog D A, West D M, Holler F J, and Crouch S R, *Fundamentals of Analytical Chemistry*, 9<sup>th</sup> Edition, Brooks/Cole Cengage Learning, Belmont, CA 94002-3098, USA, 2014.
3. Gupta M C, *Statistical Thermodynamics*, 2<sup>nd</sup> Edition, New Age International Publishers, Chennai, 1998.
4. McQuarrie D A, *Statistical Thermodynamics*, 1<sup>st</sup> Indian Edition, Viva Books Private Ltd., New Delhi, 2003.

### Web Resources



Chemical Process Instrumentation

Semester	Course code	Title of the Course									Hours	Credits
III		SELECTED TOPICS IN CHEMISTRY										4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO-1	3	3	2	2	1	3	2	3	2	1	2.2	
CO-2	3	2	2	2	2	3	2	2	3	2	2.2	
CO-3	2	2	2	2	1	2	2	2	2	1	1.8	
CO-4	3	3	2	2	2	2	3	3	2	2	2.4	
CO-5	2	3	2	2	2	2	2	3	2	2	2.2	
Mean overall Score											2.16 (Medium)	

Semester	Course Code	Title of the Course	Hours	Credits
III		NANOSCIENCE AND TECHNOLOGY		4

CO. No.	CO-Statements	Cognitive Levels (K- Level)
	On successful completion of this course, students will be able to	
CO-1	Know the different types of measurements and instrumentation	K1
CO-2	Understand the importance of operational amplifiers	K2
CO-3	Understand the basics of non-equilibrium thermodynamics	K2
CO-4	Apply the concepts of non-equilibrium thermodynamics	K3
CO-5	Explain the basics of digital electronics	K4

### Unit I: Background to Nanoscience:

Definition of Nano, Scientific revolution-Atomic Structure and atomic size, emergence and challenges of nanoscience and nanotechnology, carbon age-new form of carbon (CNT to Graphene), influence of nano over micro/macro, size effects and crystals, large surface to volume ratio, surface effects on the properties.

### Unit II: Types of nanostructure and properties of nanomaterials:

One dimensional, Two dimensional and Three dimensional nanostructured materials, Quantum Dots shell structures, metal oxides, semiconductors, composites, mechanical-physical-chemical properties.

### Unit III: Application of Nanomaterial:

Ferroelectric materials, coating, molecular electronics and nanoelectronics, biological and environmental, membrane based application, polymer based application. Environment Related Case Studies on Nanomaterials: Screening of nanomaterials for understanding potential effects to human health and the environment. Mapping of the environmental fate of nanomaterials. Relationships between key properties of nanomaterials and their environmental fate, transport, transformation, bio-distribution, toxicity.

### Unit IV: Environmental Pollution by Nanoparticles:

Health impact, safety and toxicological effects transport of nanomaterials in soil/sediments. Study of physical and chemical properties of nanomaterials influencing their behavior in the Environment and in biological systems.

### Unit V: Application of Nanotechnology:

Nanotechnology for waste reduction and improved energy efficiency, nanotechnology based water treatment strategies. Nanoporous polymers and their applications in water purification, Nanotoxicology. Use of nanoparticles for environmental remediation and water treatment. Case studies and Regulatory needs. Properties required of nanocrystalline materials used for structural, energy, environmental, textile and catalytic applications; processing techniques; techniques for retaining the nanocrystalline structure in service.

**Books Reference:**

1. Chemistry of nanomaterials: Synthesis, properties and applications by CNR Rao et.al.
2. Nanoparticles: From theory to applications – G. Schmidt, Wiley Weinheim 2004.
3. Instrument E L Principe, P Gnauck and P Hoffrogge, Microscopy and Microanalysis (2005), 11: 830- 831, Cambridge University Press.
4. Processing & properties of structural naonmaterials - Leon L. Shaw, Nanochemistry: A Chemical Approach to Nanomaterials, Royal Society of Chemistry, Cambridge UK 2005.
5. Environmental Chemistry for a Sustainable World, Volume 1: Nanotechnology and Health Risk Editors:  
Lichtfouse, Schwarzbauer, Robert
6. Advances in Nanotechnology and the Environment, Juyoung Kim, CRC Press, Taylor and Francis Group.

Semester	Course code	Title of the Course	Hours	Credits							
III		NANOSCIENCE AND TECHNOLOGY COMPOUNDS	6	6							
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO-1	3	2	2	2	2	3	2	2	2	2	2.2
CO-2	1	2	2	3	2	1	2	2	3	2	2.0
CO-3	2	2	3	2	2	2	2	3	2	2	2.2
CO-4	2	2	2	2	3	2	2	2	2	3	2.2
CO-5	2	2	2	3	2	2	2	2	3	2	2.2
<b>Mean overall Score</b>											<b>2.16 (Medium)</b>

**Web resources**

Semester	Course Code	Title of the Course	Hours	Credits
IV		COMPUTATIONAL CHEMISTRY AND NUMERICAL ANALYSIS		4

CO. No.	CO-Statements	Cognitive Levels (K- Level)
	On successful completion of this course, students will be able to	
CO-1	The numerical methods of integration and differentiations	K1
CO-2	Molecular mechanics calculation of complex system	K2
CO-3	understand the basics of non- equilibrium thermodynamics	K2
CO-4	apply the concepts of non-equilibrium thermodynamics	K3
CO-5	Quantum mechanical calculation of complex systems	K4

#### Unit I: Data analysis

[9 Hours]

Data analysis, mean and standard deviation, absolute and relative errors, linear regression, covariance and correlation coefficient. Curve fitting, solution of polynomial equation, numerical integration (Trapezoidal Rule, Simpson's Rule, Gaussian Quadrature), solution of ordinary differential equations (Euler's Method, Runge-Kutta methods, predictor-corrector method), matrix multiplication, inversion and diagonalization.

#### Unit II :Molecular Mechanics:

[9 Hours]

Basic geometrical description of molecules; force-field development, intermolecular interactions, origin and modelling of dispersion forces & hydrogen bonds, strengths, weaknesses and applicability of currently available forcefields.

#### Unit III: Static properties of complex systems:

[9 Hours]

Introduction to Monte Carlo as a way of averaging. Metropolis Monte Carlo algorithm: introduction and applications. Dynamical properties of complex systems: Molecular Dynamics as a way of averaging. Integration of the Newton's equations: initial conditions, numerical algorithms (Verlet and leap-frog), and thermostats.

#### Unit IV Quantum Chemistry:

[9 Hours]

Many electron systems, Hartree-Fock method, basis sets, electron correlation and its treatment, basics of density functional theory, DFT based reactivity descriptors. Introduction to popular softwares (like Gaussian, DMol, GAMESS). Applications to simple molecular systems.

#### Unit V Combined QM/MM methods:

[9 Hours]

Implications of the choice of QM and MM methods; Application of QM/MM methods in organic, inorganic and organometallic systems including bio-organic and bio-inorganic molecules. Quantitative structure activity relation (QSAR): Early approaches, topological indices, fragmental models; quantum mechanical descriptors.

**Text Book(s)**

1. Lewars, E. Computational Chemistry, (Springer, 2003).
2. Balagurusamy, E. Numerical Methods, (Tata McGraw-Hill Publishing Company Limited, 2002).

**Reference Book(s)**

1. Leach, A. R. Molecular Modeling: Principles and Applications, 2nd Edn., (Pearson Prentice Hall, 2001).
2. Cramer, C. J. Essentials of Computational Chemistry (Wiley 2002).
3. Jensen, F. Introduction to Computational Chemistry (Wiley 1999).



Semester	Course code	Title of the Course									Hou	Credits
IV		COMPUTATIONAL CHEMISTRY AND NUMERICAL ANALYSIS									6	6
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO-1	3	2	2	2	2	3	2	2	2	2	2.2	
CO-2	1	2	2	3	2	1	2	2	3	2	2.0	
CO-3	2	2	3	2	2	2	2	3	2	2	2.2	
CO-4	2	2	2	2	3	2	2	2	2	3	2.2	
CO-5	2	2	2	3	2	2	2	2	3	2	2.2	
<b>Mean overall Score</b>											<b>2.16 (Medium)</b>	

Semester	Course code	Title of the Course	Hours	Credits
IV		<b>SOLID STATE AND BIOINORGANIC COMPOUNDS</b>	6	6

CO No	CO-Statements	Cognitive Levels (K-Level)
	On successful completion of this course, students will be able to	
CO-1	Recall the types of inorganic crystals and their characteristics.	K1
CO-2	Understand various crystal defects.	K2
CO-3	Apply concepts of photochemistry in the reactions of organometallic complexes.	K3
CO-4	Examine metal ion binding biomolecules and explain their functions.	K4 & K5
CO-5	Design metal complexes for anti-cancer activity.	K6

### Unit-I Solid State -I (18 Hours)

Unit cell - types of cubic unit cells - three dimension close packed structures - radius ratio rule - indexing of crystal planes (miller indices) crystal structures of sodium chloride, cesium chloride, zinc blende, wurtzite, fluorite, antiferite, nickel arsenide and rutile - normal and inverse spinels - applications of crystal field theory to predict the structure of spinels - thermodynamics of ionic crystal formation - lattice energy, Madelung constant, solubility, ion size and HSAB - X-ray diffraction - Bragg's law, rotating crystal method and powder method

### Unit-II Solid State - II (18 Hours)

Defects in solids - stoichiometric defects - Schottky defect, Frenkel defect - non-stoichiometric defects - metal deficiency defect, metal excess defect - theories of bonding in metals - free electron theory, valence bond theory, band theory - semiconductors (*p*-type and *n*-type) - diodes, photovoltaic effect and light emitting diodes - super conductivity - low temperature super conducting alloys, theory of super conductivity, high temperature super conductors

### Unit-III Inorganic Photochemistry (18 Hours)

Laws of photochemistry - photophysical processes - Jablonski diagram - fluorescence - phosphorescence - Kasha's rule - Stoke's shift - types of electronic transitions in transition metal complexes - photochemistry of Cr(III) complexes - photosubstitution - photoaquation - Adamson's rules - photorearrangement - photoredox reactions - photochemistry of organometallic compounds.

### Unit IV Bioinorganic Chemistry-I (18 Hours)

Structure and function of chlorophyll - photo system-I and photo system-II - light reactions and dark reactions - Mn Catalyzed oxidation of H<sub>2</sub>O to O<sub>2</sub> in chlorophyll - role of Mg<sup>2+</sup> ion-structure and function of haemoglobin - cooperative effect in haemoglobin - role of globin - structure and function of myoglobin - structure and function of cytochrome C.

### Unit-V Bioinorganic Chemistry-II (18 Hours)

Structure and function of blue copper proteins - structure and function of vitamin B<sub>12</sub> - *in vitro* and *in vivo* nitrogen fixation - Fe-S proteins - ionophores - ion transport mechanism in





Semester	Course Code	Title of the Course	Hours	Credits
IV		<b>RESEARCH METHODOLOGY</b>		4

CO. No.	CO-Statement	Cognitive Level (K - level)
	On successful completion of this course, students will be able to	
CO-1	Relate and understand the basic aspects of research.	<b>K1 &amp; K2</b>
CO-2	Identify current chemical literature and other search engines judiciously.	<b>K3</b>
CO-3	Discover synthetic skills in carrying out research problem.	<b>K4</b>
CO-4	Appraise scientific writing and presentation skill for preparing project reports.	<b>K5</b>
CO-5	Design new research problems and carry out systematically.	<b>K6</b>

#### **UNIT I: Literature Survey: (9 hours)**

**Print:** Sources of information: Primary, secondary, tertiary sources; Journals: Journal abbreviations, abstracts, current titles, reviews, monographs, dictionaries, text-books, current contents, Introduction to Chemical Abstracts and Beilstein, Subject Index, Substance Index, Author Index, Formula Index, and other Indices with examples.

#### **UNIT II: Digital and Information Technology and Library Resources: (9 hours)**

Web resources, E-journals, Journal access, TOC alerts, Hot articles, Citation index, Impact factor, H-index, E-consortium, UGC infonet, E-books, Internet discussion groups and communities, Blogs, Preprint servers, Search engines, Scirus, Google Scholar, ChemIndustry, Wiki- Databases, ChemSpider, Science Direct, SciFinder, Scopus. The Internet and World Wide Web. Internet resources for chemistry. Finding and citing published information.

#### **UNIT III: Methods of Scientific Research Writing: (9 hours)**

Reporting practical and project work. Writing literature surveys and reviews. Organizing a poster display. Giving an oral presentation. Writing scientific papers – justification for scientific contributions, bibliography, description of methods, conclusions, the need for illustration, style, publications of scientific work. Writing ethics. Avoiding plagiarism.

#### **UNIT IV: Chemical Safety and Ethical Handling of Chemicals: (9 hours)**

Safe working procedure and protective environment, protective apparel, emergency procedure and first aid, laboratory ventilation. Safe storage and use of hazardous chemicals, procedure for working with substances that pose hazards, flammable or explosive hazards, procedures for working with gases at pressures above or below atmospheric – safe storage and disposal of waste chemicals, recovery, recycling and reuse of laboratory chemicals, procedure for laboratory disposal of explosives, identification, verification and segregation of laboratory waste, disposal of chemicals in the sanitary sewer system, incineration and transportation of hazardous chemicals.

## **UNIT V: Data Analysis and Electronics (9 hours)**

*The Investigative Approach:* Making and Recording Measurements. SI Units and their use. Scientific method and design of experiments. *Analysis and Presentation of Data:* Descriptive statistics. Choosing and using statistical tests. Chemometrics. Analysis of variance (ANOVA), Correlation and regression, Curve fitting, fitting of linear equations, simple linear cases, weighted linear case, analysis of residuals, General polynomial fitting, linearizing transformations, exponential function fit,  $r$  and its abuse. Basic aspects of multiple linear regression analysis. Basic fundamentals of electronic circuits and their components used in circuits of common instruments like spectrophotometers, typical circuits involving operational amplifiers for electrochemical instruments. Elementary aspects of digital electronics.

### **Reference Books**

1. Dean, J. R., Jones, A. M., Holmes, D., Reed, R., Weyers, J. & Jones, A. (2011)
2. *Practical skills in chemistry*. 2nd Ed. Prentice-Hall, Harlow.
3. Hibbert, D. B. & Gooding, J. J. (2006) *Data analysis for chemistry*. Oxford University Press.
4. Topping, J. (1984) *Errors of observation and their treatment*. Fourth Ed., ChapmanHall, London.
5. Harris, D. C. *Quantitative chemical analysis*. 6th Ed., Freeman (2007) Chapters 3-5.
6. Levie, R. de, *How to use Excel in analytical chemistry and in general scientific data analysis*. Cambridge Univ. Press (2001) 487 pages.
7. Chemical safety matters – IUPAC – IPCS, Cambridge University Press, 1992.

Semester	Course code	Title of the Course									Hours	Credits
IV		<b>RESEARCH METHODOLOGY</b>										4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of Cos	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO-1	3	3	2	2	3	3	3	2	2	2	2.5	
CO-2	2	2	2	2	3	2	3	2	2	3	2.3	
CO-3	3	2	2	2	3	3	3	2	2	3	2.5	
CO-4	2	3	2	2	3	2	3	2	2	3	2.3	
CO-5	3	3	2	3	3	3	3	2	3	3	2.8	
<b>Mean overall Score</b>											<b>2.48 (High)</b>	

<b>Skill Enhancement Courses (SEC)</b>			
<b>Component</b>	<b>Course Title</b>	<b>Theory / Practical</b>	<b>Credits</b>
Skill Enhancement Course - I	SEC - I: (Any one selected from the list)	Theory	3
Skill Enhancement Course - II	SEC - II: (Any one selected from the list)	Theory	3

### **List of Skill Enhancement Courses**

Selected Topics in Organic Chemistry

Industrial Products

Health Science

Herbal Drug Technology

Medical Biotechnology

Food Technology

Semester	Course code	Title of the Course	Hours	Credits
I		SELECTED TOPICS IN ORGANIC CHEMISTRY		3

CO. No.	CO-Statements	Cognitive levels (K - level)
	On successful completion of the course, students will be able to	
CO-1	Recall and understand the concepts of green chemistry.	K1 & K2
CO-2	Analyze the types of errors in analyses.	K3
CO-3	Comprehend the skeletal rearrangements in organic molecules.	K4
CO-4	Analyze the mechanism of various photochemical reactions.	K5
CO-5	Predict the hybridization of different molecules.	K6

### Unit-I Error Analysis

( 9 Hours)

Error Analysis - Significant figures - rounding off the values - accuracy and precision- errors - classification of errors - constant errors and proportional errors - determinate errors (systematic errors) and indeterminate (random and accidental) - minimization of errors: calibration of apparatus, analysis of standard samples, running a blank determination, and independent analysis.

Average, range, median, average deviation, relative average deviation and standard deviation, variance, coefficient of variation - the normal error curve - testing of significance: *F*-test, *t*-test and *Q*-test - confidence limit - method of least squares.

### Unit-II Structure and Properties

( 9 Hours)

Hybridization - Electronegativity - dipole moments - polarity of solvents - hydrogen bonding - Bonds weaker than Hydrogen Bonding - Addition Compounds - Acids and Bases - HSAB Theory. Electronic Effects - inductive, resonance and hyperconjugative effects and their influence - rules of resonance - tautomerism - steric effects.

### Unit-III Rearrangements Involving Intermediates

( 9 Hours)

Classifications - mechanisms and applications of the following rearrangements: Wagner-Meerwein in tandem and cascade rearrangements - Tiffeneau-Demjanov ring expansion - Pinacol-Pinacolone - semi-pinacolone - Baeyer-Villiger, Favorskii, Fries, Beckmann, Hoffmann, Curtius, Lossen, Schmidt, Neber, Stevens, Bamford-Stevens reaction- Von Richter, Sommelet-Hauser and Smiles rearrangements - di-*pi* methane and its related rearrangements.

### Unit-IV Photochemical reactions

( 9 Hours)

Photochemistry - Fundamental concepts - Jablonskii diagram - photosensitization - photochemistry of carbonyl compounds: - - photocycloaddition: - photochemistry of alkenes - photochemical rearrangements: - photolysis of diazo compounds - photo substitution reactions: - photochemistry of dienes and aromatic compounds

### Unit-V Green Chemistry

( 9 Hours)

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.

### Books for Study

1. Smith M B, and March J, *March's Advanced Organic Chemistry*, 6<sup>th</sup> Edition, John-Wiley and Sons, New York, 2007.  
**Unit I** Chapter 1-3
2. Bruchner R, *Advanced Organic Chemistry Reaction Mechanisms - Reactions, Stereochemistry and Synthesis*, 6<sup>th</sup> Edition, Springer-Verlag, Berlin, Heidelberg, 2010.  
**Unit II** Chapter 11
3. Clayden J, Greeves N, and Warren S, *Organic Chemistry*, Oxford University Press, New York, 2012.  
**Unit III** Chapter 36
4. Morrison R T and Boyd R T, *Organic Chemistry*, 7<sup>th</sup> Edition, Allyn and Bacon Ltd., New York, 2011.  
**Unit III** Chapter 36
5. Anastas P T, *Text Book on Green Chemistry*, Oxford University Press, UK, 2006.  
**Unit V** Chapters 1-5

### Book for References

1. Gould E S, *Mechanism and Structure in Organic Chemistry*, Holt-Reinhart and Winston, New York, 1959.
2. Smith M B, and March J, *March's Advanced Organic Chemistry*, 6<sup>th</sup> Edition, John-Wiley and Sons, New York, 2007.

Semester	Course code	Title of the Course									Hours	Credits
I		SELECTED TOPICS IN ORGANIC CHEMISTRY										3
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of Cos	
	PO 1	PO 2	PO 3	PO 4	PO 5	PSO 1	PSO 2	PSO 3	PSO4	PSO5		
CO-1	3	3	2	2	1	3	2	3	2	1	2.2	
CO-2	3	3	2	2	1	3	2	3	2	2	2.3	
CO-3	2	2	2	2	2	2	2	2	2	2	2.0	
CO-4	3	2	3	2	1	3	2	2	2	1	2.1	
CO-5	3	3	3	2	2	3	3	2	2	2	2.5	
<b>Mean overall Score</b>											<b>2.22 (High)</b>	

Semester	Course Code	Title of the Course	Hours	Credits
I		INDUSTRIAL PRODUCTS		3

CO. No.	CO-Statement	Cognitive Level ( K -Level)
	On successful completion of this course, students will be able to	
CO-1	Describe manufacturing processes of cement and glass.	K1
CO-2	Understand the importance of plastic and fibres.	K2
CO-3	Explain the composition and applications of fertilizers.	K3
CO-4	Illustrate the preparation and uses of cosmetics.	K4
CO-5	Classify dyes, pigments and paints.	K5

### Unit-I Cement and Glass

(9 Hours)

Cement - Composition, different methods of manufacturing and uses -Portland cement - Composition, different methods of manufacturing (Wet and Dry process), uses - Setting of cement, Glass- - Composition, Types, different methods of manufacturing - Melting, Blowing, Pressing, Annealing and finishing- chemical and physical properties of glass.

### Unit-II Pigments, Dyes and Paints

(9 Hours)

Pigments - Classification, Manufacture and uses. Dyes - Classification, preparation, dyeing processes. Paints - Composition, Types, Manufacture and testing of Paints.

### Unit-III Fibers, Plastics and Rubber

(9 Hours)

Fibres - definition-difference between Natural and synthetic fibres-properties of synthetic fibres-Artificial silk, rayon, nylon and Terylene Plastics - composition, Classification, manufacture, properties and uses recycling of plastics Rubber: types of rubber-synthetic rubber- natural rubber - Vulcanizations of Rubber- properties and uses of rubber.

### Unit-IV Fertilizers and Fuels

(9 Hours)

Fertilizers -Types of Fertilizers: Organic and Inorganic fertilizers, Preparation and uses, Fuels - Energy resources - Industrial gases, Water gas, Producer gas, Oil gas, natural gas, coal gas, Gobar gas, Indane gas, Petroleum products and coal products.

### Unit-V Cosmetics

(9 Hours)

Shampoo- composition and its preparation, lipstick -preparation, Face cream and face powder -composition and their preparation. Hair dyes - chemical and herbal dyes. Perfumes and Deodorants.

### Books for Study

1. Charkarabarthi B N, *Industrial Chemistry*, Oxford and IBH Publishing. Co. 1<sup>st</sup> Edition. New Delhi, 2002. **Unit I -III Chapter:2,3,4,5, & 6**
2. Sharma B K, *Industrial Chemistry*, Goel Publishing House, 1<sup>st</sup> Edition, New Delhi, 2011. **Unit IV -IV Chapter:2,3,4,5, & 6**

## Books for Reference

1. Othmer K, *Encyclopedia of Chemical Technology*, John Wiley and Sons, USA, 1999.

## Web Resources



Cosmetics



Cosmetics and Additives

Semester	Course Code	Title of the Course					Hours	Credits			
I		INDUSTRIAL PRODUCTS						3			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO-1	3	2	2	1	1	2	3	2	2	2	2.0
CO-2	1	2	3	3	2	2	3	1	2	3	2.2
CO-3	2	3	2	2	1	3	2	2	2	2	2.1
CO-4	2	3	2	3	2	2	3	2	2	2	2.3
CO-5	2	3	2	2	3	2	2	3	3	2	2.4
<b>Mean overall Score</b>											<b>2.20 (High)</b>

Semester	Course code	Title of the Course	Hours	Credits
I		HEALTH SCIENCE		3

CO. No.	CO-Statements	Cognitive Level (K -Level)
	On successful completion of course, students will be able to	
CO-1	Describe the chemistry of respiration and learn the function of bodyfluids.	K1
CO-2	Understand the function of drugs and their mode of action.	K2
CO-3	Identify basic nutrients involved in maintenance of good health.	K3
CO-4	Classify common infectious and nutrient deficient diseases.	K4
CO-5	Explain and discuss the process of digestion.	K5 & K6

### Unit-I Health

(9 Hours)

Health - mental health and physical health - food pyramid - types of malnutrition - causes and remedies - macro and micronutrients - carbohydrates - classification and their biological functions, proteins-classification and their biological functions, vitamins - classification and their biological functions - dietary elements (Na, K, Ca, P, Mg, S, Fe, Zn, Se, Mo)

### Unit-II Drugs

(9 Hours)

Drugs - classification of drugs - drugs acting on CNS - general anaesthetics, hypnotics & sedatives, narcotics, antipyretics, antirheumatics, analgesics, anticonvulsants and antitussives - chemotherapeutic drugs - antibiotics, antiseptics and disinfectants - cardiovascular agents - anti cancer drugs - adverse effects of drugs

### Unit-III Body Fluids

(9 Hours)

composition of blood- blood volume, blood groups, functions of blood, blood pressure, anaemia, blood sugar - respiration - oxygen and carbon dioxide transport in blood - haemoglobin -myoglobin - composition of urine - electrolyte balance - Na/K pump

### Unit IV Enzymes and Hormones

(9 Hours)

Enzymes - types and their roles in biochemical reactions - hormones - types and functions - digestion in mouth, stomach, intestine and pancreas

### Unit-V Common and Vitamin Deficiency Diseases

(9 Hours)

Jaundice, cancer, kidney stone - typhoid, dengue, ulcer, goiter, diabetes, rickets, scurvy, beriberi, pellagra, night blindness, Covid-19 - causes - symptoms - diagnosis - vaccines/treatment



### Books for Study

1. Ramani A V, *Food Chemistry*, MJP Publishers, Chennai, 2009.  
**Unit I** Chapter 1, 2, 3 and 5      **Unit III** Chapter 1  
**Unit IV** Chapter 1
2. Ghosh, J A, *Text book of Pharmaceutical Chemistry*, S. Chand and Co. Ltd, 1999.  
**Unit II** Chapter 1      **Unit V** Chapter 1

### Books for Reference

1. Ashutosh Kar, *Medicinal Chemistry*, Wiley Easterns Limited, New Delhi, 1993.
2. Deb A C, *Fundamentals of Biochemistry*, New Central Book Agency, Calcutta, 1994.
3. Parul R. Sheth, *Chemicals of Life*, National Institute of Science Communication (CSIR), 2000.
4. Satake M and Mido Y, *Chemistry for Health Science*, Discovery Publishing, House, New Delhi, 2003.

Semester	Course code	Title of the Course									Hours	Credits
I		<b>HEALTH SCIENCE</b>										3
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes(PSOs)					Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO-1	3	2	3	2	2	3	2	3	2	2	2.4	
CO-2	2	2	3	2	2	2	2	3	2	2	2.2	
CO-3	3	2	3	2	2	3	2	3	2	2	2.4	
CO-4	2	2	3	2	2	2	2	3	2	2	2.2	
CO-5	3	2	3	2	2	3	2	3	2	2	2.4	
<b>Mean overall Score</b>											<b>2.32 (High)</b>	

Semester	Course Code	Title of the Course	Hours	Credits
II		HERBAL DRUG TECHNOLOGY		3

CO No.	CO-Statements	Cognitive Levels (K-levels)
On successful completion of this course, students will be able to		
CO-1	Obtain the knowledge about understanding of Preparation of Herbal based remedies using various types of medicinal plant raw materials.	K1
CO-2	Learn the current trade status and role of medicinal plants in socio economic growth.	K2
CO-3	Study and Investigate the disease curing ability medicinal plants in various ailments.	K3
CO-4	Evaluate and Analyze the market value of herbal based formulations and products in pharmaceutical industries.	K4
CO-5	Create new drug formulations using therapeutically valuable plant materials for the healthy life of society.	K5, K6

#### Unit-I

Herbal decoction preparation: *Andrographis paniculata*, *Tinospora cordifolia*, *Alpinia officinarum*, *Hygrophila auriculata* and *Adhathoda vasica*. Infusion – Decoction – Digestion – Maceration – Percolation – Successive solvent extraction – Super critical fluid extraction – Steam distillation – Head space techniques – Sepbox – Selection of a suitable extraction process – Carbohydrates – Proteins – Alkaloids – Glycosides. Screening methods for anti-fertility agents – Antidiabetic drugs – Anti anginal drugs – Cardiac glycosides – Analgesic activity – Antipyretic activity – Anti cancer activity – Evaluation of hepatoprotective agents – Anti ulcer drugs.

#### Unit-II Herbal powder preparation:

*Withania somnifera*, *Cyanodon dactylon*, Anti diabetic FTN Sooranam, *Kaphasura kudineer* Sooranam. General introduction to interaction and classification. Study of following drugs and their possible side effects and interactions: *Hypercium*, *kava-kava*, *Ginkobiloba*, *Ginseng*, *Garlic*, *Pepper* & *Ephedra*.

#### Unit-III: Herbal Uses

Herbal massage oil preparation: *Pindathylam*, Herbal bath conditioner preparation: *Nalankumavu*, *Panchakarbam*. Preparation of Herbal Face pack. Herbal-Drug and Herb-Food Interactions: General introduction to interaction and classification. Study of following drugs and their possible side effects and interactions: *Hypercium*, *kava-kava*, *Ginkobiloba*, *Ginseng*, *Garlic*, *Pepper* & *Ephedra*.

#### Unit-IV

Herbal hair oil preparation: *Neelibirikathi*. Herbal cream preparation: *Mathanthylam*. Herbal health drinks preparation: *Mathulaimanabaku* (*Punica granatum* and *Hibiscus Rose Milk*). Preparation of herbal tea, herbal soup, herbal sweet and herbal cosmetics. Preparation of Herbal Mosquito Repellent. Flowers Salad.

#### Unit-V

Evaluation of Drugs, Regulatory Issues, WHO Guidelines, Nutraceuticals The fundamental aspects of market expansion in scope, size, and types of products available. Benefits for health and the significance of Nutraceuticals in treating illnesses like Diabetes, CVS diseases, Cancer Irritable Bowel Syndrome, and many other digestive illnesses. Research of the following plants as healthy foods: *Alfalfa* *Chicory*, *Ginger*, *Fenugreek*, *Garlic*, *Honey*, *Amla*, *Ginseng*, *Ashwagandha*, *Spirulina*. Herbal-Drug Interactions as well as Herb-Food introduction: to the interactions as well as classification. Investigation of the drugs in

question and the potential adverse effects and interactions Hypericum Kava-kava Ginkobiloba, Ginseng, Garlic, and pepper. Ephedra.

### Books Reference

1. Herbal Drug Technology by Mrs. K. S. Bodas - Yadav Dr. V. M. Shinde (Author)
2. Herbal Drug Technology 2nd Edition (English, Paperback, S. S. Agrawal)
3. Joanne Barnes, Linda A. Anderson, J. David Phillipson Publisher: Pharmaceutical Press, Year: 2007 ISBN: 0853696233,978-0-85369-623-0



Semester	Course Code	Title of the Course									Hours	Credits
<b>II</b>		<b>HERBAL DRUG TECHNOLOGY</b>										<b>3</b>
Course Outcome s (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
<b>CO-1</b>	3	2	3	1	3	3	3	1	2	2	2.3	
<b>CO-2</b>	3	2	3	3	3	1	2	3	3	2	2.5	
<b>CO-3</b>	3	3	3	2	3	2	3	3	2	3	2.7	
<b>CO-4</b>	3	1	3	2	3	2	3	1	2	2	2.2	
<b>CO-5</b>	2	3	2	2	3	1	2	2	3	3	2.3	
<b>Mean Overall Score</b>											<b>2.40</b>	
<b>Result</b>											<b>High</b>	

Semester	Course code	Title of the Course	Hours	Credits
II		MEDICAL BIOTECHNOLOGY		3

CO. No.	CO-Statements	Cognitive Level (K -Level)
	On successful completion of course, students will be able to	
CO-1	Describe the chemistry of respiration and learn the function of bodyfluids.	K1
CO-2	Understand the function of drugs and their mode of action.	K2
CO-3	Identify basic nutrients involved in maintenance of good health.	K3
CO-4	Classify common infectious and nutrient deficient diseases.	K4
CO-5	Explain and discuss the process of digestion.	K5 & K6

### Unit I: Biomolecules

Biomolecules Chemical basis of life; Composition of living matter; Water –properties, pH, ionization and hydrophobicity; Emergent properties of biomolecules in water; Biomolecular hierarchy; Macromolecules; Molecular assemblies; Structure-function relationships. Protein conformation Structure of protein, Protein conformation, Primary, Secondary, Tertiary, Quaternary structure of proteins, Fibrous proteins- Keratin and Collagen (associated diseases), Structure and function of hemoglobin and myoglobin (associated diseases), Chaperons and Chaperonins Protein purification and Protein/ Enzyme engineering Factors stabilizing proteins, Purification procedures,

### Unit II: Cell Function

Cell cycle-Different phases, Maturation promoting factor, Families of cyclins and cyclin dependent kinases, Regulation and cell cycle checkpoints, Inhibitors of cell cycle progression, M phase- Mitosis and Meiosis, Cytokinesis, Fertilization. Microscopy: Microscope and its modifications – Light, phase contrast and interference, Fluorescence, Confocal, Electron (TEM and SEM), Atomic Force Microscopy, Immunofluorescence microscopy. Cytochemical methods Myeloperoxidase, Acid Schiff, Pearls Prussian Blue, Sudan Black.Trypan Blue Exclusion.

### Unit III: Molecular Biology and Microbial Genetics

DNA Replication, Mutations and Repair The chemistry of DNA synthesis – Mechanism of DNA polymerase – Specialization of DNA polymerase – Initiation of DNA replication – Replication fork and DNA synthesis at replication fork – Termination of replication. Replication errors and their repair – DNA damages – DNA damage repair pathways, Chromatin Modeling: The nucleosome – Higher order chromatin structure – Regulation of chromatin structure – Nucleosome assembly Transcription and Post transcriptional modification, Transcription in prokaryotes and eukaryotes, types of RNA polymerase – RNA splicing and processing- Splice some machinery – Alternate splicing – Regulators of alternate splicing – Exon Shuffling – RNA editing – rRNA processing – tRNA processing in Prokaryotes and Eukaryote, RNA interference.

### Unit IV: Immunology and Immunogenetics

Structure, function and Cells of the immune system: The classification of human immune response: Humoral and cellular immunity, Innate and Adaptive immune response, Cellular

components of the adaptive immune system, Phases of adaptive immune responses, Clonal expression, Toll like receptors, ABO blood Group. Lymphoid cells, clinical focus on the stem cells. Clinical uses and potential. B-lymphocytes and T-lymphocytes. Primary and Secondary lymphoid organs. Antigens and Antigen presentation, Super antigens. Immunogenicity versus Antigenicity. Haptens. Autoimmunity, Epitopes and paratopes, Properties of antigens recognized by T lymphocytes. Cell biology of antigen processing. Monoclonal and polyclonal antibodies.

### Unit V: Bioinformatics

Bioinformatics in Biotechnology: PERL programming language and its application in Bioinformatics. Biological Databases: Nucleotide and protein. Primary, Secondary and Tertiary database. Definition and significance of Pairwise and Multiple Sequence Alignment. Gap penalties: Opening and extension.

#### Books for reference:

Unit I: Biochemistry – Lubert Stryer, 2. Biochemistry- Donald Voet & Judith Voet, 3. Harper’s Biochemistry- Murray, Robert K., Granner, Darryl K., Mayes, Peter A., and Rodwell, Victor W. Lehninger’s Principles of Biochemistry- David L Nelson & Michael M Cox, Cell and Molecular Biology: Concepts and Experiments- Gerald Karp, The Cell – Bruce Alberts, The Cell – Geoffrey M. Cooper and Robert E. Hausman.

Unit II: Molecular Cell Biology- Harvey Lodish, Arnold Berk, S. Lawrence Zipursky, Paul Matsudaira, David Baltimore, and James Darnell, Lehninger’s Principles of Biochemistry- David L Nelson & Michael M Cox.

Unit III: Molecular Biology of the Gene- James Watson, The Cell – Geoffrey M. Cooper and Robert E. Hausman, Fundamentals of Molecular Biology- David Friefelder

Unit IV: Kuby, RA Goldsby, Thomas J. Kindt, Barbara, A. Osborne Immunology, 6th Edition, Freeman, 2002, Brostoff J, Seaddin JK, Male D, Roitt IM., Clinical Immunology, 6th Edition, Gower Medical Publishing, 2002, Janeway et al., Immunobiology, 4th Edition, Current Biology, publications., 1999.

Unit V: David W. Mount, Bioinformatics : Sequence and Genome Analysis, S.C.Rastogi, Namita Mendiratta and Parag Rastogi, Bioinformatics Concepts, Skills & Application.

Semester	Course code	Title of the Course									Hours	Credits
II		<b>MEDICAL BIOTECHNOLOGY</b>										3
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes(PSOs)					Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO-1	3	2	3	2	2	3	2	3	2	2	2.4	
CO-2	2	2	3	2	2	2	2	3	2	2	2.2	
CO-3	3	2	3	2	2	3	2	3	2	2	2.4	
CO-4	2	2	3	2	2	2	2	3	2	2	2.2	
CO-5	3	2	3	2	2	3	2	3	2	2	2.4	
<b>Mean overall Score</b>											<b>2.32 (High)</b>	

Semester	Course code	Title of the Course	Hours	Credits
II		FOOD TECHNOLOGY		3

CO. No.	CO-Statements	Cognitive Level (K -Level)
	On successful completion of course, students will be able to	
CO-1	Describe the chemistry of respiration and learn the function of bodyfluids.	K1
CO-2	Understand the function of drugs and their mode of action.	K2
CO-3	Identify basic nutrients involved in maintenance of good health.	K3
CO-4	Classify common infectious and nutrient deficient diseases.	K4
CO-5	Explain and discuss the process of digestion.	K5 & K6

### UNIT I: Food dispersions and Sensory evaluation of food

Characteristics, sols, gels, pectin gels, colloidal sols, stabilization of colloidal system, syneresis, emulsions, properties of emulsions, formation of emulsion, emulsifying agent, food foams, formation stability and destruction of foam, application of colloidal chemistry to food preparation. type of food panels, characteristics of panel member, layout of sensory evaluation laboratory, sensitivity tests, threshold value, paired comparison test, duotrio test, triangle test, hedonic scale, chemical dimension of basic tastes, Amoore's classification of odorous compounds. Sherman and Szczniak classification of food texture.

### UNIT II: Growth of microorganisms in foods and Hurdle technology

Food as a substrate for microorganism, factors affecting growth of microbes: pH, water activity, O-R potential, nutrient contents, inhibitory substance and biological structure. Principles and applications, Hurdle effect in fermented foods, shelf stable products, intermediate moisture foods, application of hurdle technology.

#### Unit III: Food Microbiology

Principles of Food Preservation, microorganisms associated with foods- bacteria, yeast and mold, Importance of bacteria, yeast and molds in foods. Classification of microorganisms based on temperature, pH, water activity, nutrient and oxygen requirements, typical growth curve of microorganisms. Classification of food based on pH, Food infection, food intoxication, definition of shelf life, perishable foods, semi perishable foods, and shelf stable foods.

#### Unit IV: Food Preservation by Low temperature

Freezing and Refrigeration :Introduction to refrigeration, cool storage and freezing, definition, principle of freezing, freezing curve, changes occurring during freezing, types of freezing i.e. slow freezing, quick freezing, introduction to thawing, changes during thawing and its effect on food. Thermal Processing- Commercial heat preservation methods: Sterilization, commercial sterilization, Pasteurization, and blanching.

#### Unit V Food Preservation by Moisture control

Drying and Dehydration - Definition, drying as a means of preservation, differences between sun drying and dehydration (i.e. mechanical drying), heat and mass transfer, factors affecting rate of drying, normal drying curve, names of types of driers used in the food industry. Evaporation – Definition, factors affecting evaporation, names of evaporators used in food industry. Uses of radiation processing in food industry, concept of cold sterilization.

**Book reference:** B. Srilakshmi, Food science, New Age Publishers,2002, Meyer, Food Chemistry, New Age,2004 , Bawa. A.S, O.P Chauhan etal. Food Science. New India Publishing agency, 2013, Frazier WC and Westhoff DC, Food Microbiology, TMH Publication, New Delhi, 2004,

2. Desrosier NW and Desrosier JN, The Technology of Food Preservation, CBS Publication, New Delhi, 1998

3. Paine FA and Paine HY, Handbook of Food Packaging, Thomson Press India Pvt Ltd, New Delhi- 1992

4. Potter NH, Food Science, CBS Publication, New Delhi, 1998

5. Ramaswamy H and Marcott M, Food Processing Principles and Applications CRC Press, 2006

6. Rao PG, Fundamentals of Food Engineering, PHI Learning Pvt Ltd, New Delhi, 2010

7. Toledo Romeo T, Fundamentals of Food Process Engineering, Aspen Publishers, 1999

Semester	Course code	Title of the Course									Hours	Credits
II		<b>FOOD TECHNOLOGY</b>										3
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes(PSOs)					Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO-1	3	2	3	2	2	3	2	3	2	2	2.4	
CO-2	2	2	3	2	2	2	2	3	2	2	2.2	
CO-3	3	2	3	2	2	3	2	3	2	2	2.4	
CO-4	2	2	3	2	2	2	2	3	2	2	2.2	
CO-5	3	2	3	2	2	3	2	3	2	2	2.4	
<b>Mean overall Score</b>											<b>2.32 (High)</b>	

<b>Ability Enhancement Compulsory Courses (AEC)</b>			
<b>Component</b>	<b>Course Title</b>	<b>Theory / Practical</b>	<b>Credits</b>
Ability Enhancement Compulsory Course - I	AEC – I: Human Rights	Theory	4
Ability Enhancement Compulsory Course - II	AEC – II: Analytical Techniques	Theory	4

**AEC – I: Human Rights (Common to all)**

<b>Semester</b>	<b>Course Code</b>	<b>Title of the Course</b>	<b>Hours</b>	<b>Credits</b>
<b>III</b>		<b>HUMAN RIGHTS</b>		<b>4</b>

<b>CO. No.</b>	<b>CO-Statements</b>	<b>Cognitive Levels (K-Level)</b>
	On successful completion of this course, students will be able to	
<b>CO-1</b>	Know the different types of errors that could occur experimentally.	<b>K1</b>
<b>CO-2</b>	Compare different spectrophotometric methods.	<b>K2</b>
<b>CO-3</b>	Apply thermal methods to characterize minerals and polymers and differentiate the principles and applications of chromatography.	<b>K3</b>
<b>CO-4</b>	Predict the presence of functional groups and structural information of molecules using UV-Vis spectra..	<b>K4</b>
<b>CO-5</b>	Apply IR spectra to infer the structural features of organic molecules.	<b>K5</b>

**UNIT: I- Education systems**

Education systems in India-Introduction, ancient systems of education- colonial system of education- value erosion-personal level, family level, societal level, national level, global level. Personal values and family values- Introduction- types and importance of personal values Family values: definition- types of family- types of family values. Universal values: Meaning -nature of values- need for value education to the students – Dharma, truth, non violence, love and peace.

**UNIT: II- Human excellence**

Human excellence: Meaning- importance- factors induce human excellence- Social values and responsibilities towards society-Meaning, types of social values-community values responsibilities towards society/community- care for the troubled and alleviation of poverty impact of globalisation on values-negative and positive impact.

**UNIT: III- Human Rights:**

Human Rights: Meaning, Definition, characteristics-evolution-Nature and Scope Theories of Human Rights: Natural Rights- Legal rights and Historical theory of rights-UNO and Human Rights- UNO and international Human Rights, enforcement of human rights up to world war II, Universal Declaration of Human Rights ,importance of UDHR, International covenants on Civil and Political rights.

**UNIT: IV- Women's and child's Rights:**

Women's Rights: Rights of women and children-world scenario- Indian context- role of government and non-government organizations in solving women's problem. Children's Rights: Introduction- issues related to child rights- constitutional provisions-instruments on the rights of children. Contemporary issues in human rights: female infanticide- child labour- steps towards elimination of child labour- human rights of older persons-



transgender and human rights.

**UNIT: V- Indian Constitution**

Indian Constitution and Human Rights-Right to Education- Protection of Human Rights: Amnesty International- Public Interest litigation (PIL) -Right to Information Act (RTI)- Case studies. Institutions for Implementation

- a. Human Rights Commission, b. Judiciary, Violations and Redressal, a. Violation by State, b. Violation by Individuals, c. Nuclear Weapons and terrorism, d. Safeguards.

**Text book prescribed:** Value Education and Human Rights published by PSGR, Krishnammal College for Women (2015)

**REFERENCE:**

K. Mohanasundaram: Human Rights: Theories and Practice (New Delhi: Concept Publishers, 2013)  
 P.C.Sinha: India’s Human Rights Regime – Part I, (New Delhi: Kanishka Publishers, 2003).  
 Rachana Kaushal: Women and Human Rights in India, Kaveri book (New Delhi: Kaveri Book).  
 Dr. (Mrs) Sivagami Paramasivam: Human Rights – A study (Salem: Thai Pathippagam).  
 Biswarwarjan Mohanti: Dynamics of Political Theory (New Delhi: Atlantic Publishers, 2010).  
 Abdur Rahman Asshaha: Islamic Concepts of Human Rights (Delhi: Sipra Publications, 2004). Web Resources



Semester	Course code	Title of the Course					Hours	Credits			
III		HUMAN RIGHTS					4	3			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of Cos
	PO 1	PO 2	PO 3	PO 4	PO 5	PS O1	PS O2	PS O3	PSO 4	PSO 5	
CO-1	3	2	3	2	2	3	1	2	2	2	2.2
CO-2	3	3	2	2	2	2	3	2	2	3	2.4
CO-3	2	2	3	3	2	2	3	2	2	2	2.3
CO-4	3	2	2	3	2	2	1	3	2	2	2.2
CO-5	3	1	2	3	2	1	2	2	3	3	2.2
<b>Mean overall Score</b>											<b>2.26 (High)</b>

Semester	Course Code	Title of the Course	Hours	Credits
IV		ANALYTICAL TECHNIQUES		4

CO. No.	CO-Statements	Cognitive Levels (K-Level)
	On successful completion of this course, students will be able to	
CO-1	Know the different types of errors that could occur experimentally.	K1
CO-2	Compare different spectrophotometric methods.	K2
CO-3	Apply thermal methods to characterize minerals and polymers and differentiate the principles and applications of chromatography.	K3
CO-4	Predict the presence of functional groups and structural information of molecules using UV-Vis spectra..	K4
CO-5	Apply IR spectra to infer the structural features of organic molecules.	K5

#### **Unit-I Spectrophotometric methods (12 Hours)**

Spectrophotometric Methods - Colorimetry, Flame Photometry, Fluorimetry, Phosphorimetry, AAS. Colorimetry - fundamental laws - deviations from Beer's law - instrumentation and applications of spectrophotometry. Principle, instrumentation and applications of fluorimetry and phosphorimetry. Flame photometry and atomic absorption spectrophotometry - Theory, instrumentation, interferences and applications.

#### **Unit-II Thermal methods and Chromatography (12 Hours)**

**Thermal Methods** General Characteristics of thermo-analytical methods - Thermogravimetric analysis - Principle, instrumentation and applications - Factors affecting thermogram - Differential Thermal Analysis- DTA instrumentation and applications -Differential scanning calorimetry - Principle, instrumentation and applications  
**Chromatography:** Principles of chromatography - retardation factor - plate theory - column efficiency - Classification of chromatographic techniques - Principle, instrumentation and applications of gas chromatography (GC), thin-layer chromatography (TLC) and high-performance liquid chromatography (HPLC)

#### **Unit-III Optical Activity (12 Hours)**

Absolute configuration - optical activity - specific rotation - polarimeter - enantiomeric excess -resolution - methods - chiral shift reagents and chiral solvating agents - separation of enantiomers - enzymatic resolution and desymmetrization - the anomeric effect in cyclic compounds

#### **Unit-IV UV-Visible Spectroscopy (12 Hours)**

Nature of electronic transitions - UV band structure - principles of absorption spectroscopy - instrumentation-presentation of spectra - solvents - chromophore -effect of conjugation - Woodward-Fieser rules for dienes, enones, and aromatic compounds - visible spectra - colour in compounds. ORD and CD: Concept of circularly polarized light-cause of optical activity-atomic and conformational asymmetry-ORD and CD-octant rule,  $\alpha$ -haloketone rule and their applications-Cotton effect and ORD curves-applications to determine the absolute configurations of monocyclic ketones and steroids.

#### **Unit-V IR spectroscopy (12 Hours)**

Absorption process - modes of stretching and bending - bond properties and absorption trends

vibrations -Hooke's law - FT-IR spectrometer - sample preparation - correlation charts and tables - analysis of a spectrum - characteristic absorption bands of: alkanes, alkenes, alkynes - conjugation effects, ring size effects for exo and endo double bonds - aromatic rings - substituted aromatic rings - alcohols and phenols - ethers - carbonyl compounds: factors influencing C=O stretching- conjugation, ring size, substituents, and hydrogen effects - amines - nitriles, isocyanates, and imines-nitro compounds-solving spectral problems.

### Books for Study

Jeffery G H, Bassett J, Mendham J and Denney R C, *Vogel's Textbook of Quantitative Chemical Analysis*, 5<sup>th</sup> Edition, Longman Scientific & Technical, Essex, England, 1989.

**Unit I** Chapters 17, 18, 20 and 21

**Unit II** Thermal studies - Chapters 11 Chromatography - Chapters 8 and 9

Carey F A, Sundberg R J, *Advanced Organic Chemistry, Part A: Structure and mechanisms*, 5<sup>th</sup> Edition, Springer (India) Pvt. Ltd. New Delhi, 2007.

**Unit III** Chapter 2

Pavia D L, Lampman G M, Kriz G S and Vyvyan J R, *Introduction to Spectroscopy*, 5<sup>th</sup> Edition, Cengage Learning, Delhi, 2015.

**Unit IV & V** Chapter 2-10

### Books for Reference

Skoog D A, West D M, Holler F J, and Crouch S R, *Fundamentals of Analytical Chemistry*, 9<sup>th</sup> Edition, Brooks/Cole Cengage Learning, Belmont, CA 94002-3098, USA, 2014.

Silverstein R M and Bassler G C, *Spectrometric Identification of Organic Compounds*, 4<sup>th</sup> Edition, John- Wiley and Sons, New York, 1993.

Kemp W, *Organic Spectroscopy*, 3<sup>rd</sup> Edition, ELBS, London, 1987.

## Web Resources



Analytical Chemistry



MIT-Online Course



Error Analysis

Semester	Course code	Title of the Course									Hours	Credits
IV		ANALYTICAL TECHNIQUES									4	3
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of Cos	
	PO 1	PO 2	PO 3	PO 4	PO 5	PSO 01	PSO 02	PSO 03	PSO 4	PSO 5		
CO-1	3	2	3	2	2	3	1	2	2	2	2.2	
CO-2	3	3	2	2	2	2	3	2	2	3	2.4	
CO-3	2	2	3	3	2	2	3	2	2	2	2.3	
CO-4	3	2	2	3	2	2	1	3	2	2	2.2	
CO-5	3	1	2	3	2	1	2	2	3	3	2.2	
<b>Mean overall Score</b>											<b>2.26 (High)</b>	