



B.SC. CHEMISTRY

**CHOICE BASED CREDIT SYSTEM–LEARNING OUTCOMES BASED CURRICULUM
FRAME WORK (CBCS - LOCF)**

(Applicable to the candidates admitted from the academic year 2026-2027 onwards)

Sem	Part	Courses	Title	Ins. Hrs.	credits	Exam. Hours	MaximumMarks		
							Int.	Ext.	Total
I	I	Ability Enhancement Course – I (AEC - I)	(Tamil\$ / Other Languages+, #)	6	3	3	30	70	100
	II	Ability Enhancement Course –II (AEC - II)	English Course - I	6	3	3	30	70	100
	III	Core Course -1 (CC - 1)	General Chemistry - I	4	4	3	30	70	100
		Core Practical - 1 (CP - 1)	Volumetric Analysis	4	4	3	40	60	100
		Allied Course – 1 (AC - 1)	Botany I/ Computer Science I/ Zoology I/ Mathematics I	4	4	3	30	70	100
		Allied Course Practical - I (AP-I)	Botany II/ Computer Science II/ Zoology II/ Mathematics II (P)	2	**	**	**	**	**
	IV	Value Education		2	2	3	30	70	100
		Interdisciplinary Course – 1 (IDC - 1) #	One Course from Outside Department	2	2	3	30	70	100
	Total			30	22	--	--	--	700
II	I	Ability Enhancement Course – III (AEC - III)	(Tamil\$ / Other Languages+, #)	6	3	3	30	70	100
	II	Ability Enhancement Course – IV (AEC - IV)	English Course - II	6	3	3	30	70	100
	III	Core Course- 2(CC - 2)	General Chemistry - II	4	4	3	30	70	100
		Core Practical - 2(CP - 2)	Semi Micro Analysis (P)	4	4	3	40	60	100
		Allied Course – 2 (AC - 2)	Botany II/ Computer Science II/ Zoology II/ Mathematics II	4	4	3	30	70	100
		Allied Course Practical - I (AP-I)	Botany II/ Computer Science II/ Zoology II/ Mathematics II (P)	2	4	3	40	60	100
	IV	Skill Enhancement Course - 1(SEC - 1) ##	NaanMudhalvan Course/SEC (List enclosed)	2	2	3	30	70	100
		Interdisciplinary Course – 2 (IDC - 2) #	One Course from Outside Department	2	2	3	30	70	100
	Total			30	26	--	--	--	800

III	I	Ability Enhancement Course – V(AEC - V)	(Tamil\$ / Other Languages+, #)	6	3	3	30	70	100	
	II	Ability Enhancement Course – VI (AEC - VI)	English Course - III	6	3	3	30	70	100	
	III	Core Course- 3(CC - 3)	General Chemistry - III	4	4	3	30	70	100	
		Core Practical - 3 (CP - 3)	Organic Qualitative Analysis and Organic Preparation	4	4	3	40	60	100	
		Allied Course – 3 (AC - 3)	Physics – I	4	4	3	30	70	100	
		Allied Course Practical - II (AP-II)	Physics - I (P)	2	**	**	**	**	**	
	IV	Skill Enhancement Course - 2 (SEC - 2) ##	NaanMudhalvan Course/SEC (List enclosed)	2	2	3	30	70	100	
		Interdisciplinary Course – 3 (IDC - 3) \$\$	One Course from Outside Department	2	2	3	30	70	100	
		Health & Wellness @		--	1	--			100	
		Total			30	23	--	--	--	800
I	Ability Enhancement Course – VII (AEC - VII)	(Tamil\$ / Other Languages+, #)	6	3	3	30	70	100		
IV	II	Ability Enhancement Course – VIII (AEC - VIII)	English Course - IV	6	3	3	30	70	100	
	III	Core Course- 4(CC - 4)	General Chemistry - IV	4	4	3	30	70	100	
		Core Practical - 4(CP - 4)	Gravimetric Analysis and Determination of Physical constant(P)	4	4	3	40	60	100	
		Allied Course – 4 (AC - 4)	Physics – II	4	4	3	30	70	100	
		Allied Course Practical - II (AP-II)	Physics - II (P)	2	4	3	40	60	100	
	IV	Skill Enhancement Course - 3 (SEC - 3) ##	NaanMudhalvan Course/SEC (List enclosed)	2	2	3	30	70	100	
		Interdisciplinary Course – 4 (IDC - 4) \$\$	One Course from Outside Department	2	2	3	30	70	100	
	Total			30	26	--	--	--	800	
	Summer Internship / Industrial Activity during the Summer Vacation after II Year									

V	III	Core Course - 5 (CC - 5)	Inorganic Chemistry - I	4	4	3	30	70	100
		Core Course - 6 (CC - 6)	Organic Chemistry - I	5	4	3	30	70	100
		Core Course - 7 (CC - 7)	Physical Chemistry - I	5	4	3	30	70	100
		Core Course - 8 (CC - 8)	Analytical Chemistry	5	4	3	30	70	100
		Core Practical - 5(CP - 5)	Physical Chemistry (P)	5	4	3	40	60	100
	IV	Skill Enhancement Course - 4 (SEC - 4)		2	2	3	30	70	100
		Skill Enhancement Course - 5 (SEC - 5) ##	NaanMudhalvan Course/SEC (List enclosed)	2	2	3	30	70	100
		Introduction to Disaster Management		2	2	3	30	70	100
		Summer Internship / Industrial Activity @@	(with Viva-Voce)	--	2	--	20	80	100
	Total			30	28	--	--	--	900
VI	III	Core Course - 9(CC - 9)	Organic Chemistry - II	4	4	3	30	70	100
		Core Course- 10(CC - 10)	Physical Chemistry - II	5	4	3	30	70	100
		Core Course- 11(CC - 11)	Inorganic Chemistry - II	5	4	3	30	70	100
		Core Project Work(CPW) @@	Project Work (with Viva-Voce)	6	4	3	20	80	100
	IV	Value Added Course	General Studies for Competitive Examinations	2	1	--	30	70	100
		Skill Enhancement Course - 6 (SEC - 6)	Any one from the list	2	2	3	30	70	100
		Skill Enhancement Course - 7 (SEC - 7) ##	NaanMudhalvan Course/SEC (List enclosed)	2	2	3	30	70	100
		Environmental Studies		2	2	3	30	70	100
		Gender Studies		2	1	3	30	70	100
		Extension Activities *		--	1	--	--	--	--
	Total			30	25	--	--	--	900
	Grand Total			180	150	--	--	--	4900

ALLIED COURSE

First Year Students

Botany / Zoology /
Computer Science /
Mathematics

Second Year Students

Physics

SKILL ENHANCEMENT COURSE(SEC)			
Sl. No.	Title of paper	Sl. No.	MANDATORY NaanMudhalvan Scheme##
1.	Dyeing Techniques and Water Treatment	1.	2 nd Semester:
2.	Ethno medicine	2.	3 rd Semester:
3.	Soil Analysis and Soil Testing	3.	4 th Semester:
4.	AI Tools in Chemistry	4.	5 th Semester:
5.	Food Chemistry	5.	
6.	Polymer chemistry	6.	6 th Semester:
7.	Phytochemical Screening and Analysis Techniques	7.	

INTERDISCIPLINARY COURSE (IDC) FOR WHO HAVE OPT TAMIL AS PART-I (for other Department Students only)	
1 st Semester	Drugs and Cosmetics
2 nd Semester	Chemistry in Everyday life
3 rd Semester	Traditional Metallurgy
4 th Semester	Industrial Chemistry

INTERDISCIPLINARY COURSE (IDC)# FOR WHO HAVE NOT OPT TAMIL AS PART - I		
Those who have studied Tamil upto 10 th +2 but opt for other languages in degree	1 st Semester	Special Tamil - I
	2 nd Semester	Special Tamil - II
Those who have not studied Tamil in school level	1 st Semester	Basic Tamil - I
	2 nd Semester	Basic Tamil – II
Those students who opt for either special Tamil (or) Basic Tamil as IDCs, have to choose 2 more IDCs courses in their 3 rd and 4 th Semester from Outside his/her department.		

INTERDISCIPLINARY COURSE (IDC) \$\$ FOR NCC CADETS ONLY	
NCC Course is a Compulsory Course for the NCC Cadets in the 3 rd Semester:	NCC Course is a Compulsory Course for the NCC Cadets in the 4 th Semester:
Introduction to NCC	1. Special Subject Army (or) 2. Special Subject Navy (or) 3. Special Subject Air force
Those students who opt for NCC Courses as IDCs, have to choose 2 more IDCs courses in their 1 st and 2 nd Semester from Outside his/her department.	

SUMMARY OF CURRICULUM STRUCTURE OF UG PROGRAMMES

Sl. No.	Part	Types of the Courses	No.of Courses	Credits for each Course	Total Credits	Marks
1.	I	Ability Enhancement Course	4	3	12	400
2.	II	Ability Enhancement Course	4	3	12	400
3.	III	Core Course	11	4	44	1100
4.		Core Practical	5	4	20	500
5.		Allied Course (AC)	4	4	16	400
6.		Allied Course Practical (AP)	2	4	8	200
7.		Core Project Work (CPW)	1	4	4	100
8.	IV	Skill Enhancement Course (SEC)	7	2	14	700
9.		Interdisciplinary Course (IDC)	4	2	8	400
10.		Value Education	1	2	2	100
11.		Health and Wellness	1	1	1	100
12.		Introduction to Disaster Management	1	2	2	100
13.		Summer Internship / Industrial Activity	1	2	2	100
14.		Value Added Course	1	1	1	100
15.		Environmental Studies	1	2	2	100
16.		Gender Studies	1	1	1	100
17.		EXTENSION ACTIVITIES (NCC / NSS / SPORTS / ANTI DRUG CELL / YRC & Any Other Activities	--	1	1	--
Total			49	-	150	4900

\$	For those who have studied Tamil upto 10 th +2 (Regular Stream)															
+	Syllabus for other Languages should be on par with Tamil at degree level															
#	Those who have studied Tamil upto 10 th +2 but opt for other languages in degree level under Part-I should study special Tamil and those who have not studied Tamil in the school level should study Basic Tamil in Part–IV under the Interdisciplinary Course.															
**	Examination at the end of the next semester															
##	Naan Mudhalvan Scheme: As per the Naan Mudhalvan Scheme instructions, 5 courses from 2 nd to 6 th semester should be studied under Skill Enhancement Course.															
\$\$	NCC Course is one of the Choices in the Interdisciplinary Course. Only the NCC Cadets are eligible to choose this course. However, NCC Course is a Compulsory Course for the NCC Cadets.															
@	Health and Wellness: Assessments: • Use self-reflective worksheets to assess their understanding • submit the worksheets to internal audit / external audit • Every student’s activity report should be documented and the same have to be assessed by the Physical Director with Mentor. The evaluation should be for 100 marks. No examination is required. Scheme of Evaluation: <table><tr><th>Part</th><th>Description</th><th>Marks</th></tr><tr><td>A</td><td>Report</td><td>40</td></tr><tr><td>B</td><td>Attendance</td><td>20</td></tr><tr><td>C</td><td>Activities (Observation During Practice)</td><td>40</td></tr><tr><td colspan="2">Total</td><td>100</td></tr></table>	Part	Description	Marks	A	Report	40	B	Attendance	20	C	Activities (Observation During Practice)	40	Total		100
Part	Description	Marks														
A	Report	40														
B	Attendance	20														
C	Activities (Observation During Practice)	40														
Total		100														
@ @	Summer Internship / Industrial Activity Internship will be carried out during the summer vacation after the second year. Viva-Voce will be conducted by the college and Marks shall be sent to the University and the same will be included in the 5th semester Mark Statement. Summer Internship / Industrial Activity & Project Work Scheme of Evaluation: <table><tr><th>Description</th><th>Marks</th></tr><tr><td>Report</td><td>80</td></tr><tr><td>Viva-Voce</td><td>20</td></tr><tr><td>Total</td><td>100</td></tr></table>	Description	Marks	Report	80	Viva-Voce	20	Total	100							
Description	Marks															
Report	80															
Viva-Voce	20															
Total	100															
*	Extension Activities shall be outside instruction hours.															

PROGRAMME OBJECTIVES

The programme enables the students

1. To understand basic facts and concepts in chemistry while retaining the exciting aspects of chemistry to develop interest in the study of chemistry as a discipline.
2. To demonstrate, solve and understanding the major concept in organic, inorganic, physical, industrial, nuclear, polymer, food, pharmaceutical, cosmetics and environmental chemistry. (All disciplines of chemistry).
3. To develop the skill to solve the problems and think methodically, independently and draw the logical conclusion.
4. To understand the importance of the elements in the periodic table including their physical and chemical nature and role in the daily life.
5. To understand concepts of chemistry and apply scientific information to solve problems in all situation so that they get a strong foundation in chemistry.
6. To understand the concepts of chemistry to inter relate and interact to the other subject like mathematics, physics, biological science etc.
7. To develop skills in the proper handling of apparatus, chemicals and instruments.
8. To be exposed to the different processes used in industries and their applications.
9. To learn the laboratory skills and to transfer and interpret knowledge entirely in the working environment.
10. To achieve the skills required to succeed in graduate school, professional school and the chemical industry like cement industries, agro product, paint industries, rubber industries, petrochemical industries, food processing industries, fertilizer industries.
11. To expand the knowledge in available opportunities related to chemistry in the government services through public service commission particularly in the field of food safety, health inspector, pharmacist etc.
12. To discuss how science and its applications interact with social, economic, political, environmental, cultural and ethical factors.

PROGRAMME OUTCOMES

On successful completion of B.Sc. Chemistry programme, students are expected to

- Gain complete knowledge about all fundamental aspects of chemistry
- Apply chemistry knowledge to solve problems in various fields of chemistry.
- Get a skill for effective and safe handling of apparatus, chemicals and instruments in a laboratory.
- Carry out experiments in the area of organic analysis, Volumetric analysis, inorganic semi-micro analysis, conduct metric & potentiometric equipment
- Use technologies and instrumentation together to explore new areas of research.
- Get enormous job opportunities at chemical, pharmaceutical and food product industries.
- Appear in competitive exams conducted by service commissions such as UPSC and TNPSC
- Gain knowledge in the emerging field of nanochemistry and polymer chemistry.

COURSE OBJECTIVES

- To learn the arrangement of elements in the periodic table and to understand the periodic properties
- To learn the laboratory hygiene, safety measures, principles of qualitative and quantitative analysis
- To learn the various methods of preparation, structure and stability of reaction intermediates.
- To understand the chemistry of cycloalkanes, alkenes, dienes and alkynes.
- To learn the types, preparation and properties of sols, colloids and emulsions and the determination of molecular weight of macromolecules

UNIT – I PERIODIC TABLE AND PERIODIC PROPERTIES

- 1.1. Quantum Numbers, Filling up of atomic orbitals: Pauli's exclusion principle, Aufbau Principle, Hund's rule of maximum multiplicity – electronic configuration. Stability associated with half-filled and completely filled orbitals.
- 1.2. Periodic properties of elements – variation of atomic volume, atomic and ionic radii, ionization potential, electron affinity, electro negativity along periods and groups. Pauling scale of electro negativity.
- 1.3 Classification of elements into s, p, d and f blocks.

UNIT- II LABORATORY HYGIENE, SAFETY MEASURES AND ANALYTICAL METHODS

- 2.1 Storage and handling of chemicals – Corrosion, flammable, explosive, carcinogenic and toxic chemicals. Simple first aid procedures for accidents involving acids, alkalis, bromine, fire burns and cut by glass.
- 2.2 Solubility product, common ion effect, complexation, oxidation-reduction reactions involved in identification of anions and cations – separation of cations into groups – Semi micro analysis of simple salts.
- 2.3 Volumetric analysis – preparation of standard solutions – normality, molarity and molality - titrimetric reactions – acid-base, redox, precipitation and complexometric titrations – indicators – effect of change in
- 2.4 pH – selection of suitable indicators.

UNIT -III ALKANES, REACTIVE INTERMEDIATES AND METHODS FOR REACTION MECHANISMS

- 3.1 Introduction: Inductive, mesomeric, electromeric effects and hyper conjugation – structure of organic molecules based on sp^3 , sp^2 and sp hybridization. Alkanes – sources of alkanes – general preparation – general properties – conformational analysis of ethane and n-butane.
- 3.2 Carbocations, Carbanions and Carbenes: Generation and stability of reactive intermediates – Correlation of reactivity with structure of reactive intermediates. Free radicals: Generation, stability, identification methods – Free radical halogenations reactions and their mechanism.
- 3.3 Homolytic and Heterolytic cleavages of bonds, Characteristics of nucleophilic, electrophilic and free radical reactions.

UNIT- IV CHEMISTRY OF CYCLOALKANES, ALKENES, DIENES AND ALKYNES

- 4.1 Preparation of cycloalkanes – Chemical properties – Relative stability of cyclopropane to cyclooctane – Baeyer's Strain theory – Limitations – Mono and di-substituted cyclohexanes.
- 4.2 Alkenes: Nomenclature – Petroleum source of alkenes and aromatics – General methods of preparation of alkenes – Chemical properties – Markovnikov's rule and peroxide effect-Uses – Elimination reactions and its mechanisms (E1, E2).
- 4.3 Dienes: Structures and properties – conjugated dienes – stability and resonance– electrophilic addition – 1,2 addition and 1,4 addition.
- 4.4 Alkynes: Nomenclature – General methods of preparation – Physical properties – Chemical properties – Uses.

UNIT – V COLLOIDS AND MACROMOLECULES

- 5.1 Definition and types of Colloids- preparation, Purification (dialysis, electro dialysis and ultra-filtration) and stability of colloids, gold number.
- 5.2 Properties of colloids- kinetic, optical and electrical properties.
- 5.3 Emulsions – Types of emulsions, preparation, properties and applications, Donnan membrane equilibrium.
- 5.4 Osmosis – reverse osmosis and desalination. Macromolecules- Molecular weight of macromolecules- determination of molecular weight by osmotic pressure and light scattering methods.

UNIT – VICURRENT CONTOURS (For Continuous Internal Assessment Only):

Chart preparation on laboratory hygiene with safety measures and s, p, d and f block elements separately with their common properties and applications. Best chart can be placed in the laboratory for students' perusal.

REFERENCES:

1. R.D. Madan, "Modern Inorganic Chemistry", 2nd edition, S. Chand & Company Ltd., 2000.
2. P.L. Soni, "Text book of Inorganic Chemistry", 20th revised edition, Sultan Chand & Sons, 2000.
3. B.R. Puri, L.R. Sharma, K.K. Kalia, Principles of Inorganic Chemistry, 23rd edition, New Delhi, ShobanLalNagin Chand & Co., (1993).
4. J.D. Lee, 'Concise Inorganic Chemistry', 20th revised edition, Sultan Chand & Sons, 2000.
5. R. Gopalan, P.S. Subramanian & K. Rengarajan, "Elements of Analytical Chemistry", 2nd edition, Sultan Chand & Sons, 1000.
6. Morrison, R.T. and Boyd, R.N., Bhattacharjee, S. K. Organic Chemistry (7th edition), Pearson, India, (2011).
7. Bahl, B.S. and Bahl, A., Advanced Organic Chemistry, (12th edition), New Delhi, Sultan Chand & Co., (2010).
8. Jerry March, "Advanced Organic Chemistry, Reaction, Mechanism and Structure", 7th Edition, Wiley Inter Science (2013).
9. Puri B.R., Sharma L.R. and Pathania M.S. Principles of Physical chemistry, (35th edition), New Delhi: ShobanLalNaginchand and Co. (2013)
10. Glasstone S. and Lewis D., Elements of Physical Chemistry, London, Mac Millan& Co Ltd.
11. https://oms.bdu.ac.in/ec/admin/contents-/316_20211123075240176.pdf
12. <https://kanchiuniv.ac.in/coursematerials/Dr.%20RP%20%20Carbocationspdf>

COURSE OUTCOMES:

Upon successful completion of this course the students would be able:

- To predict periodic properties and position of elements in the periodic table.
- To apply theoretical aspects in qualitative and quantitative analysis and work safe and hygienically in laboratories.
- To prepare and predict the stability and reactivities of reaction intermediates.
- To prepare & explain the properties of colloids and emulsions.
- To determine the Molecular Weight of macromolecules.

Relationship Matrix											
Semester	Course Code		Title of the Course							Hours	Credits
I			GENERALCHEMISTY1							4	4
Course Outcomes	Programme Specific Outcomes (POs)										Mean Score of COs
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	
CO1	1	3	2	2	2	1	1	2	1	2	1.70
CO2	1	3	2	3	3	2	2	3	2	2	2.30
CO3	1	3	3	3	2	1	2	3	2	2	2.20
CO4	1	3	2	2	2	1	2	2	1	2	1.80
CO5	1	3	2	3	3	2	2	3	3	2	2.40
Mean Overall Score											2.08 (Medium)

COURSE OBJECTIVES

- To learn the techniques of titrimetric analysis.
- To know the estimation of several cations and anions.
- To know the estimation using neutralization and redox principle.

TITRIMETRIC QUANTITATIVE ANALYSIS

1. Estimation of HCl Vs NaOH using a standard oxalic acid solution.
2. Estimation of Na_2CO_3 Vs HCl using a standard Na_2CO_3 solution.
3. Estimation of Iron (II) sulphate Vs KMnO_4 using a standard Mohr's salt solution.
4. Estimation of oxalic acid Vs KMnO_4 using a standard oxalic acid solution.
5. Estimation of copper (II) sulphate by $\text{K}_2\text{Cr}_2\text{O}_7$ solution.
6. Estimation of KMnO_4 Vs thio using standard $\text{K}_2\text{Cr}_2\text{O}_7$ solution.

REFERENCES

Venkateswaran V. Veerasamy R. Kulandaivelu A.R., Basic principles of Practical Chemistry, 2nd edition, New Delhi, Sultan Chand & sons (1997).

COURSE OUTCOMES:

Upon successful completion of this course the students would be able:

- To understand the use of volumetric analysis.
- To explain the principles of volumetric analysis.
- To prepare standard solution to find out the concentrations of unknown analyte.
- To understand the selection of indicators and can apply the knowledge in chemical experiments.
- To predict the concentration of unknown solutions.

Scheme of Valuation Max. Marks

Record - 5
(marks) Procedure Writing
(marks) -10

Results
 < 1 % - 45 marks
 1-2 % - 35 marks
 2-3 % - 25 marks
 3-4 % - 15 marks
 > 4 % - 10 marks

Relationship Matrix											
Semester	Course Code	Title of the Course								Hours	Credits
1		VOLUMETRIC ANALYSIS								4	4
Course Outcomes	Programme Specific Outcomes (PSOs)										Mean Score of COs
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	
C01	1	3	2	2	2	1	1	2	1	2	1.70
C02	1	3	2	3	3	1	2	2	1	2	2.00
C03	1	3	2	3	3	2	2	3	3	2	2.40
C04	1	3	2	2	3	1	2	2	2	2	2.00
C05	1	3	3	3	3	1	2	3	2	2	2.30
Mean Overall Score											2.08 (Medium)

- To learn the terminologies used in drugs.
- To know the different types of drugs and to understand their mode of action
- To learn the methods of preparation of house hold cleaning reagents and cosmetics.

UNIT – I TERMINOLOGIES OF DRUGS

Definition of the terms-drug, pharmacophore, pharmacodynamics, pharmacopoeia, pharmacology, bacteria, virus, fungus, actinomycetes, metabolites, antimetabolites, LD50, ED50. Therapeutic index and its significance.

UNIT – II ANTIBIOTICS

Antibiotics – Definition-classifications - Antibiotics-penicillin, ampicillin, structure, mode of action and uses.

UNIT – III ANTIPYRETIC ANALGESICS

Analgesics – definition and actions – narcotic and non – narcotic – morphine, heroin – structure, mode of action and uses.

Antipyretic analgesics – salicylic acid derivatives – methyl salicylate, aspirin. Anti inflammatory agents – structure, mode of action and uses.

UNIT – IV PREPARATION OF DOMESTICALLY USEFUL PRODUCTS

Preparation of washing powder, cleaning powder, phenols (white, black, yellow and rose coloured phenols). Liquid blue and soap oil.

UNIT – V COSMETICS

Preparation of shampoo, Face powder, soap-manufacturing of soap (kettle process and hydrolysis process).

UNIT – VI CURRENT CONTOURS (For Continuous Internal Assessment Only):

General quiz/seminar/Assignment on - Types, symptoms and preventive measure of communicable diseases– COVID -19, HIV, Malaria and influenza. Small scale preparation training to prepare phenol, soap and aspirin in the

laboratory.

REFERENCES:

1. Industrial Chemistry (Including Chemical Engineering) by B.K. Sharma, 2016, Goel Publishing House, 16th Revised and Enlarged Edition.
2. A Text book of Pharmaceutical Chemistry by Jayashree Ghosh, 2010, S. Chand & company Ltd, New Delhi.
3. A Textbook of Pharmaceutical Chemistry by Dr.S. Lakshmi, 2004, S. Chand & company Ltd, New Delhi.
4. [https://oms.bdu.ac.in/ec/courses.php?subject=B.Sc.%20\(CHEMISTRY\)](https://oms.bdu.ac.in/ec/courses.php?subject=B.Sc.%20(CHEMISTRY))

COURSE OUTCOMES:

Upon successful completion of this course the students would be able:

- To state the terminologies used in drugs.
- To explain the mode of action of antibiotics.
- To explain the mode of action of antipyretic and analgesics.
- To prepare domestically useful products like soaps, washing powder and cleaning powder.
- To demonstrate the preparation and uses of cosmetics.

Relationship Matrix											
Semester	Course Code		Title of the Course						Hours	Credits	
1			DRUGS AND COSMETICS						2	2	
Course Outcomes	Programme Specific Outcomes (PSOs)										Mean Score of COs
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	
CO1	1	3	1	2	2	1	1	1	1	2	1.50
CO2	1	3	2	2	3	1	2	2	2	2	2.00
CO3	1	3	2	2	3	1	2	2	2	2	2.00
CO4	1	3	2	2	3	2	2	3	2	2	2.20
CO5	1	3	2	2	3	2	2	2	2	2	2.10
Mean Overall Score											1.96 (Medium)

First Year

**CORE COURSE 2
GENERAL CHEMISTRY-II
(Theory)**

Semester II

Code:

Credit: 4

COURSE OBJECTIVES

- To understand the principles of bonding and theories of chemical bonding.
- To understand the chemistry of S-block and zero group elements.
- To learn the concepts of inorganic semi micro qualitative analysis.
- To understand the aromatic character of benzene type molecules and to learn the reaction mechanisms involved in haloalkanes and halobenzenes.
- To understand the properties of atoms, characteristics, effect of radiations and the significance of wave functions.

UNIT - ICHEMICAL BONDING

- 1.1. Ionic bond – formation, variable electro valency – Lattice energy, Born – Haber Cycle. Covalent bond - formation, variable covalency, maximum covalency, covalent character in ionic bond – Fajans' Rule. Polarization – partial ionic character of a covalent bond.
- 1.2 VB theory, MO theory – Basic principles of bonding and antibonding orbitals, applications of MOT to H₂, He₂, N₂ & O₂ – molecular orbital sequence, comparison of VB & MO Theories.
- 1.3 Hybridization – Formation of BeCl₂ & BCl₃. VSEPR theory of simple inorganic molecules – BeCl₂, SiCl₄, PCl₅, SF₆, IF₇, XeF₆, BF₃ & H₂O.
- 1.4 Hydrogen bonding – Intermolecular & Intramolecular Hydrogen bonding and consequences.

UNIT - IICHEMISTRY OF S-BLOCK AND ZERO GROUP ELEMENTS

- 2.1 General characteristics of S-block elements – comparative study of elements – alkali metals and their hydroxides, oxides and halides, alkaline earth metals and their oxides, carbonates and sulphates.
- 2.2 Diagonal relationship of Li & Mg, Be & Al, chemistry of NaOH, KI & Mg (NH₄)PO₄.
- 2.3 Qualitative Inorganic Analysis – Dry Test, flame test, cobalt nitrate test wet confirmatory test for acid radicals, interfering acid radicals–elimination of interfering acid radicals.
- 2.4 Zero group elements – position in the periodic table, occurrence, isolation, applications, compounds of Xe, XeF₂, XeF₄, XeF₆ & XeOF₄.

UNIT - IIICHEMISTRY OF BENZENE AND BENZENOID COMPOUNDS

- 3.1 Aromaticity – Huckle’s rule - structure of benzene – Benzene-preparation, chemical properties and uses. Aromatic electrophilic substitution reactions and mechanism – Orientation and reactivity in substituted benzenes.
- 3.2 Polynuclear aromatic hydrocarbons – Nomenclature, Naphthalene from coal tar and petroleum – Laboratory preparation, Structure of Naphthalene, Aromatic character, Physical properties, Chemical properties and Uses. Mechanism of Aromatic electrophilic substitution – Theory of orientation and reactivity.
- 3.3 Anthracene, Phenanthrene from coal tar and petroleum, Laboratory preparation, Molecular Orbital structures, Aromatic Characters, Physical Properties, Chemical properties and uses. Preparation of biphenyls, Physical and Chemical properties and uses.

UNIT - IV ALKYL AND ARYL HALOGENS

- 4.1 Nomenclature of haloalkanes – structure - general preparations of haloalkanes - physical and chemical properties and uses.
- 4.2 Nucleophilic aliphatic substitution reaction mechanisms (S_N1 and S_N2) – Stereo chemical aspects.
- 4.3 Halobenzenes: Theory of orientation and reactivity - general preparation – properties - uses. Electrophilic and nucleophilic aromatic substitution reaction mechanisms.

UNIT -V ATOMIC STRUCTURE AND BASIC QUANTUM MECHANICS

- 5.1 Rutherford’s and Bohr’s model of atom- Bohr’s theory and origin of hydrogen spectrum. Somerfield’s extension of Bohr’s theory.
- 5.2 Electromagnetic radiation- definitions for λ , γ and velocity.
- 5.3 Dualism of light -Particle nature of radiation- black body radiation and Planck’s quantum theory, photoelectric effect and Compton effect of matter.
- 5.4 De Broglie hypothesis and Davisson and Germer experiment. Heisenberg’s uncertainty principle. Schrodinger wave equation (Derivation not needed). Physical significance of Ψ and Ψ^2 .

UNIT -VI CURRENT CONTOURS (For Continuous Internal Assessment Only):

An assignment on applications of hydrogen bonding, various atomic models and evidences for dualism of light. Chart preparations for molecular orbital theory diagram. An exposure to virtual laboratory experiments.

REFERENCES:

1. R.D. Madan, "Modern Inorganic Chemistry", 2nd edition, S. Chand & Company Ltd., 2000.
2. P.L. Soni, "Text book of Inorganic Chemistry", 20th revised edition, Sultan Chand & Sons, 2000.
3. B.R. Puri, L.R. Sharma, K.K. Kalia, Principles of Inorganic Chemistry, 23rd edition, New Delhi, ShobanLalNagin Chand & Co., (1993).
4. J.D. Lee, 'Concise Inorganic Chemistry', 20th revised edition, Sultan Chand & Sons, 2000.
5. R. Gopalan, P.S. Subramanian & K. Rengarajan, "Elements of Analytical Chemistry", 2nd edition, Sultan Chand & Sons, 1991.
6. Morrison R.T. and Boyd R.N., Bhattacharjee S. K. Organic Chemistry (7th edition), Pearson India, (2011).
7. Bahl B.S. and Bahl A., Advanced Organic Chemistry, (12th edition), New Delhi, Sultan Chand & Co., (2010).
8. Jerry March, "Advanced Organic Chemistry, Reaction, Mechanism and Structure", 7th Edition, Wiley Inter Science (2013).
9. Puri B.R., Sharma L.R. and Pathania M.S. (2013) Principles of Physical Chemistry, (35th edition), New Delhi: ShobanLalNaginchand and Co.
10. Bahl B.S., ArunBahl and Tuli G.D. (2012). Essentials of Physical Chemistry, New Delhi: Sultan Chand and Sons.
11. [https://oms.bdu.ac.in/ec/courses.php?subject=B.Sc.%20\(CHEMISTRY\)](https://oms.bdu.ac.in/ec/courses.php?subject=B.Sc.%20(CHEMISTRY))
12. http://www.chem.ualberta.ca/~vederas/Chem_164/handouts/pdf/sub_elim_rxn.pdf

COURSE OUTCOMES

Upon successful completion of this course the students would be able:

- To explain the principles and theories of chemical bonding.
- To explain the chemistry of S-block elements and Zero group elements.
- To apply the concept of common ion effect, solubility product in inorganic Semi micro qualitative analysis
- To explain the reaction mechanism of haloalkanes and halobenzene.
- To explain atomic models. Atomic spectrum and dual nature of light black body radiation and significances of wavefunctions.

Relationship Matrix											
Semester	Course Code		Title of the Course							Hours	Credits
II			GENERAL CHEMISTRY- II							4	4
Course Outcomes	Programme Specific Outcomes (PSOs)										Mean Score of COs
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	
CO1	1	3	3	3	2	1	2	2	1	2	2.00
CO2	1	3	2	2	2	1	1	2	1	2	1.70
CO3	1	3	3	3	3	2	2	3	2	2	2.40
CO4	1	3	3	3	2	1	2	3	2	2	2.20
CO5	1	3	3	3	2	1	2	2	2	3	2.20
Mean Overall Score											2.10 (Medium)

First Year

CORE PRACTICAL - 2
SEMI MICRO ANALYSIS (P)
(Practical)

Semester II

Code

Credit: 4

COURSE OBJECTIVES

- To learn the techniques of semi micro qualitative analysis of inorganic salt mixtures.
- To learn confirmatory tests to identify several cations and anions.
- To learn the principles of qualitative analysis of inorganic salts.

SEMIMICRO INORGANIC QUALITATIVE ANALYSIS

Analysis of a mixture containing two cations and two anions of which one will be an interfering acid radical. Semi-micro methods using the conventional scheme with hydrogen sulphide may be adopted.

Cations to be Studied: lead, copper, bismuth, cadmium, iron, aluminum, zinc, manganese, cobalt, nickel, barium, calcium, strontium, magnesium and ammonium.

Anions to be studied: Carbonate, Sulphide, Sulphate, nitrate, chloride, bromide, fluoride, borate, oxalate and phosphate.

REFERENCES

Venkateswaran V. Veerasamy R. Kulandaivelu A.R., Basic principles of Practical Chemistry, 2nd edition, New Delhi, Sultan Chand & sons (1997).

COURSE OUTCOMES

Upon successful completion of this course the students would be able:

- To understand the systematic steps to perform a qualitative analysis and the logical sequence of each step.
- To demonstrate the group separation of cations.
- To understand chemical equilibria involving acid/base, redox, precipitation and complexation.
- To understand the purpose of elimination of interfering acid radical, separation of groups and identifying cations and anions in aqueous solutions.
- To plan, execute and record all the experimental results.

Relationship Matrix											
Semester	Course Code	Title of the Course							Hours	Credits	
II		CORE PRACTICAL - 2 SEMI MICRO ANALYSIS (P)							3	4	
Course Outcomes	Programme Specific Outcomes (PSOs)										Mean Score of COs
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	
C01	1	3	3	3	3	1	2	3	2	2	2.30
C02	1	3	2	3	3	2	2	3	3	2	2.40
C03	1	3	3	3	3	1	2	3	2	2	2.30
C04	1	3	3	3	3	2	2	3	3	2	2.50
C05	2	3	3	3	3	3	3	3	3	2	2.80
Mean Overall Score											2.46 (High)

Note:

Internal Marks: 40 External marks:60

Marks Distribution for external

: Practical - 55 marks
: Record - 5 marks
: Total - 60 marks

4 radicals correct with suitable tests: 55 marks 3 radicals correct with suitable tests: 40 marks 2 radicals correct with suitable tests: 30 marks 1 radical correct with suitable tests: 15 marks Spotting 05 marks

First Year

SKILL ENHANCEMENT COURSE I
DYEING TECHNIQUES AND WATERTREATMENT
(Theory)

Semester II

Code

Credit: 2

COURSE OBJECTIVES:

- To develop the skills in dyeing.
- To understand the water qualities and treatments.
- To know the sewage treatments.

UNIT – IPRETREATMENT OF FIBERS AND THEORY OF DYE

- 1.1 Textile fiber pretreatments: Sizing and desizing, purpose, desizing methods (Hot water, Acid and enzymatic) - their merits and demerits - Scouring: classification, method of Kier boiling process.
- 1.2 Dye chemistry: Witt's theory of colour –important dye stuff intermediates- their names- Difference between dye and pigments.
- 1.3 Chromophore – auxochromes–bathochromic shift and hypsochromic shift -classification of dyes based on application.

UNIT – II TERMINOLOGIES IN DYEING PROCESS

- 1.1 Technical terms in dyeing: M.L. ratio – % of shade – % of exhaustion – equilibrium absorption.
- 1.2 Dyeing machineries: Description and uses of Padding mangle and Jigger.
- 1.3 Textile dyeing processes I: Direct cotton dyeing – effect of temperature, Acid dyeing – effect of electrolytes in acid dyeing.

UNIT – III PROCESS AND PROPERTIES OF DYING

- 3.1 Textile dyeing processes II: Vat dyeing, Pre – mordant dyeing, Post - mordant dyeing.
- 3.2 Fastness properties – Definition of Light, Washing Rubbings, Perspiration and sublimation fastness - Evaluation procedures for Light and Washing fastness.

UNIT – IV SEWAGE WATER TREATMENT METHODS

- 4.1 Sewage & Domestic wastes and their effects - concepts of BOD and COD.
- 4.2 Eutrophication and their effects- Biological magnification.
- 4.3 Water treatment methods: General methods of water treatment – Sewage treatment methods: preliminary, Primary, Secondary, Tertiary treatments.

UNIT – V PROCESSES FOR TREATMENT OF INDUSTRIAL EFFLUENTS

- 1.1 Industrial effluents: Nature of effluents of Chemical, Food, Drug and material industries. Industrial waste water treatment: preliminary, Primary, Secondary (Biological) treatment. Aerobic process (Lagooning, Trickling Filters, activated Sludge, oxidation ditch).
- 1.2 Anaerobic digestion – advantages of Anaerobic process – Disposal of sludge – draw backs and effective steps and Tertiary treatments (adsorption, ion-exchange and ultra-filtration).

UNIT – VI CURRENT CONTOURS (For continuous internal assessment only)

General quiz on - sources and effects of water pollutants-Heavy metals and dyes. Case studies on impact of water pollution due to industrial activities.

REFERENCES:

1. Venkataraman. K. The chemistry of synthetic dyes Vol, I, II, III & IV-, Academic Press N.Y., 1949.
2. Shenai, V.A. ,Chemistry of Textile fibres, vol.I, Sevak publication , Mumbai
3. Shenai, V.A. ,Chemistry of Dyes and Principles of dyeing , vol.II, Sevak publication, Mumbai
4. H.Kaur “Environmental Chemistry” 7th Edition, PragatiPrakashan publisher, 2013
5. A.K.De “Environmental Chemistry” 3rd Edition ,New Age International (P) Ltd.Publisher,1997.
6. https://web.iitd.ac.in/~arunku/files/CVL100_Y16/LecSep1220.pdf

COURSE OUTCOMES:

Upon successful completion of this course the students would be able:

- To perform the pretreatment of grey fabric.
- To get an experience in dyeing of natural fibers with reactive, direct and acid dyes.
- To explain theory and process of dying textile fibers
- To characterize and find the suitable treatment process of sewage water and industrial effluents
- To compare the effect of aerobic and anaerobic treatment of industrial effluents and sewage water.

Relationship Matrix											
Semester	Course Code		Title of the Course						Hours		Credits
II			DYEING TECHNIQUES AND WATER TREATMENT						2		2
Course Outcomes	Programme Specific Outcomes (PSOs)										Mean Score of COs
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	
C01	1	3	2	2	3	2	2	2	2	2	2.10
C02	1	3	2	2	3	2	3	2	2	2	2.20
C03	1	3	2	2	3	1	2	2	1	2	1.90
C04	1	3	3	3	3	2	2	3	3	2	2.50
C05	1	3	3	3	3	2	2	3	2	2	2.40
Mean Overall Score											2.22 (Medium)

First Year

**INTERDISCIPLINARY COURSE- II
CHEMISTRY IN EVERY DAY LIFE**

Semester II

Code

(Theory)

Credit: 2

COURSE OBJECTIVES

- To learn the scientific and chemical principles in water chemistry
- To learn the applications of chemistry in agriculture.
- To learn additives and adulterants used in food chemistry,
- To know the chemicals used in cosmetics and other materials used in everyday life.
- To understand the chemical used and properties of polymers, fibers and dyes.

Unit- I WATER CHEMISTRY

- 1.1 Water – Characteristics of water, soft water and hard water.
- 1.2 Removal of hardness – Purification of water by ion exchange and reverse osmosis methods.
- 1.3 Water pollution: Sources and effects of water pollution (Domestic, Industrial, Agricultural) -Eutrophication.

UNIT – II AGRICULTURAL CHEMISTRY

- 2.1 Plant nutrients –Requisites of good fertilizers - Effect of Nitrogen on plant growth, deficiency symptoms - examples for nitrogenous fertilizers: - Effect of Phosphorous on plant growth, deficiency symptoms – -examples for phosphatic fertilizers.
- 2.2 Effect of potassium on plant growth, deficiency symptoms - examples for potassium fertilizers – Functions of secondary and micro nutrients.
- 2.3 Pesticides: Classification on the basis of mode of action, types of pests and Chemical nature with examples – safety measures while using pesticides.
- 2.4 Fungicides, Herbicides, Acaricides, Rodenticides, Repellants, Fumigants, Defoliant (Definitions and Examples).

UNIT – III FOOD CHEMISTRY

- 3.1 Food classification and functions- Digestion in mouth, stomach and intestine. Absorption- spoilages, preservation techniques (canning, dehydration, freeze-drying. salting, pickling, pasteurizing, fermenting and carbonating).
- 3.2 Mineral and water as food-role of water in physiology – water balance – permitted colours (Riboflavin, beta-carotene and amaranth) – description and uses.

- 3.3 Food additives – colouring (Natural and synthetic colours)-List of permitted colours (Curcumin, Riboflavin, Beta-carotene, Plain Caramel and amaranth)- description and uses.
- 3.4 Flavouring agents – Anti oxidants – Emulsifiers- Acidulants and beverages. Soft drinks aerated water (ingredients and side effects).

UNIT – IV COSMETICS AND OTHER MATERIALS

- 4.1 Cosmetics – Face powder – constituents, uses, side effects. Nail polish, hair dye – composition and side effects.
- 4.2 Tooth powder – composition and manufacture. Lotions.
- 4.3 Preparation of phenyl, liquid blue and incense sticks.
- 4.4 Cleaning agents: Soaps- types and cleaning action – detergents – types – merits and demerits of soap and detergents –chemical definitions of shampoo, washing powder and bleaching powder.

UNIT – V MATERIAL CHEMISTRY

- 5.1 Polymers: Addition polymerization, condensation polymerization, thermoplastics-Vulcanization of rubber.
- 5.2 Fibers: Natural fibers (cellulosic and proteinaceous) –Semi synthetic (Rayon) Synthetic fibers (Poly ester, Nylon and Acrylic) –Pretreatment of fibers (Sizing, Desizing, Bleaching).
- 5.3 Dyes and Dyeing process: Difference between dye and pigment -Witt's colour theory, classification of dyes based on application (Direct, Vat, Acid, Reactive, Mordant and Disperse).

UNIT – VI CURRENT CONCEPTS (For Continuous Internal Assessment Only)

Assignment and general quiz on - Sources, structure and biological functions of Vitamins – A, B complex, C and D, Carbohydrates and proteins. Hand on training to detect food adulterants in –milk, honey, ground nut oil, turmeric powder, chilli powder.

REFERENCES

1. K. Kumarasamy, A. Alagappa Moses and M. Vasanthy, "Environmental studies", Bharathidasan University, Thiruchirappalli.
2. Alex Ramani, "Food Chemistry", MJP publishers (2009), Chennai.
3. Jayashree Gosh, "Text book of Pharmaceutical Chemistry" New Delhi, S. Chand & Company Ltd.,(2003).
4. K.Bagavathi Sundari, "Applied Chemistry" MJP Publishers, (2006)

Chennai.

5. A Thankamma Jacob (1979), A Text Book of Applied Chemistry, 1st edition, McMillan India Ltd.
6. Hesse P.R, A text book of soil chemical analysis John Murray, New York, 1971.
7. Buchel K.H, Chemistry of Pesticides, John Wiley & Sons New York 1983.
8. <https://oms.bdu.ac.in/ec/search-results.php>

COURSE OUTCOMES

Upon successful completion of this course the students would be able:

- To prepare demineralized and desalinized water.
- To explain the importance and requirements of good pesticides, fertilizers and fungicides used in agriculture.
- To explain food additives and their carcinogenic effects.
- To know the types of polymers and plastics with examples.
- To explain theory of dying processes

Relationship Matrix											
Semester	Course Code	Title of the Course								Hours	Credits
II		INTERDISCIPLINARY COURSE- II CHEMISTRY IN EVERYDAY LIFE								2	2
Course Outcomes	Programme Specific Outcomes (PSOs)										Mean Score of COs
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	
C01	1	3	2	3	3	2	2	3	2	2	2.30
C02	1	3	2	2	3	1	2	2	1	2	1.90
C03	1	3	3	3	2	1	2	2	2	3	2.20
C04	1	3	2	2	2	1	1	2	1	2	1.70
C05	1	3	2	2	3	1	2	2	1	2	1.90
Mean Overall Score											2.00 (Medium)

Second Year

**CORE COURSE-3
GENERAL CHEMISTRY- III
(Theory)**

Semester III

Code

Credit: 4

COURSE OBJECTIVES

- To learn the chemistry of p-block elements.
- To study about the preparations and properties of compounds of oxygen, Sulphur, halogens and interhalogens.
- To understand the arrangement of atoms in space, isomers and the nomenclature.
- To learn the gas laws, properties of real gases and types of molecular velocities.
- To learn the types, structure and properties of solids and liquid crystals.

UNIT – ICHEMISTRY OF P-BLOCK ELEMENTS

- 1.1 General characteristics of p-block elements. Comparative study of elements of III A & their compounds. Compounds of boron – boric acid, borax, borazole.
- 1.2 Extraction of Al and Pb - alums, alloys of Al. Chemistry of oxides of carbon – CO, CO₂. Allotropic forms of carbon.
- 1.3 Compounds of nitrogen and phosphorous – NH₂.NH₂, H₂NOH, hydrazoic acid, N₂- Cycle, fixation of N₂, PH₃ and P₂O₅.

UNIT – IICOMPOUNDS OF OXYGEN, SULPHUR AND HALOGENS

- 2.1 Peracids of sulphur, Thionic acids, sodium thiosulphate – preparation, properties, structure and uses.
- 2.2 Classification of oxides – acidic, amphoteric, neutral oxides, peroxides and superoxides.
- 2.3 Interhalogen compounds, Pseudo halogens, Oxyacid of halogens, Polyhalides and basic nature of iodine.

UNIT – IIISTEREOCHEMISTRY

- 3.1 Principles of symmetry-symmetry elements (C_n, C_i and S_n) asymmetry and dissymmetry – isomerism – constitutional isomers – stereoisomers - enantiomers - diastereomers – geometrical isomerism -constitutional isomers – stereoisomers -enantiomers - diastereomers - geometrical isomers – meso and dl compounds used in stereochemistry.
- 3.2 D, L notations to express configurations – chirality-optical isomerism – optical activity – polarimeter – specific rotation.

- 3.3 Stereo selectivity, stereo specificity in organic reactions with examples. Resolution of racemic mixture – Walden Inversion – conformational analysis of cyclohexane - asymmetric induction.

UNIT – IV GASEOUS STATE

- 4.1 Gases – Boyle's law, Charles's law and Avogadro's law- ideal gas equation.
4.2 Real Gases- deviation from ideal behaviour – van der Waals equation of states- derivation –significance of critical constants- law of corresponding states- compressibility factor.
4.3 Inversion temperature and liquefaction of gases- Linde and Claude – demagnetization methods.
4.4 Maxwell's distribution of molecular velocities (Derivation not needed). Types of molecular velocities- mean, most probable and root mean square velocities-Inter relationships. Collision diameter mean free path and collision number.

UNIT – V SOLID STATE AND LIQUID CRYSTALS

- 1.1 Classification of solids- Isotropic and anisotropic crystals- elements of symmetry- basic seven crystal systems- laws of crystallography representation of planes- miller indices, space lattice and unit cell.
1.2 X-ray diffraction- derivation of Bragg's equation- determination of structures of NaCl by Debye Scherrer (powder method) and rotating crystal methods.
1.3 Types of crystals, close packing of identical solid spheres, interstitial sites, limiting radius ratios (derivation not needed), radius ratio rule and shapes of ionic crystals, structures of NaCl, CsCl and ZnS.
1.4 Semiconductors- intrinsic and extrinsic semiconductors- n and p-type semiconductors. Liquid crystals- types and applications.

UNIT – VI CURRENT CONTOURS (For Continuous Internal Assessment Only):

An assignment on general characteristics of p-block elements. Chart preparation for various symmetry elements – best can be placed for the students perusal. An exposure to crystallography software.

REFERENCES:

1. B.R. Puri, L.R. Sharma, K.K. Kalia, Principles of Inorganic Chemistry, 23rd edition, New Delhi, ShobanLalNagin Chand & Co., (1993).
2. R.D. Madan, "Modern Inorganic Chemistry", 2nd edition, S. Chand & Company Ltd., 2000.
3. J.D. Lee, 'Concise Inorganic Chemistry', 20th revised edition, Sultan Chand & Sons, 2000.
4. Gurdeep Raj, 'Advanced Inorganic Chemistry', 20th revised edition, Sultan Chand & Sons, 2000.
5. Morrison R.T. and Boyd R.N., Bhattacharjee S. K. Organic Chemistry (7th edition), Pearson India, (2011).
6. Bahl B.S. and Bahl A., Advanced Organic Chemistry, (12th edition), New Delhi, Sultan Chand & Co., (2010).
7. Glasstone S. and Lewis D., Elements of Physical Chemistry, London, Mac Millan& Co Ltd.
8. Puri B.R., Sharma L.R. and Pathania M.S. (2013) Principles of Physical Chemistry, (35th edition), New Delhi: ShobanLalNagin Chand and Co.
9. https://cbpbu.ac.in/userfiles/file/2020/STUDY_MAT/CHEM/liquid%20crystal.pdf.
10. <https://youtu.be/hH2Zfucp0oo>.
11. [https://oms.bdu.ac.in/ec/courses.php?subject=B.Sc.%20\(CHEMISTRY\)](https://oms.bdu.ac.in/ec/courses.php?subject=B.Sc.%20(CHEMISTRY))

COURSE OUTCOMES:

Upon successful completion of this course the students would be able:

- To prepare and to predict the structure and properties of compounds of oxygen, sulphur, halogens & interhalogen compounds.
- To predict the absolute and relative configuration of organic molecules.
- To isolate, resolve the mixture of conformational isomers
- To explain the gas laws, properties of real gases and types of molecular velocities.
- To explain the types, structure and properties of solids and liquid crystals.

Relationship Matrix											
Semester	Course Code	Title of the Course								Hours	Credits
III		GENERAL CHEMISTRY -III								4	4
Course Outcomes	Programme Specific Outcomes (PSOs)										Mean Score of COs
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	
CO1	1	3	2	3	2	1	2	2	1	2	1.90
CO2	1	3	3	3	2	1	2	3	2	2	2.20
CO3	1	3	3	3	3	2	2	3	2	2	2.40
CO4	1	3	2	3	3	1	2	3	1	2	2.10
CO5	1	3	2	3	2	1	2	2	2	2	2.00
Mean Overall Score											2.12 (Medium)

Second Year

CORE PRACTICAL 3
ORGANIC QUALITATIVE ANALYSIS AND
ORGANIC PREPARATION
(Practical)

Semester III

Code

Credit: 4

COURSE OBJECTIVES:

- To learn the techniques of qualitative analysis of organic compounds
- To know the preparation methods of them.
- To learn the identification of functional groups in organic compounds.

I ORGANIC QUALITATIVE ANALYSIS:

Analysis of Simple Organic compounds.

- (a) Characterization of functional groups
- (b) Confirmation by preparation of solid derivatives / characteristic colour reactions.

Note: Mono –functional compounds are given for analysis. In case of bi-functional compounds, students are required to report any one of the functional groups.

II ORGANIC PREPARATION: (ANY FOUR)

Preparation of organic compounds involving the following chemical conversions.

- 1.Oxidation 2. Reduction 3.Hydrolysis 4.Nitration 5.Bromination
6.Diazotization 7. Osazone formation.

REFERENCES:

Venkateswaran V. Veerasamy R. Kulandaivelu A.R., Basic principles of Practical Chemistry, 2nd edition, New Delhi, Sultan Chand & sons (1997).

COURSE OUTCOMES:

Upon successful completion of this course the students would be able to

- Perform systematic qualitative organic analysis of common organic compounds
- Detect of special elements N, S and halogens
- Apply chemical tests to identify unknown chemical species

- Synthesise simple organic compounds on a laboratory scale.
- Perform Isolation and purification of organic compounds.

Relationship Matrix											
Semester	Course Code	Title of the Course								Hours	Credits
III		ORGANIC QUALITATIVE ANALYSIS AND ORGANIC PREPARATION								4	4
Course Outcomes	Programme Specific Outcomes (PSOs)										Mean Score of COs
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	
C01	1	3	3	3	3	2	2	3	3	2	2.50
C02	1	3	2	3	3	2	2	3	2	2	2.30
C03	1	3	3	3	3	2	2	3	3	2	2.50
C04	1	3	3	3	3	2	3	3	3	2	2.60
C05	1	3	3	3	3	2	3	3	3	2	2.60
Mean Overall Score											2.50 (High)

Note:

Internal Marks: 40
 External marks: 60

Marks Distribution for external

Record: - 5 marks

Organic Analysis: -35 marks

Aromatic/Aliphatic -5 marks

Saturation

unsaturation - 5 marks

Element test - 7 marks

Functional group -13 marks

Derivative - 5 marks

Organic preparation: - 20 marks

Total: - 60 marks

Second Year

SKILL ENHANCEMENT COURSE –II

Semester III

Ethno Medicine

Code

(Theory)

Credit: 2

Course Objectives

- To understand the fundamentals of ethno medicine, including its role, historical context and evolution within indigenous communities.
- Properly record and preserve traditional, often unwritten, knowledge about herbal remedies and local medicinal plants before it disappears.
- Examine the diverse cultural approaches to health, illness and treatment, including spiritual, shamanic and folk healing methods.
- Emphasize the sustainable harvesting, cultivation and preservation of medicinal plants and natural resources.
- Address the ethics of studying and utilizing indigenous knowledge, including intellectual property rights and intellectual property theft concerns.
- Educate learners on the commercial potential, quality control, market regulations and value added product development from medicinal plants.

UNIT-I INTRODUCTION TO ETHNO MEDICINE

Ethno medicine - Definition, history and its scope – Interdisciplinary approaches in ethnobotany - Collection of ethnic information.

UNIT-II BALANCED DIET

Importance of medicinal plants - Role in human health care - health and balanced diet (Role of proteins, carbohydrates, lipids and vitamins).

UNIT-III TRIBAL MEDICINE

Tribal medicine - methods of disease diagnosis and treatment - Plants in folk religion-*Aegle marmelos*, *Ficus benghalensis*, *Curcuma domestica*, *Cyanodondactylon* and *Sesamum indicum*.

UNIT-IV UTILITY OF SOME MEDICINAL PLANTS

Traditional knowledge and utility of some medicinal plants in Tamilnadu - *Solanum trilobatum*, *Cardiospermum halicacabum*, *Vitex negundo*, *Adathodavasisa*, *Azadirachta indica*, *Gloriosa superba*, *Eclipta alba*, *Aristolochia indica* and *Phyllanthus fraterculus*.

UNIT-V PLANTS IN DAY TODAY LIFE

Ocimum sanctum, *Centella asiatica*, *cassia auriculata*, *Aloe vera*. Nutritive and medicinal value of some fruits (Guava, Sapota, Orange, Mango, Banana, Lemon, Pomegranate) and vegetables – Greens (*Moringa*, *Solanum nigrum*, *Cabbage*).

UNIT-IV : CURRENT CONTOURS (For Continuous Internal Assessment Only)

Identification and awareness of the medicinal value of locally available medicinal plants. To be familiar with the preparation of herbarium specimen of the ethno medicinal plants. Understanding the preparation method like decoction, paste and powders for treating ailments. *Eg., Tulsi, Keezhanelli and Aloe vera*.

REFERENCES:

1. Ethnobiology - R.K. Sinha & Shweta Sinha. Surabhe Publications - Jaipur. 2001
2. Tribal medicine - D.C. Pal & S.K. Jain Naya Prakash, 206, Bidhansarani, Calcutta, 1998.
3. Contribution to Indian ethnobotany - S.K. Jain, 3rd Edition, scientific publishers, B. No. 91, Jodhpur, India. 2001
4. A Manual of Ethnobotany - S.K. Jain, 2nd Edition, 1995.

Course Outcomes:

Upon completion of the course, students will be able to

- Identify, classify and understand the role of medicinal plants used in traditional healing systems.
- Analyze the pharmacological properties, bioactive compounds and safety of traditional herbal medicines.
- Understand the cultural, spiritual and social dimensions of health, sickness and traditional healing methods.
- Develop skills in ethnobotanical documentation, field interviews and preparing herbaria.
- Evaluate intellectual property rights, conservation issues and the ethical commercialization of traditional knowledge.

Relationship Matrix											
Semester	Course Code		Title of the Course						Hours	Credits	
III			SKILL ENHANCEMENT COURSE- II Ethno Medicine						2	2	
Course Outcomes	Programme Specific Outcomes (PSOs)										Mean Score of COs
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	
CO1	1	3	3	3	3	1	2	3	2	2	2.30
CO2	2	2	3	2	1	2	2	1	1	3	1.90
CO3	3	2	3	2	2	3	2	2	3	2	2.40
CO4	2	2	3	3	2	2	2	2	3	3	2.40
CO5	1	3	3	3	3	1	2	3	2	2	2.30
Mean Overall Score											2.18 (Medium)

Course Objectives

1. To acquire knowledge in the origin of metallurgy in ancient India.
2. To understand the significance of metals in Vedic era.
3. To explore the knowledge of alchemy.
4. To explain the mining techniques.
5. To recognize the metal works in pre-modern India.

UNIT-I INTRODUCTION TO METALS AND ORES

Metals and Metal working in Indian knowledge systems- historical development-origin of metal working in India- vedic and post-vedic period-introduction to metals and ores.

UNIT-II VEDIC METALLURGY

Vedic Metallurgy- Introduction, sources in ancient era and uses- Copper, Iron, Zinc, Gold and Silver and significance- Delhi Iron Pillar-Corrosion Resistance (Case Study).

Unit-III MEDICINAL IMPORTANCE OF METALS

Alchemy- origin- Concepts of Rasa, Dhatu and Bhasma- Preparation of different types of bhasmas- Gold, Silver, Copper, Lead-Medicinal Importance and Modern Perspective.

UNIT-IV TRADITIONAL INDIAN METAL WORKS

Traditional Mining Methods, Mining techniques- types of metal and ores – Extraction Techniques – Roasting, Smelting, Reduction- Metalworking technology- apparatuses used for extraction of metallic components.

UNIT-V METAL IN PRE-MODERN INDIA

Metal works in pre-modern India (Bronze, Brass, Panchaloha)- Indian Metal Art – Idols and Artefacts- Traditional Casting Techniques (Lost Wax Method) Metals and alloys in India, cultural and artistic aspects-idols and artefacts- Field visit.

TEXT BOOK

- 1.1. Thankamma Jacob (1987) 'A Text Book of Applied Chemistry' Macmillan India Ltd.
2. History of Technology in India, Vol. I, ed. A K Bag (1997); Vol III, ed. K V Mital (2001); Vol-II by Harbans Mukhia (2012).

REFERENCES

1. Knowledge Traditions and Practices of India, Book code 11151, Chemistry and Metallurgy in India, Class XI, NCERT Publication
2. Jyoti Pathak, Chemistry in Ancient India, International Research Journal of Management Science & Technology, Vol 7 Issue 3, 2016, ISSN 2250 – 1959 (Online) 2348 – 9367 (Print)
3. Mahadevan, B., Bhat Vinayak Rajat, Nagendra Pavana R.N. (2022), "Introduction to Indian Knowledge System: Concepts and Applications", PHI Learning Private Ltd. Delhi. A. L. Basham (1954), *The Wonder That Was India*, Rupa Publications.
4. Jyoti Pathak (2016), "Chemistry in Ancient India", *International Research Journal of Management Science & Technology*, Vol. 7, Issue 3.
5. *Rasaratna Samuccaya* (Ancient text on Indian Alchemy – translated versions).
6. Dharampal (1971), *Indian Science and Technology in the Eighteenth Century*, Other India Press.

Web References:

1. https://mjcollege.kces.in/pdf/download_documents/study_material_iks_sem_2/unit_1_c_Vedic_metallurgy_ppt_English.pdf
2. https://mjcollege.kces.in/pdf/download_documents/study_material_iks_sem_2/unit_1_c_Vedic_Metallurgy_Notes_English.pdf
3. https://onlinecourses.swayam2.ac.in/imb23_mg53/preview
4. <https://www.iisc.ac.in> (Materials Engineering content)

COURSE OUTCOMES

Upon completion of the course, students will be able to

- Recall the historical development of metal works in India.
- Describe the scientific approaches and techniques in Indian Metallurgy.
- Understand the origin and development of alchemy.
- Summarize the utility of metals and alloys in idols and artefacts
- Illustrate the significances and benefits of bhasmas in Ayurveda and medicines.

Relationship Matrix											
Semester	Course Code	Title of the Course								Hours	Credits
III		INTERDISCIPLINARYCOURSE -III TRADITIONAL METALLURGY								2	2
Course Outcomes	Programme Specific Outcomes (PSOs)										Mean Score of COs
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	
CO1	1	3	2	1	1	1	2	1	1	2	1.5
CO2	1	3	2	3	3	1	2	2	2	2	2.1
CO3	1	3	2	2	1	1	2	1	1	2	1.6
CO4	1	3	2	2	2	1	3	2	1	2	1.9
CO5	1	3	2	2	3	1	2	2	2	3	2.1
Mean Overall Score											1.84 (Medium)

COURSE OBJECTIVES:

1. To learn the general characteristics of d and f block elements.
2. To know the principles of metallurgy.
3. To understand the reactions of organometallic compounds, alcohols, phenols and ethers.
4. To learn the fundamental concepts of first law of thermodynamics, to relate heat, work and energy and to calculate work from pressure – volume relationships.
5. To learn the fundamental concepts of rate of the reaction, determination of order of the reaction and theories of reaction rates

UNIT – I d-BLOCK, f- BLOCK ELEMENTS AND METALLURGY

- 1.1 General characteristics of d-block elements, comparative study of zinc group elements, extraction of Mo & Pt - Alloys of copper, amalgams and galvanization
- 1.2 General characteristics of f-block elements – Lanthanide contraction and its consequences. Extraction of Th.
- 1.3 Metallurgy: Occurrence of metals – concentration of ores – froth floatation, magnetic separation, calcination, roasting, smelting, flux, aluminothermic process, purification of metals – electrolysis, zone refining, van Arkel de-Boer process.

UNIT – II CHEMISTRY OF ORGANOMETALLIC COMPOUNDS

- 2.1 Introduction – preparation of organomagnesium compounds- physical and chemical properties- uses. Organozinc compounds – general preparation, properties and uses.
- 2.2 Organolithium, organocopper compounds – preparation, properties and uses.
- 2.3 Organolead, organophosphorus and organoboron compounds– preparation, properties and uses.

UNIT – III CHEMISTRY OF ALCOHOLS, PHENOLS AND ETHERS

- 3.1 Nomenclature – industrial source of alcohols – preparation of alcohols: hydration of alkenes, oxymercuration, hydroboration, Grignard addition, reduction – physical properties – chemical properties - uses – glycols from dihydroxylation, reduction, substitution reactions and glycerol and their uses.
- 3.2 Preparation of phenols including di- and trihydroxy phenols – physical and chemical properties - uses – aromatic electrophilic substitution mechanism – theory of orientation and reactivity.

- 3.3 Preparation of ethers: dehydration of alcohols, Williamson's synthesis – silylether. epoxides from peracids - Sharpless asymmetric epoxidation – reactions of epoxides– uses – introduction to crown ethers – structures – applications.

UNIT – IV THERMODYNAMICS-I

- 4.1 Definitions- system and surrounding- isolated, closed and open system-state of the system- Intensive and extensive variables. Thermodynamic processes-
4.2 reversible and irreversible, isothermal and adiabatic processes- state and path functions.
4.3 Work of expansion at constant pressure and at constant volume. First law of thermodynamics- statement- definition of internal energy (E), enthalpy (H) and heat capacity. Relationship between C_p and C_v .
4.4 Calculation of w , q , dE and dH for expansion of ideal gases under isothermal and adiabatic conditions of reversible and irreversible processes.
4.5 Thermochemistry- relationship between enthalpy of reaction at constant volume (q_v) and at constant pressure (q_p)- temperature dependence of heat of reaction- Kirchhoff's equation.

UNIT – V CHEMICAL KINETICS

- 5.1 Rate of reaction- rate equation, order and molecularity of reaction. Rate Laws- rate constants- derivation of first order rate constant and characteristics of zero order, first order and second order reactions-derivation of time for half change ($t_{1/2}$) with examples.
5.2 Methods of determination of order of reactions- experimental methods-determination of rate constant of a reaction by volumetry, colorimetry and polarimetry.
5.3 Effect of temperature on reaction rate- concept of activation energy, energy barrier, Arrhenius equation. Theories of reaction rates- collision theory-derivation of rate constant of bimolecular reaction- failure of collision theory-Lindemann's theory of unimolecular reaction.
5.4 Theory of absolute reaction rates – derivation of rate constant for a bimolecular reaction- significance of entropy and free energy of activation. Comparison of collision theory and absolute reaction rate theory (ARRT).

UNIT – VI CURRENT CONTOURS (For Continuous Internal Assessment Only):

An assignment on general characteristics organometallic compounds with their applications and recent techniques implemented in metallurgy. Exposure on analysis of alcohols and phenols-hydrometer-breath analysis-chemical tests - active hydrogen method.

REFERENCES:

2. B.R. Puri, L.R. Sharma, K.K. Kalia, Principles of Inorganic Chemistry, 23rd edition, New Delhi, ShobanLalNagin Chand & Co., (1993).
3. R.D. Madan, "Modern Inorganic Chemistry", 2nd edition, S. Chand & Company Ltd., 2000.
4. J.D. Lee, 'Concise Inorganic Chemistry', 20th revised edition, Sultan Chand & Sons, 2000.
5. Morrison R.T. and Boyd R.N., Bhattacharjee S. K. Organic Chemistry (7th edition), Pearson India, (2011).
6. Bahl B.S. and Bahl A., Advanced Organic Chemistry, (12th edition), New Delhi, Sultan Chand & Co., (2010).
7. Puri B.R., Sharma L.R. and Pathania M.S. (2013) Principles of Physical Chemistry, (35th edition), New Delhi: ShobanLalNagin Chand and Co.
8. Samuel Glasstone (1974), Thermodynamics for Chemists (3rd printing), East- West Edn.
9. Puri B.R., Sharma L.R. and Pathania M.S. (2013), Principles of Physical Chemistry, (35th edition), New Delhi: ShobanLalNagin Chand and Co.
10. Gurtu J.N. and AmitGurtu (1979), Chemical Kinetics, 5th Edn, Mittal K.K.
11. <https://nptel.ac.in/courses/104101128>
12. <https://youtu.be/AVDSQ0xaBJI>
13. [https://oms.bdu.ac.in/ec/courses.php?subject=B.Sc.%20\(CHEMISTRY\)](https://oms.bdu.ac.in/ec/courses.php?subject=B.Sc.%20(CHEMISTRY))

COURSE OUTCOMES:

Upon successful completion of this course the students would be able:

- To explain the general characteristics of d and f block elements.
- To apply the principles of metallurgy for extraction of metals from ores
- To explain the reactions of organometallic compounds, alcohols, phenols and ethers.
- To relate heat, work and energy and to calculate work from pressure – volume relationships.
- To determine order of the reaction and to explain theories of reaction rates.

Relationship Matrix											
Semester	Course Code	Title of the Course								Hours	Credits
IV		CORE COURSE- IV GENERAL CHEMISTRY- IV								4	4
Course Outcomes	Programme Specific Outcomes (PSOs)										Mean Score of COs
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	
CO1	1	3	2	2	2	1	2	1	1	2	1.70
CO2	1	3	2	3	3	2	2	3	2	2	2.30
CO3	1	3	2	2	3	1	2	2	2	2	2.00
CO4	1	3	2	3	2	1	2	3	1	2	2.00
CO5	1	3	3	3	3	2	2	3	3	2	2.50
Mean Overall Score											2.10 (Medium)

Second Year

CORE PRACTICAL 4
GRAVIMETRIC ANALYSIS AND DETERMINATION OF
PHYSICAL CONTANT

Semester IV

Code

(practical)

Credit: 4

COURSE OBJECTIVES:

- To learn the techniques of gravimetric analysis.
- To learn the methods for determining physical constants of organic compounds.
- To learn the principle of precipitation techniques and application in gravimetry analysis.

GRAVIMETRIC ANALYSIS:

1. Estimation of Lead as lead chromate.
2. Estimation of Barium as barium chromate.
3. Estimation of Nickel as Nickel - DMG complex.
4. Estimation Calcium as calcium oxalate monohydrate
5. Estimation of Barium as barium sulphate.

ONLY FOR DEMONSTRATION:

1. Estimation of Copper as copper (I) thiocyanate.
2. Estimation of Magnesium as magnesium oxalate.
3. Estimation of Iron as Iron (III) oxide.

DETERMINATION OF PHYSICAL CONSTANTS:

Determination of boiling / melting points of by semimicro method.

REFERENCES:

Venkateswaran V. Veerasamy R. Kulandaivelu A.R., Basic principles of Practical Chemistry, 2nd edition, New Delhi, Sultan Chand & sons (1997).

COURSE OUTCOMES:

Upon successful completion of this course the students would be able:

- To recognize the principles of gravimetric analysis.

- To understand the basics of gravimetric analysis of selected cations involving methods, selection of precipitants, nucleation, aggregation of precipitate, removal of contamination and weighing a precipitate.
- To conduct experiments to determine boiling point of unknown compounds.
- To determine the melting points of unknown solid compounds.
- To use proper apparatus to minimize the errors.

Relationship Matrix												
Semester	Course Code	Title of the Course									Hours	Credits
IV		CORE PRACTICAL- IV GRAVIMETRIC ANALYSIS AND DETERMINATION OF PHYSICAL CONSTANTS									4	4
Course Outcomes	Programme Specific Outcomes (PSOs)										Mean Score of COs	
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10		
CO1	1	3	2	2	3	1	2	2	1	2	1.90	
CO2	1	3	3	3	3	2	2	2	2	2	2.30	
CO3	1	2	2	2	3	2	3	2	2	2	2.10	
CO4	1	2	2	2	3	2	3	2	2	2	2.10	
CO5	1	2	3	3	3	2	3	3	3	2	2.50	
Mean Overall Score											2.18 (Medium)	

Mark distribution:

Internal : 40

Ext. Evaluation : 60

Record: - 5 marks

Determination of physical constant: - 10

marks Gravimetric analysis:

Manipulation - 10 marks

Results error

< 1 %	- 35 marks
1-2 %	-30 marks
2-3 %	-25 marks
3-4 %	-20 marks
> 4 %	- 10 marks

Second Year

**SKILL ENHANCEMENT COURSE -III
SOIL ANALYSIS AND SOIL TESTING**

Semester IV

Code

(Theory)

Credit: 2

Course Objectives

- To introduce basic concepts of soil and its importance
- To develop skills in simple soil sampling and preparation
- To understand basic soil properties and nutrients
- To train students in simple analytical methods for soil testing
- To enable interpretation of soil test results for practical use

UNIT -I BASICS OF SOIL

Meaning and importance of soil; Formation of soil (basic idea); Components of soil (air, water, minerals, organic matter) ; Soil types (sandy, clay, loamy) ; Soil profile (simple understanding),

Importance of soil in agriculture

UNIT -II SOIL SAMPLING AND PREPARATION

Need for soil testing ; Methods of soil sampling (simple field methods); Tools used for sampling ; Collection of soil samples from different depths; Drying, grinding, and sieving of soil ; Storage and labeling of samples ; Common errors and precautions

UNIT- III BASIC SOIL CHEMICAL PROPERTIES

Soil pH: meaning and importance; Measurement of soil pH (simple method) ;Electrical conductivity (basic idea) ; Organic matter in soil (basic concept) ; Primary nutrients: Nitrogen, Phosphorus, Potassium (basic understanding) ; Importance of micronutrients

UNIT- IV SIMPLE SOIL TESTING METHODS

Use of pH meter ; Use of conductivity meter ; Basic titration methods in soil analysis ; Simple color tests for nutrients ; Introduction to soil testing kits ; Safety measures in laboratory

UNIT- V INTERPRETATION AND APPLICATIONS

Understanding soil test reports; Basic idea of soil fertility ; Simple fertilizer recommendations ; Soil health and its importance; Causes of soil pollution (basic

idea); Simple methods to improve soil quality (organic manure, crop rotation)

UNIT-VI APPLICATION OF SOIL TESTING AND ANALYSIS (For continuous internal assessment only)

Collection of soil sample, Determination of soil pH, Determination of electrical conductivity , Simple estimation of soil nutrients (basic methods) , Preparation of a soil test report

REFERENCES

1. Biswas, T. D., & Mukherjee, S. K. (2014). *Textbook of Soil Science* (3rd ed.). New Delhi: McGraw Hill Education (India) Pvt. Ltd.
2. Brady, N. C., & Weil, R. R. (2016). *The Nature and Properties of Soils* (15th ed.). New Delhi: Pearson Education (Indian Reprint).
3. Das, D. K. (2013). *Introductory Soil Science* (4th ed.). New Delhi: Kalyani Publishers.
4. Das, D. K. (2017). *Soil Testing and Analysis: Plant, Water and Pesticide Residues* (2nd ed.). New Delhi: New Age International (P) Ltd.
5. Donahue, R. L., Miller, R. W., & Shickluna, J. C. (1990). *Introduction to Soils and Plant Growth* (5th ed.). New Delhi: Prentice Hall of India.
6. Indian Council of Agricultural Research (ICAR). (2011). *Handbook of Agriculture* (6th ed.). New Delhi: ICAR Publications.
7. Indian Council of Agricultural Research (ICAR). *Soil Testing and Fertility Management Manuals*. New Delhi: ICAR (Various publications and training manuals).
8. Indian Institute of Soil Science (IISS). *Training Manual on Soil Analysis*. Bhopal: IISS Publications.
9. Tamil Nadu Agricultural University (TNAU). *Soil Testing and Soil Fertility Management Notes*. Coimbatore: TNAU Agritech Portal Publications.
10. Tandon, H. L. S. (2005). *Methods of Analysis of Soils, Plants, Waters and Fertilizers*. New Delhi: Fertiliser Development and Consultation Organisation (FDCO).
11. Tandon, H. L. S. (2009). *A Handbook of Soil Analysis*. New Delhi: Fertiliser Development and Consultation Organisation (FDCO).

COURSE OUTCOMES

On completion of the course, students will be able to:

CO1: Explain basic concepts of soil formation, types, and properties

CO2: Demonstrate proper soil sampling and preparation methods

CO3: Analyze basic chemical properties of soil such as pH and nutrients

CO4: Use simple instruments for soil testing

CO5: Interpret soil test results and suggest basic soil management practices

Relationship Matrix											
Semester	Course Code	Title of the Course								Hours	Credits
IV		SOIL ANALYSIS AND SOIL TESTING								2	2
Course Outcomes	Programme Specific Outcomes (PSOs)										Mean Score of COs
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	
C01	1	3	2	2	2	1	2	1	1	2	1.70
C02	1	2	2	2	3	2	3	2	2	2	2.10
C03	1	3	3	3	3	2	2	3	2	2	2.40
C04	1	2	2	2	3	2	3	2	2	2	2.10
C05	1	3	3	3	2	2	2	3	2	3	2.40
Mean Overall Score											2.14 (Medium)

COURSE OBJECTIVES:

- To understand chemistry of oils and fats.
- To know about the types of fertilizers, manufactures and uses.
- To understand pesticides and its applications.
- To know about the types of water hardness, determination and its measures.
- To understand the corrosion types and its control.

UNIT-I OILS AND FATS

Classification of oils, fat splitting, distillation of completely miscible and non-miscible oils, hydrogenation of oils, rancidity, saponification value, iodine number, acid value, Soap and Synthetic Detergent, preparation of soap and detergent, different types of soap and their composition, surfactants (LAS, ABS, LABS), detergent binders and builders.

UNIT-II FERTILIZERS

Different types of fertilizers. Manufacture of the following fertilizers: Urea, Ammonium nitrate, Calcium ammonium nitrate, Ammonium phosphates; Polyphosphate, Super phosphate, Compound and mixed fertilizers Potassium Chloride, Potassium sulphate.

UNIT-III PESTICIDES

General introduction to pesticides (natural and synthetic), benefits and adverse effects, changing concepts of pesticides, structure activity relationship, synthesis and technical manufacture and uses of representative pesticides in the following classes: Organochlorines; Organophosphates (Malathion, Parathion); Carbamates (Carbofuran and carbaryl); Quinones (Chloranil), Anilides (Alachlor and Butachlor).

UNIT-IV DETERMINATION OF HARDNESS OF WATER

Titration method - complexometric method using EDTA - expressing hardness - equivalents of calcium carbonate - problems to determine temporary & permanent hardness. Water softening methods - Clark's process - lime soda process - modified lime soda process - permutit or zeolite process - Ion exchange process - demineralization of water.

UNIT-V CORROSION AND ITS CONTROL:

Introduction - Economic aspects of corrosion - Dry or Chemical Corrosion - Wet or electrochemical corrosion - Mechanism of Electrochemical Corrosion. Galvanic Corrosion - Concentration Cell Corrosion - Differential aeration corrosion - Pitting Corrosion - Underground or soil corrosion - Passivity.

UNIT-VI LEATHER CHEMISTRY: (For continuous internal assessment only)

Introduction, chief process used in leather manufacture, structure of hide and skin, leather processing process before tannage- tanning process- vegetable tanning and chrome tanning. Tannery effluent and by product problems and treatment.

REFERENCES:

1. O. P. Vermani, A. K. Narula: Industrial Chemistry, Galgotia Publications Pvt. Ltd., New Delhi.
2. J. A. Kent: Riegel's Handbook of Industrial Chemistry, CBS Publishers, New Delhi.
3. R. Cremllyn: Pesticides, John Wiley.
4. B.K.Sharma, Industrial Chemistry, 13th Edition, Goel Publishing House, Reprint 2008.
5. Bardal, E., *Corrosion and Protection*, Springer, 2003, 2.

COURSE OUTCOMES:

Upon successful completion of this course the students would be able:

- Understand the chemistry of oils, types, properties and also chemistry of fats.
- Explain the importance and types of fertilizers, manufactures and uses.
- Demonstrate the role of pesticides, classification and its applications.
- Describe the hardness of water, types, analysis, effects and measures.
- Illustrate the importance corrosion, types, effects and its control.

Relationship Matrix												
Semester	Course Code	Title of the Course									Hours	Credits
IV		INTERDISIPLINARY COURSE – 4 INDUSTRIAL CHEMISTRY									2	2
Course Outcomes	Programme Specific Outcomes (PSOs)										Mean Score of COs	
	PSO 1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10		
CO1	1	3	2	2	2	1	2	1	1	2	1.70	
CO2	1	3	2	2	2	2	2	2	1	2	1.90	
CO3	1	3	2	2	2	2	2	2	1	2	1.90	
CO4	1	3	3	3	3	2	2	3	2	2	2.40	
CO5	1	3	3	3	3	2	2	3	2	3	2.50	
Mean Overall Score											2.08 (Medium)	

COURSE OBJECTIVES

- To understand the basics and theories of coordination compounds.
- To study a few biologically important coordination compounds.
- To understand the preparation and properties of nitrosyl compounds
- To learn the basic principles and applications of magnetic properties.

UNIT-ICOORDINATION COMPOUNDS I

- 1.1 Introduction - Types of ligands: unidentate, bidentate and polydentate ligands, chelating ligands and chelates- IUPAC nomenclature of coordination compounds.
- 1.2 Isomerism in coordination compounds: Structural isomerism, hydrate isomerism, coordination isomerism, ionization isomerism, linkage isomerism, coordination position isomerism.
- 1.3 Stereoisomerism: Geometrical isomerism of four and six coordinate complexes, optical isomerism of four and six coordinate complexes, Werner and Sidgwick theories, methods of detecting complex formation.

UNIT – IICOORDINATION COMPOUNDS II

- 2.1 Theories of coordination compounds: Valence bond theory, limitations of valence bond theory, crystal field theory – splitting of d orbitals in octahedral, tetrahedral and square planar fields, CFSE, factors affecting CFSE, colour, geometry and magnetic properties of coordination compounds, Jahn – Teller distortion (an elementary idea).
- 2.2 Molecular orbital theory: Molecular orbital diagram for $[\text{Co}(\text{NH}_3)_6]^{3+}$. Ligand field theory. (An elementary treatment only).

UNIT – III COORDINATION COMPOUNDS III

- 3.1 Labile and inert complexes, stability of coordination compounds – thermodynamic and kinetic stability, relationship between stepwise formation constant and overall formation constant, factors affecting the stability of complexes.
- 3.2 Unimolecular and biomolecular nucleophilic substitution reactions in octahedral and square planar complexes, trans effect – theories of trans effect and applications.
- 3.3 Few biologically important coordination compounds: Chlorophyll, hemoglobin and vitamin B12.

UNIT – IV METAL CARBONYLS AND ORGANOMETALLIC COMPOUNDS

- 4.1 Metal carbonyls: Mono and binuclear carbonyls of Cr, Co and Mn – preparation, structure, reactions, bonding and uses.
- 4.2 Structure and bonding in π -metal alkenyl and-metalalkynyl complexes of $[\text{PtCl}_3(\text{C}_2\text{H}_4)]$ $[\text{Co}(\text{CO})_6(\text{RC} \equiv \text{CR})]$ and ferrocene.
- 4.3 Binary metallic compounds: borides, carbides, and nitrides – classification, preparation, properties and uses.

UNIT – V NITROSYL COMPOUNDS AND MAGNETIC PROPERTIES:

- 5.1 Nitrosyl compounds: Classification-nitrosyl chloride and sodium nitroprusside - preparation, properties and structure.
- 5.2 Magnetic properties meaning of the terms magnetic susceptibility-magnetic moment-types of magnetism-Gouy balance-applications of magnetic properties.
- 5.3 Dipole moment-determination, application in the study of simple inorganic molecules.

UNIT – VI CURRENT CONTOURS (For Continuous Internal Assessment Only):

General quiz/seminar on structure, magnetic, electrical properties, biological functions of the *cis*-platin. Therapeutic importance of iron, cobalt, copper, silver and gold complexes.

REFERENCES:

1. R.D. Madan, "Modern Inorganic Chemistry", 2nd edition, S. Chand & Company Ltd., 2000.
2. W.U. Malik, G.D. Tuli and R.D. Madan, S.Chand and Company Ltd., 'Selected topics in Inorganic Chemistry', 7th edition, 2001.
3. Gopalan R, Text Book of Inorganic Chemistry, 2nd Edition, Hyderabad, Universities Press, (India), 2012.
4. P.L. Soni, 'Text Book of Inorganic Chemistry', 20th revised edition, Sultan Chand & Sons, 2000.
5. B.R. Puri, L.R. Sharma, K.C. Kalia, 'Principles of Inorganic Chemistry', 21st edition, Vallabh Publications, 2004-2005.
6. J.E. Huheey, 'Inorganic Chemistry', 4th edition, Pearson Education. Inc. 1993.
7. F.A. Cotton, 'Advanced Inorganic Chemistry', 6th edition, John Wiley & Sons, Pvt. Ltd., 2003 – 2004.
8. R. Gopalan, P.S. Subramanian and K. Rengarajan, 'Elements of Analytical Chemsitry', 2nd edition, Sultan Chand & Sons, 1991.

9. <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=13G8VouhmrFfuhs6rkiyTA==>
10. <https://archive.nptel.ac.in/content/storage2/courses/104106064/lectures.pdf>

COURSE OUTCOMES:

Upon successful completion of this course the students would be able:

- To predict different types of isomerism exhibited by a coordination compounds
- To explain the various theories of coordination compounds to explain their geometry, stability and magnetic properties.
- To explain kinetics and thermodynamic stability of coordination complexes
- To explain preparation, magnetic properties and structure of metal carbonyls.
- To explain preparation, magnetic properties and structure of nitrosyls.

Relationship Matrix											
Semester	Course Code	Title of the Course								Hours	Credits
V		CORE COURSE - 5 INORGANIC CHEMISTRY-I								4	4
Course Outcomes	Programme Specific Outcomes (PSOs)										Mean Score of COs
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	
C01	1	3	3	3	2	1	2	3	1	2	2.10
C02	1	3	3	3	3	1	2	3	2	2	2.30
C03	1	3	3	3	3	1	2	3	2	2	2.30
C04	1	3	2	3	3	1	2	2	2	2	2.10
C05	1	3	2	3	3	1	2	2	2	2	2.10
Mean Overall Score											2.18 (Medium)

COURSE OBJECTIVES:

- To learn the reactions of carbonyl compounds, carboxylic acids, amines, heterocycles.
- To know the oxidizing and reducing agents for synthesis.
- To understand chemistry of heterocyclic compounds and dyes.

UNIT-I CHEMISTRY OF CARBONYL COMPOUNDS

- 1.1 Nomenclature - structure of carbonyl compounds - chemical properties - nucleophilic addition mechanism at carbonyl group (eg: HCN, ROH, RNH₂) - acidity of alpha hydrogen - keto-enol tautomerism (proof for the two forms).
- 1.2 Reduction and oxidation reactions of carbonyl compounds - paraformaldehyde, meta formaldehyde - uses of aliphatic carbonyl compound - Claisen condensation - Aldol condensation - Robinson annulation.
- 1.3 General methods of preparation of aromatic carbonyl compounds - physical and chemical properties - uses - Effect of aryl group on the reactivity of carbonyl group.

UNIT - II CHEMISTRY OF CARBOXYLIC ACIDS

- 2.1 Nomenclature - Acidity of carboxylic acids based on substituent effect - comparison of acid strengths of halogen substituted acetic acids - acid strengths of substituted benzoic acids.
- 2.2 Preparation, properties and uses of acid derivatives: acid chloride, anhydrides, esters, amides - chemistry of compounds containing active methylene group - synthesis and synthetic applications of acetoacetic ester and malonic ester.
- 2.3 Preparation of dicarboxylic acid - physical and chemical properties - uses. Introduction to oils and fats - fatty acids - manufacture of soap - mechanism of cleaning action of soap.

UNIT - III CHEMISTRY OF NITROGEN COMPOUNDS

- 3.1 Nomenclature - nitro alkanes - alkyl nitrites - differences - aromatic nitro compounds - preparation and reduction of nitro benzene under different conditions, TNT.
- 3.2 Amines - effect of substituents on basicity of aliphatic and aromatic amines -

Reactions of amino compounds (primary, secondary, tertiary and quaternary amine compounds) - Mechanism of carbylamines reaction, diazotization and comparison of aliphatic and aromatic amines.

- 3.3 Diazonium compounds - preparation and synthetic applications of diazomethane, benzene diazonium chloride and diazo acetic ester.

UNIT – IV CHEMISTRY OF HETEROCYCLIC COMPOUNDS AND DYES

- 4.1 Introduction – nomenclature of heterocyclic compounds having not more than two heteroatoms such as oxygen, nitrogen and sulphur - structure, synthesis and properties of furan, pyrrole, thiophene. Pyridine – structure, preparation - compare the basicity of pyridine with pyrrole and amines.
- 4.2 Quinoline - structure and Skraup synthesis. Isoquinoline – structure and Napieralski synthesis and Indole – structure and Fischer-indole syntheses.
- 4.3 Dyes - color and constitution – chromophore - auxochrome - classification according to application and structure - preparation and uses of - methyl orange, fluorescein, Alizarin, Indigo and malachite green dyes.

UNIT – V REAGENTS FOR OXIDATION AND REDUCTION REACTIONS

- 5.1 Oxidation: Osmium tetroxide – Chromyl chloride – Ozone – DDQ – Dioxiranes.
- 5.2 Lead tetraacetate - selenium dioxide – DMSO either with Ac₂O or oxalyl chloride – Dess-Martin reagent.
- 5.3 Reduction: Catalytic hydrogenation using Wilkinson Catalyst – Reduction with LAH, NaBH₄, tri-tertiarybutoxy aluminum hydride, NaCNBH₃, hydrazines.

UNIT – VI CURRENT CONTOURS (For Continuous Internal Assessment Only)

An assignment on the topics- significance of keto-enol tautomerism in biochemical reactions, fatty acids composition of vegetable oils and its contribution to dietary energy intake and health impact on dietary intake of fatty acids, industrial applications of diazotization, role of heterocyclic compounds in medicines, redox reactions in everyday life.

REFERENCES

1. Finar I.L., Organic Chemistry, Vol 1&2, (6th edition) England, Addison Wesley Longman Ltd. (1996).
2. Morrison R.T. and Boyd R.N., Bhattacharjee S. K. Organic Chemistry (7th edition), Pearson India, (2011)
3. Bahl, B.S. and Bahl, A., Advanced Organic Chemistry, (12th edition), New Delhi, Sultan Chand & Co., (2010)

4. Pine S.H., Organic Chemistry, (5th edition) New Delhi, McGraw – Hill International Book Company (1987)
5. Seyhan N. Ege, Organic Chemistry, (5th edition) New York, Houghton Mifflin Co., (2005).
6. <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=13G8VouhmrFfuhs6rkiyTA==>
7. <https://youtu.be/EaGWcnsm05A>
8. <http://acl.digimat.in/nptel/courses/video/104101127/lec5.pdf>
9. <http://www.adichemistry.com/inorganic/organometallic/catalysis/wilkinson/wilkinsons-catalyst.html>

COURSE OUTCOMES:

Upon successful completion of this course the students would be able:

- To correlate acidity of carboxylic acids based on substituents
- To distinguish the basicity of aromatic amines and aliphatic amines based on substituents
- To compare the properties and reactions of five, six membered and fused hetero cyclic compounds
- To identify suitable reagent for specific reactions of oxidation and reduction
- To classify the dyes according to application and structure

Relationship Matrix											
Semester	Course Code	Title of the Course								Hours	Credits
V		CORE COURSE 6 ORGANIC CHEMISTRY -I								5	4
Course Outcomes	Programme Specific Outcomes (PSOs)										Mean Score of COs
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	
C01	1	3	3	3	2	1	2	3	1	2	2.10
C02	1	3	3	3	2	1	2	3	1	2	2.10
C03	1	3	3	3	2	1	2	3	2	2	2.20
C04	1	3	3	3	3	1	2	3	2	2	2.30
C05	1	3	2	2	2	1	2	2	1	2	1.80
Mean Overall Score											2.10 (Medium)

COURSE OBJECTIVES

- To know the various concepts of photochemistry and group theory.
- To learn the second law of thermodynamics, Carnot cycle, Carnot theorem, entropy, free energy and Maxwell's relations.
- To learn the third law of thermodynamics, van't Hoff isotherm, Clausius–Clapeyron equation and Nernst heat theorem.
- To understand the laws and properties of solutions.
- To learn the fundamental concepts of phase rule and its applications to one, two and three component systems.

UNIT – I PHOTOCHEMISTRY AND GROUP THEORY

- 1.1 Consequences of light absorption- Jablonski diagram- radiative and non-radiative transitions. Lambert's Beer law, quantum efficiency.
- 1.2 Photochemical reactions-Comparison between thermal and photochemical reactions. Photosensitization and quenching. Fluorescence, phosphorescence and chemi luminescence. Laser and uses of lasers.
- 1.3 Group theory – symmetry elements and symmetry operation- group postulates and types of groups- abelian and non abelian – symmetry operation of H₂O molecule.
- 1.4 Illustration of group postulates using symmetry operations of H₂O molecule - construction of multiplication table for the operation of H₂O molecule – point group- definition- elements (symmetry operations) of the following molecules- H₂O, BF₃ and NH₃.

UNIT – II THERMODYNAMICS-II

- 2.1 Second law of thermodynamics – need for the law- different statements of the law- Carnot's cycle and efficiency of heat engine- Carnot's theorem- thermodynamic scale of temperature.
- 2.2 Concept of entropy- definition and physical significance of entropy- entropy as a function of P, V and T – entropy changes during phase changes- entropy of mixing – entropy criterion for spontaneous and equilibrium processes in isolated system.
- 2.3 Gibb's free energy (G) and Helmholtz free energy (A) – variation of A and G with P, V and T- Gibb's – Helmholtz equation and its applications.
- 2.4 Thermodynamic equation of state, Maxwell's relations - ΔA and ΔG as criteria for spontaneity and equilibrium.

UNIT – III THERMODYNAMICS-III

- 3.1 Equilibrium constant and free energy change- thermodynamic derivation of law of mass action- equilibrium constants in terms of pressure and concentration for NH_3 , PCl_5 and CaCO_3 .
- 3.2 Thermodynamic interpretation of Lechatelier's principle (Concentration, temperature, pressure and addition of inert gases).
- 3.3 Systems variable composition- partial molar quantities- chemical potential – variation of chemical potential with T, P and X (mole fraction) – Gibb's Duhem equation. Van't Hoff's reaction isotherm- van't Hoff's isochore. Clapeyron equation and Clausius – Clapeyron equation-Applications.
- 3.4 Third law of thermodynamics- Nernst heat theorem. Statement of III law and concept of residual entropy – evaluation of absolute entropy from heat capacity data.

UNIT – IV SOLUTIONS

- 4.1 Raoult's law, Henry's law, Ideal and non-ideal solutions, completely miscible liquid systems-benzene and toluene. Deviation from Raoult's law and Henry's law. Duhem-Margules equation. Theory of fractional distillation. Azeotropes- HCl – water and ethanol- water system.
- 4.2 Partially miscible liquids- phenol- water, triethylamine- water and nicotine- water systems. Lower and upper CSTs – effect of impurities on CST. Completely immiscible liquids- principle and applications of steam distillation. Nernst distribution law – derivation.
- 4.3 Dilute solutions- colligative properties, relative lowering of vapour pressure, osmosis, law of osmotic pressure, derivation of elevation of boiling point and depression in freezing point. Application- determination of molecular mass by Rast method only.

UNIT – V PHASE CHANGES

- 5.1 Definitions of terms in the phase rule- derivation and application to one component system – water and sulphur- super cooling, sublimation.
- 5.2 Two-component systems-solid liquid equilibria, simple eutectic (lead- silver, Bi- Cd), de-silverisation of lead.
- 5.3 Compound formation with congruent melting point (Mg-Zn) and incongruent melting point (Na-K).
- 5.4 Solid Solutions-(Ag-Au)-fractional crystallization, freezing mixtures- FeCl_3 - H_2O systems, CuSO_4 - H_2O system.

UNIT-VICURRENT CONTOURS (For Continuous Internal Assessment Only)

A general quiz on classification of molecules as linear planar and nonlinear based on symmetry elements, applications of colligative properties and phase rule. An assignment on recent advancements in photochemistry and various methods to utilize solar energy to solve energy crisis.

REFERENCES

1. Gurdeep Chatwal R, Photochemistry, Good publishing House.
2. Raman, K. (1990), Group theory and its application to Chemistry, New Delhi: Tata McGraw-Hill.
3. Samuel Glasstone (1974), Thermodynamics for Chemists (3rd printing), East-West Edn.
4. Rajaram J. and Kuriacose, J.C. (1986) Thermodynamics for students of Chemistry, New Delhi: LalNagin Chand.
5. Puri B.R., Sharma L.R. and Pathania M.S. (2013), Principles of Physical Chemistry, (35th edition), New Delhi: ShobanLalNagin Chand and Co.
6. Glasstone S. and Lewis D., Elements of Physical Chemistry, London, Mac Millan & Co Ltd.
7. Atkins P.W. (1994), Physical chemistry, (5th edition), Oxford University press.
8. Sangaranarayanan, M.V., Mahadevan, V., Text Book of Physical Chemistry, 2nd Edition, Hyderabad, Universities Press, (India) 2011.
9. <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=13G8VouhmrFfuhs6rkiyTA==>
10. <https://nptel.ac.in/courses/112104220>

COURSE OUTCOMES

Upon successful completion of this course the students would be able:

- To correlate the photo physical processes and their applications
- To apply symmetry operations and find point group of molecules H_2O , BF_3 , NH_3
- To apply the principle of Carnot cycle in all types of heat engines and working fluids
- To compute equilibrium constants of PCl_5 , NH_3 , $CaCO_3$ at constant pressure and concentration
- To predict qualitatively the effect of changing temperature, pressure or concentration on heterogeneous system in equilibrium using Phase diagram

Relationship Matrix												
Semester	Cours e Code	Title of the Course									Hours	Credits
V		CORE COURSE -VII PHYSICAL CHEMISTRY -I									5	4
Course Outcomes	Programme Specific Outcomes (PSOs)										Mean Score of COs	
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10		
CO1	1	3	2	2	3	1	2	2	1	2	1.90	
CO2	1	3	3	3	2	1	2	3	1	2	2.10	
CO3	1	3	3	3	3	1	2	3	1	2	2.20	
CO4	1	3	3	3	3	1	2	3	2	2	2.30	
CO5	1	3	3	3	3	1	2	3	2	3	2.40	
Mean Overall Score											2.18 (Medium)	

COURSE OBJECTIVES

- To learn the purification techniques of solids and liquids.
- To understand data analysis, various separation techniques.
- To learn gravimetric analysis and various thermo analytical methods.
- To learn visible spectrophotometry and colorimetry.
- To know the various electro analytical techniques.

UNIT – I LABORATORY SAFETY AND PURIFICATION OF CHEMICALS

- 1.1 Precautions to avoid poisoning-treatment for specific poisons, threshold vapour concentrations-safe limits-laboratory safety measures.
- 1.2 Waste disposal-fume disposal-precautions for avoiding accidents.
- 1.3 Purification of solid organic compounds: recrystallisation, extraction, sublimation.
- 1.4 Purification of liquids: fractional distillation, steam distillation and azeotropic distillation.

UNIT – II DATA ANALYSIS

- 2.1 The Mean-significant numbers, the median-precision, accuracy- confidence limits, standard deviation.
- 2.2 Errors-method for improving accuracy-rejection of data-presentation of tabulated data-Scatter diagram –method of least squares- S.I. units.
- 2.3 Separation techniques: Precipitation-solvent extraction-chromatography – types, column chromatography-thin layer chromatography.
- 2.4 Paper chromatography – paper electrophoresis– ion exchange chromatography –Gas liquid chromatography.

UNIT – III GRAVIMETRIC ANALYSIS AND THERMO ANALYTICAL TECHNIQUES

- 3.1 Gravimetric analysis - principles-methods of gravimetric analysis - requirement of gravimetric analysis-precipitation-theories of precipitation.
- 3.2 Types of precipitation – co-precipitation, post precipitation - and precipitation from homogeneous solution-digestion, filtration and washing, drying and ignition. Inorganic and organic precipitating agents.
- 3.3 Thermo analytical techniques – types-TGA principle-Instrumentation - TGA analysis of $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$. Differential thermal analysis-principle-DTA of $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$.-factors affecting TGA &DTA.

UNIT – IV VISIBLE SPECTROPHOTOMETRY AND COLORIMETRY

- 1.1 Theory of spectrophotometry and colorimetry, Beer-Lambert's law (statement

only), Molar absorptivity and absorbance.

- 1.2 Visual comparators-multiple standard methods, duplication and dilution method, balance method, photoelectric colorimeter, spectrophotometer.
- 1.3 Criteria for satisfactory colorimetric estimation-advantages of colorimetric estimation, determination of composition of complexes, colorimetric estimation of iron.

UNIT – VELECTRO ANALYTICAL METHODS

- 5.1 Electro gravimetry –theory - electro gravimetric analysis of Fe and Cu.
- 5.2 Electrolytic separation of metals: principle –separation of copper and nickel, Electro deposition- principle –overvoltage.
- 5.3 Coulometry -Principle of coulometric analysis –coulometry at controlled potential-apparatus and technique-separation of nickel and cobalt. Amperometry titrations-principle –Instruments –types-applications.

UNIT – VICURRENT CONTOURS (For Continuous Internal Assessment Only)

General quiz on – inter conversion of the units of energy – joules, calories and ergs. Wave properties–wave length, wave number and frequency. Assignment on – electroplating of nickel on steel surface, gravimetric estimation of lactose in milk, preparing rose oil by solvent extraction. Estimation of iron in ground water by colorimetric method. Preparing chart for handling and storage of glassware and chemicals in laboratory.

REFERENCES:

1. Gopalan R, Subramanian PS and Rengarajan K (1993) “Elements of analytical chemistry” second revised edition, Sultan Chand.
2. Gurdeep R Chatwal, Sham K. Anand (2005) “Instrumental methods of chemical analysis”, Himalaya publishing house.
3. Vogel A.I. Text Book of Quantitative Inorganic analysis,” The English Language Book Society, Fourth edition.
4. Douglas A. Skoog, Donald M. West and F. J. Holler, Fundamentals of Analytical chemistry, 7th edition, Harcourt College Publishers.
5. Mendham J., Denney R. C., Barnes J.D., Thomas M., Vogel’s Test book of Quantitative Chemical analysis 6th edition, Pearson education.
6. Sharma, B. K., Instrumental methods of chemical analysis, Goel Publishing House, Merrut (1997).
7. <https://www.iitk.ac.in/che/pdf/resources/TGA-DSC-reading-material.pdf>
8. https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000944AC/P001632/M028158/ET/1520585748Q1M21.pdf

COURSE OUTCOMES

Upon successful completion of this course the students would be able:

- To determine various types of error in analysis of data.
- To apply chromatographic principle to identify and separate the substances from mixture.
- To predict the factors affecting gravimetric estimation.
- To characterize thermal stability of a substance using TGA and DTA.
- To apply spectroscopic principle to analyses the purity and identify the nature of the substances.

Relationship Matrix												
Semester	Cour se Code	Title of the Course									Hours	Credits
V		CORE COURSE-8 ANALYTICAL CHEMISTRY									5	4
Course Outcomes	Programme Specific Outcomes (PSOs)										Mean Score of COs	
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10		
C01	1	3	3	3	3	1	2	3	2	2	2.30	
C02	1	3	3	3	3	1	3	3	3	2	2.50	
C03	1	3	3	3	3	1	2	3	2	2	2.30	
C04	1	3	3	3	3	1	3	3	3	2	2.50	
C05	1	3	3	3	3	1	3	3	3	2	2.50	
Mean Overall Score											2.42 (High)	

Third Year

**CORE PRACTICAL - 5
PHYSICAL CHEMISTRY
(Practical)**

Semester V

Code

Credit: 4

COURSE OBJECTIVES

- To learn the fundamentals of conductometric and potentiometric titrations.
- To understand the method of determination of molecular weight, CST, TT and rate constant
- To learn to determine rate constant of ester hydrolysis reactions.

LIST OF EXPERIMENTS

1. Critical Solution Temperature
2. Effect of impurity on Critical Solution Temperature
3. Transition Temperature
4. Molecular weight determination by Rast Method
5. Phase Diagram (Simple eutectic system)
6. Kinetics of Ester Hydrolysis
7. Partition Co-efficient
8. Conductometric Acid-Base Titration
9. Potentiometric Redox Titration
10. Determination of cell constant.

REFERENCES

Venkateswaran V. Veerasamy R. Kulandaivelu A.R., Basic principles of Practical Chemistry, 2nd edition, New Delhi, Sultan Chand & sons (1997).

COURSE OUTCOMES

Upon successful completion of this course the students would be able to

- demonstrate the principles of conductometric and potentiometric titrations
- apply the principles of physical chemistry to the given system and evaluate the experiments.
- explain the colligative properties, chemical kinetics and phase equilibria.
- illustrate the electrochemical methods for acid/base titrations, conductometric/Potentiometric curves and evaluation methods.
- describe electrochemical cell and the electrode potentials and explain about reference electrodes.

Relationship Matrix												
Semester	Course Code	Title of the Course									Hours	Credits
V		CORE PRACTICAL - 5 PHYSICAL CHEMISTRY									5	4
Course Outcomes	Programme Specific Outcomes (PSOs)										Mean Score of COs	
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10		
CO1	1	3	3	3	3	1	3	3	2	2	2.40	
CO2	1	3	3	3	3	2	3	3	2	2	2.50	
CO3	1	3	3	3	2	1	2	3	1	2	2.10	
CO4	1	3	3	3	3	1	3	3	3	2	2.50	
CO5	1	3	2	3	3	1	2	3	2	2	2.20	
Mean Overall Score											2.34 (High)	

Internal	40	
Ext. Evaluation	60	
Record		05
Procedure writing with formula		10
Practicals		45

Course Objectives

- To provide fundamental knowledge of Ai tools in chemistry
- To learn how to find out the Literatures in chemistry by using Ai tools
- To learn how to handle the Ai tools for chemistry
- To learn how to predict the synthesis and structure of molecules by Ai tools in chemistry
- To understand the uses of Ai tools for Research in chemistry.

UNIT -I INTRODUCTION TO AI TOOLS IN CHEMISTRY

Definition - scope - machine learning - Ai revolution in Chemistry - Benefits of Ai in Chemistry - Role of artificial intelligence in chemistry - Current Trends and Future Directions

UNIT -II AI TOOLS FOR CHEMISTRY LITERATURE & DATA MANAGEMENT

SciFinder : searching chemical literature, reactions, and substance databases - Elicit : Ai research assistant - DeepChem : open-source library - iThenticate : plagiarism and intellectual property verification too

UNIT -III AI TOOLS FOR COMPUTATIONAL CHEMISTRY & DRUG DESIGN

Schrödinger: physics-based molecular modeling and materials science - AlphaFold : biology and drug design - Isomorphic Labs : Ai-driven drug discovery

UNIT -IV AI TOOLS FOR CHEMISTRY SYNTHESIS & REACTION PLANNING

IBM RXN for Chemistry - Syntelly : Modular Ai platform - Chemical.Ai : Computer Aided Synthesis Planning (CASP)

UNIT- V AI APPLICATIONS IN DIGITAL CHEMISTRY

Molecular Property prediction - designing the new molecules - Drug Discovery - Material Discovery - Retro synthesis - Reaction Outcomes - Wastewater treatment - nanotechnology-Self-DrivingLabs in Chemistry

UNIT -VI CURRENT CONTOURS (Self-Directed Learning Activities for Continuous Internal Assessment Only)

Computer Vision & Boundary Detection - Medical Auto-Contouring - Model Optimization - Loss Contours - Life Sciences - Biomedical Research - Materials Science

References :

1. Ai Revolution in Chemistry by Brian McKew
2. Autonomous lab experimentation, and process control. Computational and Data-Driven Chemistry Using Artificial Intelligence by T. Akitsu
3. Machine Learning in Chemistry by Jon Paul Janet & Heather J. Kulik
4. Machine Learning in Chemistry The Impact of Artificial Intelligence, Editor - Hugh M Cartwright Royal Society of Chemistry, Royal Society of Chemistry, 2020
5. Computational and Data-Driven Chemistry Using Artificial Intelligence, Editor - Takashiro Akitsu, Elsevier, 2021
6. Role of Ai in Drug discovery or in Chemistry, Editors: Dr. Harsh K. GAikwad, Dr. Malhari C. Nagtilak, Dr. Priyanka R. Sakhare, Dr. Renukacharya G. Khanapure, IIP Iterative International Publishers, 2026
7. Using Artificial Intelligence in Chemistry and Biology, Author: Hugh Cartwright, Physical and Theoretical Chemistry Laboratory Hugh Cartwright, Taylor & Francis Group, 2019

Course Outcomes

Upon completion of the course, students will be able to

- Describe the basic knowledge and prevention about the Ai tools.
- Explain the way of finding the research articles and more data in chemistry
- Improve the research work about the computational based works in chemistry
- Reduce the chemical's needs, time duration and avoiding of repeated process for molecules synthesis
- Illustrate the current applications by using of Ai in chemistry for next level of updating

Relationship Matrix											
Semester	Course Code	Title of the Course								Hours	Credits
V		SKILL ENHANCEMENT COURSE-4 AI TOOLS IN CHEMISTRY									2
Course Outcomes	Programme Specific Outcomes (PSOs)										Mean Score of COs
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	
CO1	2	2	2	2	1	2	1	1	1	3	1.70
CO2	2	2	2	2	2	3	2	1	3	3	2.20
CO3	1	3	3	3	2	2	2	3	3	3	2.50
CO4	1	3	3	3	3	2	2	3	2	3	2.50
CO5	2	3	2	3	2	2	2	2	2	3	2.30
Mean Overall Score											2.24 (Medium)

Course Objective

- To know the importance of food and nutrition.
- To know the chemical composition and importance of balanced diet.
- To learn the food adulterants and identification of them.
- To develop the skill in food processing, food preservation technique and in detecting food adulterants

UNIT – I Nutritional food and biological importance of food

Definition -food, nutrition, nutritional care and health, classification of food-nutrients as body constituents-digestion and absorption of food, Nutritional problems in India.

UNIT – II Basic chemicals constituents of food

Classification and Biological functions of carbohydrates, proteins, fats, vitamins, minerals and water.

UNIT – III Food adulteration and health problems

Common adulterants in food-testing methods of all food adulterants (Ghee, Chilli powder, Oil, Milk, Turmeric powder) and its effect on health.

UNIT – IV Food additives

Food additives: definition, need and classification of food additives, preservatives - Natural and Artificial, antioxidants, chelating agents, coloring agents, curing agents, Emulsions, flavors, sweeteners, stabilizer and thickeners, humectants, anti-caking agents, firming agent, clarifying agent, flour bleaching agents.

UNIT – V Processing and preservation of food

Basic concept of food processing and preservation: Reason of food Spoilage and Scope of food processing preservation; principles of food processing and preservation, Principle and preservation by low temperature: (refrigeration and freezing,), Processing and preservation by drying: factors affecting drying, and types of drying technique (freeze drying, vaccum drying), Processing and preservation by heat: (blanching, pasteurization, sterilization, UHT processing, heating, dehydration, canning.

UNIT – VI Current Contours (For continuous internal assessment only)

Assignments and seminar on Hurdle technology: definition, physical, chemical and microbial hurdles in food processing, guide lines of hurdle technology to prepare stable food products

REFERENCES

- 1 Alex Ramani V, Food Chemistry, MJP Publishers, Triplicane, Chennai, 2009
- 2 Thangamma Jacob, Food adulteration, Macmillan company of India limited, New Delhi, 1976
- 3 Jeyaraman J, Laboratory manual in biochemistry, Wiley Eastern limited, New Delhi, 1981.
- 4 Branen AL, Davidson PM & Salminen S. 2001. Food Additives. 2nd Ed. Marcel Dekker.
- 5 [Advanced-Food-Prod.-System-HS-301-Chapter-8.pdf](#)

COURSE OUTCOMES:

Upon successful completion of this course the students would be able:

- To explain properties and reactions of carbohydrates, lipids and proteins during storage and processing of food.
- To explain the importance of water for stability and quality of foods.
- To explain food adulterants and their harmful effect to health.
- To classify the food additives and their role and harmful effect to health.
- To give an over view on food and precautions to avoid food infections and food poisoning and precautions to avoid food infections and food poisoning.

Relationship Matrix											
Semester	Course Code		Title of the Course						Hours		Credits
V			SKILL ENHANCEMENT COURSE-5 FOOD CHEMISTRY						2		2
Course Outcomes	Programme Specific Outcomes (PSOs)										Mean Score of COs
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	
CO1	1	3	2	2	2	1	2	2	1	2	1.80
CO2	1	3	2	2	2	1	2	2	1	2	1.80
CO3	1	3	3	2	2	2	2	2	1	3	2.10
CO4	1	3	3	2	2	2	2	2	1	3	2.10
CO5	2	3	3	3	2	2	2	3	1	3	2.40
Mean Overall Score											2.04 (Medium)

Third Year

**CORE COURSE - 9
ORGANIC CHEMISTRY- II
(Theory)**

Semester VI

Code

Credit: 4

COURSE OBJECTIVES

- To learn the chemistry of carbohydrates, proteins and vitamins.
- To learn isolation and synthesis of alkaloids and terpenoids.
- To understand the mechanism of rearrangement reactions and spectral techniques for the structural elucidation of organic compounds..

UNIT- ICHEMISTRY OF CARBOHYDRATES

- 1.1 Carbohydrates - classification, properties of monosaccharides (glucose and fructose), structure and configuration of monosaccharides, interconversion.
- 1.2 Ascending and descending series, mutarotation, epimerization- cyclic structure - determination of size of sugar rings.
- 1.3 Disaccharides - sucrose, maltose - structure elucidation - polysaccharide - starch and cellulose (elementary treatment).

UNIT – IICHEMISTRY OF PROTEINS AND VITAMINS

- 2.1 Amino acids – Zwitter ion – isoelectric point - general methods of preparation and reactions of amino acids. Peptides - Peptide linkages – proteins - classification of proteins.
- 2.2 Structure of proteins - primary structure - end group analysis - Edman method - secondary structure - tertiary structure - denaturation - colour reactions of proteins.
- 2.3 Nucleic acids - elementary treatment of DNA and RNA - Vitamins - classification, structure and biological importance of vitamins A, B1, B2, B6, B12 and C.

UNIT – IIICHEMISTRY OF ALKALOIDS AND TERPENOIDS

- 3.1 Chemistry of natural products - alkaloids – classification, isolation - methods for synthesis of coniine, piperine, nicotine and quinine - structural elucidation of nicotine only.
- 3.2 Terpenoids - classification - isoprene, special isoprene rule, methods for synthesis of citral, limonene, menthol, camphor, structural elucidation of menthol only.

UNIT -IV MOLECULARREARRANGEMENTS

- 4.1 Molecular rearrangements - types of rearrangement (nucleophilic and electrophilic) – mechanism with evidence for the following rearrangements: pinacol – pinacolone.
- 4.2 Benzil - benzilic acid, benzidine, Claisen, Fries, Hofmann, Curtius, Lossen, Beckmann and dienone – phenol rearrangements.

UNIT – VORGANIC SPECTROSCOPY

- 5.1 UV - VIS spectroscopy - types of electronic transitions – Instrumentation- solvent effects on λ max - Woodward - Fieser rules for calculation of λ max: dienes only – bathochromic shift and hypochromic shift.
- 5.2 IR spectroscopy - number and types of fundamental vibrations – selection rules-modes of vibrations and their energies. Instrumentation - position of IR absorption frequencies for functional groups like aldehyde, ketone, alcohol, acid, amine and amide.
- 5.3 NMR spectroscopy - principle - chemical shift- factors affecting the chemical shift - inductive effect and hydrogen bonding - TMS, delta scales, splitting of signals - spin-spin coupling, NMR spectrum of EtOH, n -propyl bromide and isopropyl bromide.

UNIT – VICURRENT CONTOURS (For Continuous Internal Assessment Only):

Prepare charts on the topic - quantity of carbohydrates, sugars and calorific values in commercially available health drinks and cool drinks, benefits and sources of essential amino acids and vitamins, uses and physiological effects of alkaloids, benefits of terpenoids present in spices, role of Beckmann rearrangement in synthesis of Nylon 66, calculation of λ max for pigments found in plant products.

REFERENCES:

1. Finar I.L., Organic Chemistry, Vol 1&2, (6th edition) England, addison Wesley Longman Ltd. (1996).
2. Morrison R.T. and Boyd R.N., Bhattacharjee S. K. Organic Chemistry (7th edition), Pearson (India)., (2011)
3. Bahl B.S. and Bahl A., Advanced Organic Chemistry, (12th edition), New Delhi, Sultan Chand & Co., (2010)
4. Pine S.H., Organic Chemistry, (5th edition) New Delhi, McGraw – Hill International Book Company (1987)
5. Seyhan N. Ege, Organic Chemistry, (5th edition) New York, Houghton Mifflin Co., (2005).
6. William Kemp, Organic Spectroscopy, 3rd edition, ELBS.
7. Introduction to Spectroscopy by Pavia, D. L. Lampman, G. M, Kriz, G. S, Vyvyan,

J.A. 5th edition, Cengage Learning, (2015)

8. Spectroscopy identification of Organic compounds, Silverstein, R. M, Webster, F. M 7th edition, CRC Press, (2015).
9. <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=13G8VouhmrFfuhs6rkiyTA==>
10. Organic spectroscopy, Sharma Y.R., S.chand& company ltd., 20th edition reprint (2007).

Course Outcomes:

Upon successful completion of this course the students would be able:

- To comprehend the properties, structure and configuration of Carbohydrates
- To explain the chemistry of Vitamins , alkaloids and terpenoids
- To predict the formation of intermediate and products in rearrangement reactions
- To Illustrate the type of electronic transitions in UV-Visible spectroscopy
- To interpret the NMR and IR spectral data to arrive the structure of molecules.

Relationship Matrix												
Semester	Course Code	Title of the Course									Hours	Credits
VI		ORGANIC CHEMISTRY- II									4	4
Course Outcomes	Programme Specific Outcomes (PSOs)										Mean Score of COs	
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10		
C01	1	3	2	2	2	1	2	2	1	2	1.8	
C02	1	3	2	2	2	1	2	2	2	2	1.9	
C03	1	3	3	3	2	1	2	3	2	2	2.2	
C04	1	3	2	3	3	1	3	2	2	2	2.2	
C05	1	3	3	3	3	1	3	3	3	2	2.5	
Mean Overall Score											2.12 (Medium)	

COURSE OBJECTIVES:

- To learn the various concepts of electrochemistry.
- To know the types and theories of catalysis.
- To learn the adsorption isotherms.
- To know the spectroscopic techniques such as IR, UV-visible, Raman and NMR.

UNIT – I ELECTRICAL CONDUCTANCE

- 1.1 Conductance in metal and in electrolytic solution- specific conductance and equivalent conductance. Arrhenius theory of electrolytic dissociation and its limitation. Weak and strong electrolyte according to Arrhenius theory. Ostwald's dilution law- Derivation, applications and limitation.
- 1.2 Effect of dilution on equivalent conductance and specific conductance. Kohlrausch's law and its applications. The elementary treatment of the Debye- Huckel- Onsager equation for strong electrolytes-evidence for ionic atmosphere.
- 1.3 Transport number and Hittorf's rule. Determination of transport number by Hittorf's method and moving boundary method.
- 1.4 Application of conductance measurements- conductometric titrations.

UNIT – II ELECTROCHEMICAL CELLS

- 2.1 Galvanic cells - reversible and irreversible cells. Conventional representation of electrochemical cells. Electromotive force of a cell and its measurement – computation of E.M.F.– calculation of thermodynamic quantities of cell reactions (ΔG , ΔH , ΔS and K).
- 2.2 Types of reversible electrodes- gas/metal ion- metal/metal ion, metal/insoluble salt/anion and redox electrodes, electrode reactions.
- 2.3 Nernst equation – derivation of cell E. M. F and single electrode potential – standard hydrogen electrode- reference electrodes- standard electrode potentials-sign convention- electrochemical series and its significance.
- 2.4 Potentiometric titrations -Acid-Base titrations- Oxidation-reduction (Redox) titrations- Precipitation titrations. Corrosion- general and electrochemical theory – passivity-prevention of corrosion.

UNIT – III CATALYSIS AND SURFACE PHENOMENA

- 3.1 Catalyst-Definition and Characteristics - Types of catalysis-Homogeneous and heterogeneous, induced, auto, positive and negative catalysis, catalytic

poisons and catalytic promoters.

- 3.2 Enzyme catalysis – Michaelis-menten equation and Michaelis-menten law.
- 3.3 Adsorption-types-chemical and physical, characteristics of adsorption. Theories of catalysis- intermediate compound formation theory and adsorption theory. Different types of isomerism -Freundlich and Langmuir adsorption isomerism.

UNIT – IV SPECTROSCOPY-I

- 4.1 Electromagnetic spectrum- the region of various types of spectra. Microwave spectroscopy- rotational spectra of diatomic molecules treated as rigid rotator, condition for a molecule to be active in microwave region.
- 4.2 Rotational constants (B) and selection rules for rotational transition. Frequency of spectral lines, calculation of inter-nuclear distance in diatomic molecules.
- 4.3 Infrared spectroscopy- vibrations of diatomic molecule- harmonic oscillators, zero-point energy, dissociation energy and force constant, condition for molecule to be active in the IR region, selection rules for vibrational transition, fundamental bands, overtones and hot bands.
- 4.4 UV- Visible spectroscopy conditions, Franck-Condon principle, pre-dissociation-applications.

UNIT – V SPECTROSCOPY-II

- 5.1 Raman spectroscopy – Rayleigh scattering and Raman scattering. Stokes and anti-stokes lines in Raman spectra, Raman frequency, quantum theory of Raman effect, conditions for a molecule to be Raman active.
- 5.2 Comparison of Raman and IR spectra – structural determination from Raman and IR spectroscopy, rule of mutual exclusion.
- 5.3 NMR spectroscopy- nuclear spin and conditions for a molecule to give rise to NMR spectrum – theory of NMR spectra, number of NMR signals, equivalent and non-equivalent protons.

UNIT – VICURRENT CONTOURS (For Continuous Internal Assessment Only):

Prepare charts on the topic - quantity of carbohydrates, sugars and calorific values in commercially available health drinks and cool drinks, benefits and sources of essential amino acids and vitamins, uses and physiological effects of alkaloids, benefits of terpenoids present in spices, role of Beckmann rearrangement in synthesis of Nylon 6-6, calculation of λ_{max} for pigments found in plant products

REFERENCES

1. B.R., Sharma L.R. and Pathania M.S. (2013), Principles of Physical Chemistry, (35th edition), New Delhi: ShobanLalNaginchand and Co.
2. Bahl B.S., ArunBahl and Tuli G.D. (2012). Essentials of Physical Chemistry, New Delhi: Sultan Chand and Sons.
3. Moore W. J. (1972), Physical chemistry, 5th Edition, Orient Longman Ltd.
4. Glasstone S. and Lewis D., Elements of Physical Chemistry, London, Mac Millan& Co Ltd.
5. Colin Bannwell N and Elaine Mc Cash M, Fundamentals of molecular spectroscopy, 4th edition, McGraw hill publishing company limited.
6. Russell S. Drago, (1978), Physical methods in Inorganic chemistry, East-west student edition.
7. <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=13G8VouhmrFfuhs6rkiyTA==>
8. [https://oms.bdu.ac.in/ec/courses.php?subject=B.Sc.%20\(CHEMISTRY\)](https://oms.bdu.ac.in/ec/courses.php?subject=B.Sc.%20(CHEMISTRY))

Course Outcomes

Upon successful completion of this course the students would be able:

- To explain the concepts of Electrochemistry and its applications
- To demonstrate the construction of different kinds of electrochemical cells
- To explain the factors influencing enzyme catalysis
- To predict the nature of adsorption using Langmuir adsorption isotherm
- To identify the functional groups and structure of simple molecules using IR and NMR spectra

Relationship Matrix												
Semester	Course Code	Title of the Course									Hours	Credits
VI		CORE COURSE X PHYSICAL CHEMISTRY II									5	4
Course Outcomes	Programme Specific Outcomes (PSOs)										Mean Score of COs	
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10		
CO1	1	3	2	2	3	1	2	2	2	2	2.0	
CO2	1	3	2	2	3	1	3	2	2	2	2.1	
CO3	1	3	2	2	3	1	2	2	2	2	2.0	
CO4	1	3	3	3	2	1	2	3	2	2	2.2	
CO5	1	3	3	3	3	1	3	3	3	2	2.5	
Mean Overall Score											2.16 (Medium)	

COURSE OBJECTIVES:

- To know the fundamentals of nuclear chemistry.
- To understand the applications of nuclear chemistry.
- To study the metallic bond, theories and applications.
- To understand the applications of inorganic polymers.

UNIT- INUCLEAR CHEMISTRY-I

- 1.1 Introduction, nuclear structure – composition of the nucleus, subatomic particles, nuclear forces, nuclear stability – mass defect and binding energy, whole number rule and packing fraction, n-p ratio, odd even rules, nuclear models – liquid drop and shell models, isobars, isotones and isomers.
- 1.2 Isotopes – detection, physical and chemical methods of separation, isotopic constitution of elements.
- 1.3 Radioactivity – introduction – radioactive emanations – characteristics of α , β and γ -rays, disintegration theory, modes of decay-group displacement law, rate of integration and half-life period, disintegration series, Geiger- Nuttal rule.

UNIT- IINUCLEAR CHEMISTRY-II

- 2.1 Detection and measurement of radioactivity – Wilson cloud chamber, Geiger – Muller counter.
- 2.2 Particle accelerators – linear accelerator and cyclotron.
- 2.3 Artificial radioactivity – nuclear transformation – classification of nuclear reactions, fission – atom bomb, fusion – hydrogen bomb, Stellar energy – nuclear reactor – atomic power projects in India.
- 2.4 Applications of radioisotopes as tracers in reaction mechanism, medicine, agriculture, industry and carbon dating. Hazards of radiations.

UNIT – IIIMETALLIC STATE

- 3.1 Metallic bond: Packing of atoms in metals (BCC, CCP, HCP) electron gas, Pauling and band theories, structure of alloys, substitutional and interstitial solid solutions, Hume-Rothery ratios, crystal defects –stoichiometric and non- stoichiometric defects.
- 3.2 Semiconductors - intrinsic and extrinsic – n-type and p-type. Composition, properties, structure and uses in electronic industry.

UNIT – IV INORGANIC POLYMERS AND THERMO ANALYTICAL METHODS:

- 4.1 Inorganic polymers – coordination polymers, metal alkyls, phosphonitrilic polymers.
- 4.2 Silicates – classification into discrete anions – one, two- and three-dimensional structures with typical examples.
- 4.3 Composition, properties and uses of beryl, asbestos, talc, mica, feldspar and zeolite.

UNIT – V INDUSTRIAL CHEMISTRY

- 5.1 Gaseous fuels: Natural gas, gobar gas, water gas, semi water gas, carbureted water gas, producer gas and liquified petroleum gas (LPG) – composition, manufacture and applications.
- 5.2 Fertilizers: Manufacture of nitrogen, phosphorus, potassium and mixed fertilizers, micro nutrients and their role in plant life.
- 5.3 Safety matches: Introduction, raw materials and manufacturing method.
- 5.4 Paints and varnishes: Definition, types and composition.
- 5.5 Glass: Composition, manufacture, types and uses.
- 5.6 Cement: Manufacture – wet and dry processes, composition and setting of cement.

UNIT- VI CURRENT CONTOURS (For Continuous Internal Assessment Only):

General quiz/Assignment/Seminar on –Environmental impact of fertilizers, plastics and petroleum refining industries-global warming, ozone layer depletion, smog, fog and acid rain. Case studies on accidents in nuclear and chemical industries.

REFERENCES:

1. R.D. Madan, “Modern Inorganic Chemistry”, 2nd edition, S. Chand & Company Ltd., 2000.
2. Gilreath, ‘Fundamental concepts of Inorganic Chemistry’, 18th Printing, McGraw Hill International Book Company, 1985.
3. S. Glasstone, ‘Source book on Atomic Energy’, East-West Press, 1967.
4. R.Gopalan, P.S. Subramanian and K. Rengarajan, ‘Elements of Analytical Chemistry’, Sultan Chand & Sons, 2nd edition, 1991.
5. P.L.Soni, ‘Text Book of Inorganic Chemistry’, 20th revised edition, Sultan Chand & Sons, 2000.
6. <https://www.uou.ac.in/sites/default/files/slm/BSCCH-301.pdf>
7. https://zbphysik.univie.ac.at/broda/dokumente/160-Nuclear_Chemistry.pdf
8. Atkins, P.W. Physical Chemistry. Oxford, UK. Oxford University press, 8th Edition. (2008).
9. Puri, Sharma, Pathania, Principle of Physical Chemistry. Jalandhar, India. Vishal publication & Co. 47th Edition (2019).

10. <https://www.ebooknetworking.net/ebooks/industrial-chemistry-bk-sharma.html>

COURSE OUTCOMES:

Upon successful completion of this course the students would be able:

- To identify the mechanisms and characteristics of radioactive decays.
- To describe the electronic structure of atoms of important semiconductors (Si, Ge, Ga, As) and to distinguish between *intrinsic* and *extrinsic* semiconductors,
- To explain the origin of energy gap
- To apply nuclear chemistry in medicine, energy production, environmental protection.
- To classify and compare the structure, composition of silicates and fuels.

Relationship Matrix											
Semester	Course Code	Title of the Course								Hours	Credits
VI		INORGANIC CHEMISTRY-II								5	4
Course Outcomes	Programme Specific Outcomes (PSOs)										Mean Score of COs
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	
CO1	-	3	2	2	3	-	2	2	2	1	2.13
CO2	-	3	2	3	2	-	2	3	1	1	2.13
CO3	-	3	2	3	2	-	2	3	1	1	2.13
CO4	1	3	3	2	3	2	2	3	3	2	2.40
CO5	-	3	2	2	2	-	2	2	1	1	1.88
Mean Overall Score											2.13 (Medium)

The candidate shall be required to take up a Project Work by group or individual and submit it at the end of the final year. The Head of the Department shall assign the Guide who, in turn, will suggest the Project Work to the students in the beginning of the final year. A copy of the Project Report will be submitted to the University through the Head of the Department on or before the date fixed by the University.

The Project will be evaluated by an internal and an external examiner nominated by the University. The candidate concerned will have to defend his/her Project through a Viva-voce.

ASSESSMENT/EVALUATION/VIVA VOCE:

2. PROJECT REPORT EVALUATION (Both Internal & External)

I. Plan of the Project - 20 marks

II. Execution of the Plan/collection of Data / Organisation of Materials / Hypothesis, Testing etc. and presentation of the report. - 45 marks

III. Individual initiative - 15 marks

3. Viva-Voce / Internal & External - 20 marks

TOTAL - 100 marks

PASSING MINIMUM:

Project	Vivo-Voce 20 Marks 40% out of 20 Marks (i.e. 8 Marks)	Dissertation 80 Marks 40% out of 80 marks (i.e. 32 marks)
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A candidate who gets less than 40% in the Project must resubmit the Project Report. Such candidates need to defend the resubmitted Project at the Viva-voce within a month. A maximum of 2 chances will be given to the candidate.

COURSE OBJECTIVES:

- To know the chemistry of polymers.
- To study the importance of polymers.
- To study the concepts of polymerization techniques.

UNIT – I INTRODUCTION TO POLYMERS AND RUBBERS

Basics of polymers – monomers and polymers - definition.classification of polymers on the basis applications - thermosetting and thermoplastics – distinction among plastics.Functionality-Copolymers.Degree of polymerization. Types of polymerization reactions – chain polymerization - free radical and ionic polymerization – coordination and step polymerization reactions- polyaddition and polycondensation – miscellaneous reactions: ring- opening and group transfer polymerization. Basics of rubbers: types - vulcanization of rubber-ebonite- uses of rubbers.

UNIT – II PROPERTIES AND REACTIONS OF POLYMERS

Properties: Glass transition temperature (T_g) -definition – factors affecting T_g . Relationship between T_g and molecular weight. Importance of T_g . Molecular weight of polymers: number average (M_n), weight average (M_w), sedimentation and viscosity average molecular weights. Reactions: Hydrolysis – hydrogenation – addition – substitutions – cross linking and cyclisations reaction. Polymer degradation- thermal, photo and oxidation degradation of polymers (basics only).

UNIT – III POLYMERIZATION TECHNIQUES AND MOULDING TECHNIQUE

Polymerization techniques: bulk, solution, emulsion, melt condensation and interfacial polycondensation polymerization. Moulding technique: Injection, compression, extrusion, rotational and calendaring.

UNIT – IV CHEMISTRY OF COMMERCIAL POLYMERS:

Preparation, properties and uses of the polymers: Polyethylene, polypropylene, polystyrene, PVC, teflon and polymethylmethacrylate, polycarbonate, polyurethanes, polyamides (Kevlar), phenol-formaldehyde,

urea-formaldehyde resin, epoxy resins, rubber-styrene and neoprene rubbers.

UNIT – V ADVANCES IN POLYMERS

Biopolymers – biomaterials. Polymers in medical field - High temperature and fire – resistant polymers. Silicones - conducting polymers- carbon fibers. (basic idea only) and polymer composites.

UNIT – VI CURRENT CONTOURS (For Continuous Internal Assessment Only):

Assignment and seminar on managing plastic wastes - storing, recycling and disposal methods of plastic wastes – challenges and opportunity in recycling of plastics - case studies on environmental impacts of plastic wastes.

REFERENCES:

2. Billmeyer F.W., Text book of polymer science, Jr. John Wiley and Sons, 1984.
3. Gowariker V.R., Viswanathan N.V. and Jayadev Sreedhar, Polymer Science, Wiley Eastern Ltd., New Delhi, 1978.
4. Sharma, B.K., Polymer Chemistry, Goel Publishing House, Meerut, 1989.
5. Arora M.G., Singh M. and Yadav M.S., Polymer Chemistry, 2nd

Revised edition, Anmol Publications Private Ltd., New Delhi, 1989.

6. <http://web.mit.edu/5.33/www/lec/poly.pdf>

COURSE OUTCOMES:

Upon successful completion of this course the students would be able:

- To compare thermoplastics and thermosetting polymers.
- To predict the various mechanism of polymerization
- To describe various techniques of polymerization
- To relate the glass transition temperature and molecular mass of the polymers.
- To explain the synthesis of commercially important polymers and the applications of biopolymers in medical field

Relationship Matrix												
Semester	Cou rse Cod e	Title of the Course									Hours	Credits
6		SKILL ENHANCEMENT COURSE- VI POLYMER CHEMISTRY									2	2
Course Outcomes	Programme Specific Outcomes (PSOs)										Mean Score of COs	
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10		
C01	-	3	2	2	3	-	2	2	2	1	2.13	
C02	-	3	2	3	2	-	2	3	1	1	2.13	
C03	-	3	2	3	2	-	2	3	1	1	2.13	
C04	1	3	3	2	3	2	2	3	3	2	2.40	
C05	-	3	2	2	2	-	2	2	1	1	1.88	
Mean Overall Score											2.13 (Medium)	

COURSE OBJECTIVES

- To provide fundamental knowledge of plant secondary metabolites and their classification.
- To understand qualitative and quantitative phytochemical screening methods.
- To introduce modern analytical techniques used in phytochemical analysis.
- To develop skills in extraction, isolation, and characterization of bioactive compounds.
- To familiarize students with applications of phytochemicals in pharmaceuticals and research.

UNIT - I INTRODUCTION TO PHYTOCHEMICALS

Definition, scope, and importance of phytochemistry, Classification of phytochemicals- alkaloids, flavonoids, tannins, terpenoids, glycosides, saponins, phenolics, Biosynthesis of secondary metabolites, Role of phytochemicals in plant defense and human health.

UNIT - II EXTRACTION AND PRELIMINARY SCREENING

Principles of extraction: maceration, percolation, Soxhlet extraction, steam distillation

Selection of solvents and extraction conditions, Preparation of plant extracts, Qualitative phytochemical screening tests for major classes (alkaloids, flavonoids, tannins), Thin Layer Chromatography (TLC) for preliminary analysis

UNIT- III QUANTITATIVE ANALYSIS OF PHYTOCHEMICALS

Estimation of total phenolics, flavonoids, tannins, alkaloids, Spectrophotometric methods and calibration curves, Gravimetric and volumetric methods, Standardization and validation of analytical procedures, Factors affecting quantitative analysis

UNIT- IV ADVANCED ANALYTICAL TECHNIQUES

Chromatographic techniques- Column chromatography, Gas Chromatography (GC), High Performance Liquid Chromatography (HPLC), Spectroscopic techniques-UV-Visible spectroscopy, Infrared (IR) spectroscopy, Nuclear Magnetic Resonance (NMR) spectroscopy, Mass spectrometry (MS), Hyphenated techniques (GC-MS, LC-MS)

UNIT -V ISOLATION, CHARACTERIZATION AND APPLICATIONS

Isolation and purification of phytochemicals, Structure elucidation using spectral data, Bioassay-guided fractionation, Applications in pharmaceuticals, nutraceuticals and cosmetics, Quality control of herbal drugs and regulatory aspects.

Unit -VI Current Contours (Self-Directed Learning Activities for Continuous InternalAssessment Only)

Literature Review and Seminar-Critical review of recent research articles from peer-reviewed journals on phytochemical analysis, Field Work / Survey-Collection and identification of medicinal plants from local regions, Ethnobotanical survey to document traditional uses of plants, Preparation of herbarium sheets and plant authentication records, Data Analysis and Interpretation-Interpretation of spectral data (UV, IR, NMR, MS) from published datasets, Development of calibration curves and quantitative estimations using software tools, Statistical analysis and validation of experimental data.

REFERENCES

1. Harborne, J.B. – Phytochemical Methods: A Guide to Modern Techniques of Plant Analysis
2. Trease, G.E. & Evans, W.C. – Pharmacognosy
3. Wagner, H. &Bladt, S. – Plant Drug Analysis: A Thin Layer Chromatography Atlas
4. Sethi, P.D. – HPLC: Quantitative Analysis of Pharmaceutical Formulations
5. Dewick, P.M. – Medicinal Natural Products: A Biosynthetic Approach
6. Kokate, C.K., Purohit, A.P., Gokhale, S.B. – Pharmacognosy
7. Stahl, E. – Thin Layer Chromatography: A Laboratory Handbook

Course Outcomes

Upon completion of the course, students will be able to

- Classify and describe major groups of phytochemicals and their biological significance.
- Perform qualitative and quantitative screening of plant constituents.
- Apply appropriate extraction and isolation techniques for phytochemicals.
- Utilize analytical instruments such as chromatography and spectroscopy for compound identification.
- Interpret analytical data and evaluate phytochemical profiles for research and industrial applications.

Relationship Matrix											
Semester	Cours e Code	Title of the Course								Hours	Credits
VI		SKILL ENHANCEMENT COURSE- VII PHYTOCHEMICAL SCREENING AND ANALYSIS TECHNIQUES								2	2
Course Outcomes	Programme Specific Outcomes (PSOs)										Mean Score of COs
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	
CO1	—	3	2	2	2	—	1	2	1	1	1.75
CO2	—	3	3	3	3	—	2	3	2	1	2.50
CO3	—	3	2	2	3	1	2	2	2	1	2.00
CO4	—	3	2	3	3	—	2	3	2	1	2.38
CO5	1	3	2	2	3	2	2	3	3	2	2.30
Mean Overall Score											2.19 (Medium)
