UG SYLLABUS
DIGBOI COLLEGE (AUTONOMOUS)
FYUGP 2025

B.Sc. in CHEMISTRY (NEP 2020)

Approved in BOS, Chemistry held on 17/05/2025

1. THE PREAMBLE

The primary aim of education is to develop an individual into an intellectual human being through moral, spiritual, and cultural development. It also aims to the acquirement of understanding, skills, and attitudes to fine-tune properly to one's environment. In addition to the societal development, education also has the responsibility of developing basic competencies such as communication skills required to express thoughts and ideas efficiently, and presenting information and its explanations in an organized manner. Change is inevitable. With constantly progressing society, the nature and scope of education also gets modified and widen. Educators and educational practitioners should also alter the aims and objectives of education policy accordingly. The main intention of the Undergraduate Programme in Chemistry is to equip students with basic-level to high-level Chemistry which connects the research and post-graduate program. Major efforts are made via the curriculum to motivate students to pursue research in Chemistry. Due importance is also given to the study of application and skill oriented topics which is very much relevant and useful to the present scenario.

2. INTRODUCTION

Undergraduate programmes had certain drawbacks like the rigidness in selecting subjects, all-round development, skill based knowledge, and lack of research but the National Education Policy-2020 (NEP-2020) has shaped and presented better framework of the curriculum. Significant importance has been given to the role of higher education in promoting personal along with societal well-being in NEP- 2020. NEP 2020 aspire quality higher education to develop good, well-rounded, creative, and thoughtful individuals. To make the curriculum relevant to modern day society, it has integrated the humanities and arts with Science, Technology, Engineering and Mathematics (STEM). The Bachelor of Science in Chemistry degree (FYUGP) of Digboi College (Autonomus) adapted as per the recommendations of NEP 2020 will be of either a three or four-year duration, with multiple exit options within the period with appropriate certification. On completion of one year a UG certificate, completion of two years a UG diploma, and after completion of three years, a Bachelor's degree in the programme will be provided to the students. The four-year undergraduate programme in chemistry will allow the student an opportunity to learn problem solving abilities, communication skills, more in-depth learning, as well as increased creativity aiming the full range of holistic and multidisciplinary education.

3. AIMS OF FOUR YEAR UNDER-GRADUATE PROGRAMME (FYUGP) IN CHEMISTRY:

The aims of the Four Year Under-Graduate Programme (FYUGP) in Chemistry are:

1. To enable the students with the potential to adapt to academic and industrial environments.
2. To provide knowledge in fundamental aspects of various branches of Chemistry.
3. To be able to apply the concepts and standard methodologies to solve problems related to Chemistry.
4. To prepare students for higher education, advanced research and a career in Chemistry.
5. To provide laboratory skills, viz. proper handling of apparatus, chemicals, and experimental techniques.
6. To make students enable to apply chemistry in their day-to-day life.
7. To generate responsible citizens by creating environmental awareness.

4. PROGRAMME LEARNING OUTCOMES

At the completion of the programme an undergraduate student of Chemistry should be able to:

1. Understand the basic principles of various branches of Chemistry.
2. get equipped with practical skills to conduct and infer experiments independently and in groups.
3. Apply the key concepts and standard methodologies to solve problems related to Chemistry.

4. Apply methodologies to the solution of unfamiliar types of problems.

5. Exhibit skills leading to employability in Chemistry and allied industries.

6. Comprehend the fundamental aspects of research in Chemistry.

7. To gather proficiency in the subject required for post-graduation as well as for pursuing research in Chemistry and related interdisciplinary subjects.

8. Demonstrate teaching competencies required for keeping oneself professionally engaged.

5. TEACHING LEARNING PROCESS

The programme allows using of varied pedagogical methods and techniques both within the classroom and in laboratories that includes

- Lecture
- Tutorial
- PowerPoint presentation
- Project Work/Dissertation
- Seminars/workshops/conferences
- IndustryVisits/Field Visits and Report

6. TEACHING LEARNING TOOLS

- White/Green/Black Board
- LCD projectors/Monitor
- Smart Board¬ Model Demonstration
- Learning through lab experiments
- Industry and research visits

7. ASSESSMENT

- Home assignment
- Project Report
- Seminar Presentation
- Objective /MCQ test
- In semester examinations (Theory and Practical)
- End Semester examinations (Theory and Practical)
- Viva-voce

FYUGP Structureas per UGC Credit Framework

Year	Semester	Course	Title of the Course	Paper Code	Credit	Total Credit
Year 01	1st Semester	C 101	Chemistry C1: Inorganic+Physical + Organic	C-CHM-101	3	4
			Practical	C-CHM-101 Lab	1	
		Minor 101	Fundamentals of Chemistry-1	MIN-CHM-101	3	4
			Practical	MIN-CHM-101Lab	1	
		MDC 101	Chemistry in Daily Life-1	MDC-CHM-101	3	3
		AEC 101	Modern Indian Language	*	4	4
		SEC 101	Basic Analytical Chemistry-1	SEC-CHM-101	2	3
			Practical	SEC-CHM-101 Lab	1	
		VAC 101		*	2	2
	Total				20	20
	2nd Semester	C 202	Chemistry C2: Inorganic+Physical + Organic	C-CHM -202	3	4
			Practical	C-CHM-202 Lab	1	
		Minor 202	Fundamentals of Chemistry-2	MIN-CHM-202	3	4
			Practical	MIN-CHM-202- Lab	1	
		MDC 202	Chemistry in Daily Life-2	MDC-CHM-202	3	3
		AEC 202	English Language and Communication Skills	*	4	4
		SEC 202	Basic Analytical Chemistry-2	SEC-CHM-202	2	3
			Practical	SEC-CHM-202 Lab	1	
		VAC 202		*	2	2
		Total			20	20
Grand Total (Semester I and II)					**40**	**40**
The students on exit shall be awarded an *Undergraduate Certificate* (in the Field of Study/Discipline) after securing the requisite *40 Credits in Semesters 1 and 2* provided they secure 4 credits in work based vocational courses offered during the summer term or internship/Apprenticeship in addition to 6 credits from skill based courses earned during 1st and 2nd Semester						
Year	**Semester**	**Course**	**Title of theCourse**	**PaperCode**	**Credit**	**Total Credit**
	3rd Semester	C -303	Chemistry C3: Inorganic+Physical + Organic	C-CHM-303	3	4
			Practical	C-CHM-303 Lab	1	
		C -304	Chemistry C4: Inorganic+Physical + Organic Inorganic+Physical +	C-CHM-304	3	4

Year 02			Practical	C-CHM-304 Lab	1	
		Minor-303	Fundamentals of Chemistry-3	MIN-CHM-303	3	4
			Practical	MIN-CHM-303 Lab	1	
		MDC -303	Chemistry in Daily Life-3	MDC-CHM-303	3	3
		SEC -303	Industrial Chemistry of petrochemicals and polymer products	SEC-CHM-303	2	3
			Practical	SEC-CHM-303 Lab	1	
		VAC-303		*	2	2
	Total				20	20
	4th Semester	C -405	Chemistry C5: Inorganic Chemistry	C-CHM-405	3	4
			Practical	C-CHM-405 Lab	1	
		C -406	Chemistry C6: Physical Chemistry	C-CHM-406	3	4
			Practical	C-CHM-406 Lab	1	
		C -407	Chemistry C7: Organic Chemistry	C-CHM-407	3	4
			Practical	C-CHM-407 Lab	1	
		C -408	Chemistry C8: Symmetry & Quantum Chemistry	C-CHM -408	3	4
			Practical	C-CHM-408 Lab	1	
		Minor-404	Fundamentals of Chemistry-4	MIN-CHM-404	3	4
			Practical	MIN-CHM-404 Lab	1	
		Total	20		20	20
	Grand Total (Semester I, II, III and IV)				**80**	**80**

Abbreviations Used:

- **C = Core/Major**
- **MDC = Multi Disciplinary (Generic Elective) Course**
- **AEC=Ability Enhancement Course**
- **SEC=Skill Enhancement Course**
- **VAC= Value Added Course**
- **CHM = Chemistry**
- **MIN= Minor**

Table1:Credit Distribution matrix of FYUGP (Single Major)										
Year	**Semester**	**Core**	**Minor**	**MDC**	**AEC**	**SEC**	**Internship/ Community Engagement/ Project**	**VAC**	**Research/ Dissertation/**	**Total**
1	I	4	4	3	4	3		2		20
	II	4	4	3	4	3		2		20
UG Certificate										**40**
2	III	4+4	4	3		3		2		20
	IV	4+4+4+4	4							20
UG Diploma		**32**	**16**	**09**	**08**	**09**		**06**		**80**

Exit Options and Degree Structure for UG Programme

The Four-Year Undergraduate Programme (FYUGP), aligned with the NEP 2020, offers a flexible exit option structure for its UG programmes, catering to diverse student needs and ensuring academic and professional mobility. Students can exit after completing one year (40 credits, including a 4-credit IAPC within 1 year of last Even End-Sem exam) to earn an Undergraduate Certificate. After two years (80 credits, including another 4-credit IAPC), they can exit with an Undergraduate Diploma. Completion of three years (120 credits) grants a 3-Year UG Degree, provided all credit requirements are met. For those pursuing the full four years (160 credits), a 4-Year UG Degree (Honours) is awarded upon satisfying major credit requirements. Additionally, students achieving a minimum of 75% marks or a CGPA of 7.5 across the first three years can opt for a 4-Year UG Degree (Honours with Research), which includes 12 research credits and a mandatory research project or dissertation. This multi-exit framework, supported by the Academic Bank of Credits (ABC), allows students to accumulate and transfer credits, facilitating lifelong learning and seamless re-entry into the program within specified timeframes, such as three years for re-entry after obtaining a certificate or diploma, and up to seven years to complete the Honours or Honours with Research degrees.

EXIT LEVEL	DURATION	CREDITS EARNED	ADDITIONAL REQUIREMENT/ MARKS
UG CERTIFICATE	1 year	40 Credits	1 IAPC (4 credits) within 1 year of last Even End Sem exam
UG DIPLOMA	2 years	80 Credits	1 IAPC (4 credits) within 1 year of last Even End Sem exam
3 YR UG DEGREE	3 years	120 Credits	Must satisfy major credit requirements. IAPC in Summer Break
4 YR UG DEGREE (HONOURS)	4 years	160 Credits	Must satisfy major credit requirements
4 YR UG DEGREE (HONOURS WITH RESEARCH)	4 years	160 Credits (including 12 research credits)	75%+ marks in first 3 years + Research Project

FYUGP
DETAILED SYLLABUS OF 1st SEMESTER

Title of the Course	**:**	**Chemistry C1: Inorganic+Physical+Organic**
Course Code	**:**	**C-101**
Nature of the Course	**:**	**CHEMISTRY MAJOR**
Total Credits	**:**	**3**
DistributionofMarks	**:**	**45 (End Sem) + 40 (In-Sem)**

COURSE OBJECTIVES:

- To develop idea about the basic knowledge of chemistry in inorganic, organic and physical chemistry

UNITS	CONTENTS	L	T	P	Total Hours
I	**Periodic properties:** Effective nuclear charge (screening constant – Slater's rule only), ionic and covalent radii, ionization potential, electron affinity and electronegativity (Pauling, Mulliken's and Allred-Rochow Scales).	**04**	**0**	**-**	**04**
	Bonding and structure: Ionic Bonding: Energy consideration in ionic bonding, lattice Energy. Born - Haber cycle and its application, polarizing power and polarizability. Fajan's rule, Bond moment, dipole moment and percentage ionic character. Hydrogen Bonding. Covalent Bonding: VB Approach-Concept of hybridization (sp, sp^2, sp^3, sp^3d, sp^3d^2 and dsp^2). VSEPR Theory. Resonance and Resonance energy: Study of some inorganic and organic compounds (O_3, NO_3^- , CO_3^{2-}, SO_4^{2-}, $RCOO^-$, C_6H_6). Co-ordinate or Dative Bond. Bonding and antibonding MOs and their characteristics for s-s, s-p and p-p combination of atomic orbitals non-bonding combination of orbitals, MO treatment of homonuclear diatomic molecules and heteronuclear diatomic molecules such as CO, NO and NO^+	**08**	**0**	**-**	**08**
II	**Gas:** Derivation of kinetic gas equation, Maxwell distribution of molecular speed, different types of speeds, collision properties, Mean free path, determination of collision diameter, transport phenomenon in gases, coefficient of viscosity, law of equipartition of energy, degrees of freedom and average energy of a molecule, molecular basis of heat capacity, barometric formula and its uses for Determination of Avogadro number. Deviation from ideal behavior, van der Waals and Dieterici's, Virial	**09**	**0**	**-**	**09**

	Equation of state, Boyle's temperature, Critical constants, reduced equation of state, co-efficient of compressibility and thermal expansion. **Liquid:** Qualitative treatment of the structure of liquids, physical properties of liquids, vapour pressure, surface tension-Explanation of cleansing action of detergents, parachor-determination and application, viscosity, Newtonian and non-Newtonian liquid, liquid crystals.	**06**	**0**		**06**
III	**Basics of Organic Chemistry:** Organic Compounds: classification and Nomenclature. Hybridization: Shape of molecules, Influence of hybridization on bond properties. Electronic displacements: Inductive, Electromeric, Resonance, Mesomeric effects and Hyper conjugation and their applications. Dipole moment. Organic acids and bases: Their relative strength, Homolytic and Heterolytic fission, Electrophiles and Nucleophiles: Nucleophilicity and basicity. Reactive intermediates: Carbocations, carbanions, free radicals, carbenes, nitrenes, Types, Shape and their relative Stability. Energy profile diagrams of one step, two steps and three steps reactions, Rate limiting steps. Activation Energy. Kinetically and thermodynamically controlled reactions.	**08**	**0**	**-**	**08**
	Stereochemistry: Elements of symmetry and their application in simple organic molecules. Definition and classification of stereoisomerism, Representation of organic molecules inthree&twodimensions: Fischer Projection, Newman projection, Sawhorse and flying wedge projection formula and their interconversions. **Optical isomerism**: Concepts of asymmetry, dissymmetry, optical activity, Specific rotation, Chirality, enantiomers, Diastereomers, racemic mixture, racemization and Resolution, Threo and Erythro forms, Meso structures & Epimers. Relative and absolute configuration: D/L and R/S designations. Walden inversion. **Geometrical Isomerism**: Restricted rotation about C=C bonds, physical and chemical properties of diasteroisomers, determination of configuration of geometrical isomers: cis-trans isomerism, syn-anti and E/Znotation with CIP rules. Geometrical isomerism in oximes and alicyclic compounds.	**10**	**0**	**-**	**10**

Where, ***L: Lectures*** ***T: Tutorials*** ***P: Practicals***

MODES OF IN-SEMESTERASSESSMENT: **40 Marks**

- Two Internal Examinations - 20 Marks
- Others - 20 Marks
    - Home Assignment
    - Seminar presentation on any of the relevant topics

FYUGP

DETAILED SYLLABUS OF 1st SEMESTER

Title of the Course : Chemistry C1 Lab
Course Code : C-101 Lab
Nature of the Course : CHEMISTRY MAJOR
Total Credits : 1
Distribution of Marks : 15

Sl No	EXPERIMENTALWORK (anyone)	Marks
I	(i) Determination of the surface tension of various liquids by drop number method. (ii) Determination of the viscosity of aqueous solutions at room temperature. (iii) Study the variation of surface tension of detergent solutions with concentration. (iv) Determination of viscosity of aqueous solutions of (a) polymer (b) ethanol and (c) sugar at room temperature.	**12**
II	**Viva-Voce**	**03**

COURSE OUTCOMES:
By the completion of this course, students will be able to:

CO1: Acquire a solid understanding of fundamental concepts in periodic properties, bonding, gas and liquid properties, organic chemistry, and stereochemistry.
CO2: Apply theoretical knowledge to solve problems and predict chemical behavior.
CO3: Perform experimental techniques proficiently, analyze data, and draw accurate conclusions.
CO4: Measure surface tension and viscosity which will improve problem-solving and technical abilities in analytical techniques.

Cognitive map of course outcomes with Bloom'sTaxonomy:

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1	CO2	CO3		
Procedural					CO4	
Metacognitive						

TEXT BOOKS:

1. Inorganic Chemistry–J.E. Huheey, E. A. Keiter, R. L. Keiter and O.K. Medhi; (Pearson), 4th Edition, 2006.
2. Inorganic Chemistry–Puri, Sharma and Kalia (Milestone), 1st Edition, 2007-2008.
3. Principles of Physical Chemistry, Puri, Sharma, Pathania (Vishal), 47th Edition, 2018.
4. A Text Book of Physical Chemistry–Negi &S.C.Anand, (New Age), 2nd Edition, 2005.
5. Organic Chemistry–B.S.Bahl and, A. Bahl (Vol. I&II) (S Chand), 2nd Edition, 2015.

6. Advanced General Organic Chemistry (Part I and Part II)-S. C.Ghosh (NCBA) 3rd Edition, 2019.

REFERENCE BOOKS:

1. Selected Topics in InorganicChemistry—Wahid U. Malik, G.D.Tuli and R.D.Madan. (S. Chand & Co. Ltd.)
2. Advanced Inorganic Chemistry–Satyaprakash, Basu, Tuli
3. Inorganic Chemistry–J.D.Lee
4. Basic Inorganic chemistry–Cotton and Wilkinson
5. Physical Chemistry--Atkins, P.W. & Paula, J.
6. Physical Chemistry, Castellan G.W., Narosa Publishing
7. Physical Chemistry–P.W.Atkins,Oxford UniversityPress
8. Advanced Physical Chemistry–J.N. Gurta & H. Snehi, Pragati Prakashan
9. OrganicChemistry–M.K.Jain, S.Chand & Co.
10. A Text Book of Organic Chemistry (Vol.I&II)–B.K. Sharma, G.P. Pokhriji and S.K. Sharma, (S. Chand & Co.)
11. Organic Chemistry–I.L.Finar,Vol.I&II,ELBS
12. Organic Chemistry, R.I.Morrison & R.N.Boyd,S.K. Bhattacharjee
13. Organic Chemistry–Vol.I & II, Mukherjee and Kapoor
14. Organic Chemistry (Oxford)-Clayden, Warren, Greeves and Wothers.
15. Organic Reactions and their Mechanisms (NewAgeInternational Private Limited)-P.S.Kalsi.

FYUGP
DETAILED SYLLABUS OF 1st SEMESTER

Title of the Course	**:**	**Fundamentals of Chemistry-1**
Course Code	**:**	**MIN-101**
Nature of the Course	**:**	**CHEMISTRY MINOR**
Total Credits	**:**	**3**
Distribution of Marks	**:**	**45 (EndSem) + 40 (In-Sem)**

COURSE OBJECTIVES:

- To aquire the basic knowledge of chemistry in atomic structure and bonding, To develop basic knowledge on different states of matter & their mechanical treatment; to gather preliminary knowledge in basic organic chemistry, hydrocarbons, stereochemistry & conformational analysis etc

UNITS	CONTENTS	L	T	P	Total Hours
I	**Atomic Structure:** (Review of Bohr's Theory, de Broglie Theory, Heisenberg Uncertainty Principle). Time independent Schrödinger wave equation (H=E). Significance of ¥ and ¥^{2} Schrodingerequation for Hydrogen atom (qualitative treatment only). Quantum numbers, electronic configuration of elements based upon electronic configuration in the periodic table, periodic properties-effective nuclear charge, ionization energy, electron affinity, electronegativity (Pauling, Mulliken's and Allred-Rochow scales). Redoxpotential.	**09**	**0**	**-**	**09**
	Chemical Bonding and Molecular Structure-1: Ionic Bonding: Energy consideration in ionic bonding, Lattice Energy and Solvation Energy and their importance in the context of Stability and Solubility of ionic compounds. Polarizing power and polarizability. Fajan's rule,dipole moment and Percentage ionic character. Hydrogen Bonding.	**06**	**0**	**-**	**06**
II	**Kinetic Theory of gases:** Derivation of Kinetic gas equation, Types of molecular velocities, deduction of simple problems on – root mean square speed, most probable speed, collision frequency, collision diameter, mean free path, heat capacity of gases, Deviation from ideal behavior, van der Waals equation, van der Waals constant, critical state of gas, critical constants, continuity of states, law of corresponding states, Degree of freedom, law of equipartition of energy	**11**	**0**	**-**	**11**

	(derivation not required), viscosity of gases and the effect of temperature and pressure on the coefficient of viscosity). **Liquid state**: Qualitative treatment of the structure of liquids, Physical properties of liquids, and vapour pressure. Surface tension and its determination using a stalagmometer. Viscosity of a liquid and determination of the coefficient of viscosity using the Ostwald Viscometer. Effect of temperature on surface tension and coefficient of viscosity of a liquid (qualitative treatment) Parachor-Determination and application.	**04**	**0**		**04**
III	**Introduction to Organic Chemistry:** Introduction to Organic Chemistry, Electronic displacements: Inductive effect, Electrometric effect, Resonance and hyperconjugation. Mechanism of organic reactions: Cleavage of Bonds- Homolysis and Heterolysis. Structure, shape and reactivity of organic molecules- Nucleophiles and electrophiles. Reactive Intermediates- Carbocations, carbanions, free radicals, carbenes & nitrenes. Strength of organic acids and bases: comparative.	**08**	**0**	**-**	**08**
	Aliphatic Hydrocarbons-1: ***Alkanes*** (upto 5 carbons) Preparation:- Catalytic hydrogenation, Wurtz reaction, Kolbe's Synthesis, from Grignard reagent. Corey-House Synthesis.Reactions: Free—radical Substitution: Halogenations.	**07**	**0**	**-**	**07**

Where, ***L:Lectures*** ***T:Tutorials*** ***P:Practicals***

MODES OF IN-SEMESTER ASSESSMENT: **40 Marks**

- Two Internal Examinations - 20 Marks
- Others - 20 Marks
  - Home Assignment
  - Seminar presentation on any of the relevant topics

FYUGP

DETAILED SYLLABUS OF 1st SEMESTER

Title of the Course	**:**	**Fundamentals of Chemistry-1 Lab**
Course Code	**:**	**MIN-101 Lab**
Nature of the Course	**:**	**CHEMISTRY MINOR**
Total Credits	**:**	**1**
Distribution of Marks	**:**	**15**

Sl No	Experimental Work (anyone)	Marks
I	**Surface tension/Viscosity** (i) Determine the surface tension of various liquids by drop number method. (ii) Determination of viscosity of aqueous solutions at room temperature. (iii) Study the variation of surface tension of detergent solutions with concentration. (iv) Determination of viscosity of aqueous solutions of (a) polymer (b) ethanol and (c) sugar at room temperature	**12**
	Viva –voce	**03**

COURSE OUTCOMES:

By the completion of this course, students will be able to-

CO1: Apply fundamental principles of atomic structure and chemical bondingto predict the behavior of elements and compounds.

CO2: solve the Schrödinger wave equation, determine electronic configurations, and analyze periodic properties.

CO3: Explain Schrödinger's wave equation, periodic properties, kinetic gas equation, andthe significance of electronic displacements and mechanisms in organic reactions.

CO4: Use principles of ionic bonding, kinetic theory, and organic reaction mechanisms to solve related problems and predict outcomes in practical scenarios.

CO5: Understandingthe difference between various types of molecular interactions, such as ionic bonds, hydrogen bonds, and van der Waals forces, and interpret the behavior of gases and liquids under different conditions.

CO6: Assess the stability and solubility of ionic compounds, the effects of temperature and pressure on physical properties ofliquids, and the strength oforganic acids and bases.

CO7: measure surface tension and viscosity which will improve problem-solving and technical abilities in analytical techniques.

Cognitivemapof courseoutcomeswithBloom's Taxonomy:

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual			CO6			
Conceptual		CO3, CO4,CO5		CO1		
Procedural			CO2		CO7	
Metacognitive						

TEXT BOOKS:

1. Inorganic Chemistry–J.E. Huheey, E. A. Keiter, R. L. Keiter and O.K. Medhi; (Pearson), 4th Edition, 2006.
2. Inorganic Chemistry–Puri, Sharma and Kalia (Milestone), 1st Edition, 2007-2008.
3. Principles of Physical Chemistry, Puri, Sharma, Pathania (Vishal), 47th Edition, 2018.
4. A Text Book of Physical Chemistry–Negi &S.C.Anand, (New Age), 2nd Edition, 2005.
5. Organic Chemistry–B.S.Bahl and, A. Bahl (Vol. I&II) (S Chand), 2nd Edition, 2015.
6. Advanced General Organic Chemistry (Part I and Part II)-S. C.Ghosh (NCBA) 3rd Edition, 2019.

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1. Selected Topics in InorganicChemistry—Wahid U. Malik, G.D.Tuli and R.D.Madan. (S. Chand & Co. Ltd.)
2. Advanced Inorganic Chemistry–Satyaprakash, Basu, Tuli
3. Inorganic Chemistry–J.D.Lee
4. Basic Inorganic chemistry–Cotton and Wilkinson
5. Physical Chemistry--Atkins, P.W. & Paula, J.
6. Physical Chemistry, Castellan G.W., Narosa Publishing
7. Physical Chemistry–P.W.Atkins,Oxford UniversityPress
8. Advanced Physical Chemistry–J.N. Gurta & H. Snehi, Pragati Prakashan
9. OrganicChemistry–M.K.Jain, S.Chand & Co.
10. A Text Book of Organic Chemistry (Vol.I&II)–B.K. Sharma, G.P. Pokhriji and S.K. Sharma, (S. Chand & Co.)
11. Organic Chemistry–I.L.Finar,Vol.I&II,ELBS
12. Organic Chemistry, R.I.Morrison & R.N.Boyd,S.K. Bhattacharjee
13. Organic Chemistry–Vol.I & II, Mukherjee and Kapoor
14. Organic Chemistry (Oxford)-Clayden, Warren, Greeves and Wothers.
15. Organic Reactions and their Mechanisms (NewAgeInternational Private Limited)-P.S.Kalsi.

FYUGP

DETAILED SYLLABUS OF 1st SEMESTER

Title of the Course : Chemistry in Daily Life-1
Course Code : MDC-101
Nature of the Course : CHEMISTRY MDC
Total Credits : 3
Distribution of Marks : 60 (End Sem) + 40(In-Sem)

COURSE OBJECTIVES:

- To give idea about the chemistry of some food products. This course focuses on food packaging, processing and preservation.

UNITS	CONTENTS	L	T	P	Total Hours
I	**Dairy Products:** Composition of milk and milk product. Principles of dairy safety; Milk processing. Qualitative analysis offat content, minerals in milk and butter. Qualitative analysis of caffeine in coffee and tea, detection of chicory in coffee, chloral hydrate in toddy	14	0	-	14
II	**Food additives:** Food preservatives like benzoates, propionates, sorbates, disulphites. Artificial sweeteners: Aspartame, saccharin, dulcin, sucralose, and sodium cyclamate. Flavors: Vanillin, alkyl esters (fruit flavors), and monosodium glutamate.	10	0	-	10
III	**Food adulterants,and contaminants:** Food processing and packaging; Food adulteration: definition and its importance, adulterants present in-coffee, tea, milk, spices, grains and food colour; Difference between food adulteration and contamination.	10	0	-	10
IV	**Artificial food colorants:** Natural and synthetic colors, fake colors, inorganic pigments, application of colors in food industry, flavoring agents, Coal tar dyes and non-permitted colors and metallic salts. Utility of coal tar dyes infood and cosmetics and its harmful effect.	11	0	-	11
	Total	45	0	0	45

Where, L: Lectures T: Tutorials P:Practicals

MODES OF IN-SEMESTER ASSESSMENT: **30 Marks**

- Two Internal Examination - **20 Marks**
- Others (Anyone) - **10 Marks**
  - Home Assignment
  - Seminar presentation on any of the relevant topics

COURSE OUTCOMES:

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

CO1: Know the composition of dairy products and food additives, to know the concepts in food safety and processing.

CO2: Understanding the principles behind dairy safety, milk processing, and the roles of various food preservatives and artificial sweeteners.

CO3: Understanding the methods for qualitative analysis of fat, minerals, and caffeine in dairy products and beverages, and detect common adulterants and contaminants in foods.

CO4: Compare the different food additives, artificial colorants, and their applications in the food industry, including their potential health impacts.

CO5: Determine the significance of food adulteration and contamination and evaluatethe harmful effects of synthetic colorants and non-permitted substances.

CO6: Develop methods to detect food adulterants and contaminants, and innovate safer and more effective food processing and packaging techniques.

Cognitive map of course outcomes with Bloom's Taxonomy:

Knowledge Dimension	**Remember**	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Create**
Factual	CO1					
Conceptual		CO2,CO3	CO4, CO5			
Procedural					CO6	
Metacognitive						

TEXT BOOKS:

1. Organic Chemistry–B.S.Bahl and, A. Bahl (Vol. I&II) (S Chand), 2nd Edition, 2015.

2. Food Science & Quality Control by SMT. B. Poornima - Centrum Press First edition 2014.

3. Post-Harvest Management of Horticultural crops- S.Saraswathy, T.L. Preethi AGROBIOS (India) 2013.

REFERENCE BOOKS:

1. A Handbook of Agn. Food processing and marketing by S.C. Gaur, Agro Bios (India) 2012.
2. Quality Control for value edition in Food processing–by Dev Raj, Rakesh Sharma & V.K. Joshi, NewIndia PublishingAgency, 2011.
3. Food processing and preservation–Subbulakshmi, G. Shobha, A. Udipi, New Age International (P) Ltd., 2006.

FYUGP

DETAILED SYLLABUS OF 1st SEMESTER

Title of the Course	**:**	**Basic Analytical Chemistry-1**
Course Code	**:**	**SEC-101**
Nature of the Course	**:**	**CHEMISTRY SEC**
Total Credits	**:**	2
Distribution of Marks	**:**	**45 (End-Sem) + 40(In-Sem)**

COURSE OBJECTIVES:

- To develop basic understanding of chemical analysis of soil, water, food products, cosmetics and separation techniques (viz. chromatography, ion exchange, etc.)

UNITS	CONTENTS	L	T	P	Total Hours
I	**Introduction:** Introduction to Analytical Chemistry. Accuracy, precision and importance, Errors in analytical measurements, Significant figures.	**03**	**0**	**-**	**03**
	Analysis of soil: Soilcomposition, Concept of pH and pH measurement, Complexometric titrations, Chelatingagents, use of indicators, Estimation of Calcium and Magnesium ions as Calcium carbonate by complexometric titration.	**05**	**0**	**-**	**05**
II	**Analysis of water:** Contamination of water, sources responsible for contaminating water,water sampling methods,water purification methods, determination of pH,acidity, alkalinity and dissolved oxygen (DO) of a water sample.	**05**	**0**	**-**	**05**
	Analysis of food products: Nutritional value of foods, food processing and food preservation and adulteration. Identification of adulterants in some common food items like coffee powder, chilli powder, turmeric powder, coriander powder and pulses, etc. Analysis of preservatives and colouring matter.	**05**	**0**	**-**	**05**
III	**Chromatography:** Definition, general introduction on principles of chromatography, paper chromatography, TLC. Paper chromatographic separation of mixture of amino acids, determination of Rf, applications.	**04**	**0**	**-**	**04**
	Ion-exchange: Column, ion-exchange chromatography and their applications. Determination of ion exchange capacity of anion / cation exchange resin.	**04**	**0**	**-**	**04**

	Analysis of cosmetics: Major and minor constituents and their function.Analysis of deodorants and antiperspirants, Al, Zn, boric acid, chloride, sulphate. Determination of constituents of talcum powder by complexometric titration.	**04**	**0**	**-**	**04**

Where, ***L: Lectures*** ***T: Tutorials*** ***P:Practicals***

MODES OF IN-SEMESTERASSESSMENT: **30 Marks**

- Two Internal Examination - **20 Marks**
- Others (Anyone) - **10 Marks**
    - Home Assignment
    - Seminar presentation on any of the relevant topics

FYUGP

DETAILED SYLLABUS OF 1st SEMESTER

Title of the Course : Basic Analytical Chemistry Lab-1
Course Code : SEC-101 Lab
Nature of the Course : CHEMISTRY SEC
Total Credits : 1
Distribution of Marks : 15

Sl No	Experimental Work	Marks
I	**Any one experiment:** (i) Determination of dissolved oxygen in water. (ii) Determination of Chemical Oxygen Demand (COD) (iii) Determination of Biological Oxygen Demand (BOD) (iv) Estimation of macro nutrients: Potassium, Calcium, Magnesium in soil samples by flame photometry (v) Spectrophotometric determination of Iron in Vitamin / Dietary Tablets. (vi) Spectrophotometric Identification and Determination of Caffeine and BenzoicAcid in Soft Drinks	12 - -
	Viva-Voce	**03**

COURSEOUTCOMES:

By the completion of thiscourse, students will be able to-

CO1: Understanding of the principles and practices in analytical chemistry, including sampling, measurement accuracy, and data presentation.

CO2: Acquire practical experience in analyzing soil, water, and food products, understanding their composition, and detecting adulterants.

CO3: Understanding thetechniques in chromatography and ion-exchange, and applying these techniques to real-world samples.

CO4: Analyzing cosmetics and conducting advanced practical experiments to measure various chemical parameters.

CO5: Enhance critical thinking and problem-solving abilities in the context of analytical chemistry applications.

Cognitivemap of courseoutcomeswithBloom's Taxonomy:

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual				CO5		
Conceptual	CO1	CO2	CO3			
Procedural				CO4		
Metacognitive						

TEXT BOOKS:

1. Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. *Instrumental Methods of Analysis*, 7th Ed. Wadsworth Publishing Company Ltd., Belmont, California, USA, 1988.
2. Skoog, D.A., Holler, F.J. & Crouch, S. *Principles of Instrumental Analysis*, Cengage Learning India Edition, 2007.
3. Skoog, D.A.; West, D.M. & Holler, F.J. *Analytical Chemistry: An Introduction 6th Ed.*, Saunders College Publishing, Fort Worth, Philadelphia (1994).

REFERENCE BOOKS:

1. Cooper, T.G.TheTools of Biochemistry, JohnWiley & Sons, N.Y.USA.16 (1977).
2. Vogel, A.I. *Vogel's Qualitative Inorganic Analysis 7th Ed.*, Prentice Hall, 1996.
3. Mendham, J., *A. I. Vogel's Quantitative Chemical Analysis 6th Ed.*, Pearson, 2009.

FYUGP
DETAILED SYLLABUS OF 2nd SEMESTER

Title of the Course	**:**	**Chemistry C2: Inorganic + Physical + Organic**
Course Code	**:**	**C-202**
Nature of the Course	**:**	**CHEMISTRY MAJOR**
Total Credits	**:**	**3**
Distribution of Marks	**:**	**45 (End Sem) +40 (In-Sem)**

COURSE OBJECTIVES:

- To provide concept about the chemistry of non-transition elements, metallurgy, 1st law of thermodynamics, solid state chemistry and chemistry of aliphatic hydrocarbons.

UNITS	CONTENTS	L	T	P	Total Hours
I	**Non Transition elements:** a) NobleGas: Compounds of Xenononly (structure determination using VSEPR) b) Boron: wade's rule, nomenclature of closo, nido andarachnoboranes, structure of boron hydrides (B_2H_6), metalloborane and metallocarboranes, borazine, phosphazine, S_4N_4, $(SN)_x$ – preparation, structure and uses. c) Carbon:Fullerenes(C_{60}) d) Silicon: silicones, classifications and structure of silicates. Zeolites, use of Zeolites as catalyst and molecular sieve, aluminosilicates. e) Nitrogen: Oxides and oxoacids of nitrogen, Hydrazine, hydroxylamine and hydrazoic acid. f) Phosphorus: oxides and oxy acids of phosphorus, organophosphorus compounds.	**09**	**0**	**-**	**09**
	Metals: Theory of reduction (Thermodynamic approach), Ellingham's diagram, role of carbon and other reducing agents, electrolytic reduction, roasting and calcinations. Method of purification and refining of metals including modern methods like zone refining, vacuum arc process, ion exchange, solvent extraction and electrolytic method, Van- Arkel process and hydrometallurgy. **Chemical Thermodynamics-I:** Extensive and intensive properties of a system, thermodynamic processes: cyclic, reversible, irreversible processes, thermodynamic function, complete differential, Zeroth law of thermodynamics. First law of thermodynamics- internal energy, enthalpy, molar heat capacities, relation between Cp and Cv, work of expansion in reversible and irreversible process, adiabatic process, relation	**06**	**0**	**-**	**06**

II	P, V, T. Variation in internal energy and enthalpy with temperature, Joule Thomson effect, calculation of Joule Thomson coefficient for ideal and van der Waal's gas. Thermo chemistry- Hess's law, Kirchhoff's law, relation of reaction enthalpy with internal energy, Bond energy and Bond dissociation energy, calculation from thermochemical data.	**08**	**0**	**-**	**08**
	Solids: Basic laws of crystallography, crystal system, crystal lattice, Miller indices, and simple face centered and body centered cubic lattice, number of points in a unit cell. X-Ray diffraction study of crystals, Bragg's law, determination of crystal structure- introduction to powder and single crystal methods of structure analysis, crystal structure of NaCl and KCl, packing of crystals, closed packed structure, radius ratio, crystal defect-point defects, conductors, semiconductors and insulators from band theory.	**06**	**0**	**-**	**06**
III	**Carbon-Carbon sigma bonds:** Chemistry of Alkanes: preparation of alkanes with special emphasis on Corey House Synthesis, Wurtz reaction, Wurtz-Fittig reaction. Reactions of alkanes: Free Radical substitution:- Halogenations-relative reactivities and selectivity.	**04**	**0**	**-**	**04**
	Carbon-Carbonpibonds: Formation of alkenes and alkynes by Elimination: Mechanism of E1., E2, E1cB reactions. Saytzeff and Hoffmann elimination, special emphasis onpreparation of alkenes by *syn* elimination:- pyrolysis of esters, Chugaev reaction and Wittig reaction. ***Reaction of alkenes***: Addition Reaction- Electrophilic and free radical additions, their mechanisms. (Markonikoff/ Anti Markonikoff addition) regioselectivity (directional selectivity), and stereoselective of addition reactions. Mechanism of	**12**	**0**	**-**	**12**
	Oxymercuration–demercuration, Hydroboration-Oxidation, Ozonolysis, reduction. ***Syn and Anti hydroxylation*** (oxidation), simple effect of stereo selectivity and stereo specificity. ***Reactions of Alkynes***: Acidity, Electrophilic and Nucleophilic additions, Hydration to form carbonyl compounds. Alkylation of terminal alkynes.				

Where, ***L: Lectures*** ***T: Tutorials*** ***P:Practicals***

MODES OF IN-SEMESTER ASSESSMENT: **40 Marks**

- Two Internal Examination - **20 Marks**
- Others (Anyone) - **20 Marks**
    - Home Assignment
    - Seminar presentation on any of the relevant topics

FYUGP

DETAILED SYLLABUS OF 2ND SEMESTER

Title of the Course : Chemistry C 2 Lab
Course Code : C-202 Lab
Nature Of the course : CHEMISTRY MAJOR
Total Credits : 1
DistributionofMarks : 15

Sl No	EXPERIMENTAL WORK:	Marks
I	Oxidation-Reduction Titrimetry (anyone) (i) Estimation of Fe (II) or oxalic acid using standardized $KMnO_4$ solution. (i) Estimation of Fe (II) with $K_2Cr_2O_7$ using diphenylamine as internal indicator.	12 -
II	**Viva-voce**	**03**

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

CO1: Understand the properties and reactions of non- transition elements and metals.
CO2: Aquire the knowledge of chemical thermodynamics and the properties of solids, including crystallography and X-ray diffraction.
CO3: Understand the formation and reactions of carbon-carbon sigma and pi bonds with reference to alkanes, alkenes, and alkynes.
CO4: Gain analytical skills in estimation of strength of unknown oxalic acid and iron.

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual		CO1				
Conceptual	CO2		CO3			
Procedural					CO4	
Metacognitive						

TEXT BOOKS:

1. Inorganic Chemistry–J.E. Huheey, E. A. Keiter, R. L. Keiter and O.K. Medhi; (Pearson), 4th Edition, 2006.
2. Inorganic Chemistry–Puri, Sharma and Kalia (Milestone), 1st Edition, 2007-2008.
3. Principles of Physical Chemistry, Puri, Sharma, Pathania (Vishal), 47th Edition, 2018.
4. A Text Book of Physical Chemistry–Negi &S.C.Anand, (New Age), 2nd Edition, 2005.
5. Organic Chemistry–B.S.Bahl and, A. Bahl (Vol. I&II) (S Chand), 2nd Edition, 2015.
6. Advanced General Organic Chemistry (Part I and Part II)-S. C.Ghosh (NCBA) 3rd Edition, 2019.

REFERENCE BOOKS:

1. Selected Topics in InorganicChemistry—Wahid U. Malik, G.D.Tuli and R.D.Madan. (S. Chand & Co. Ltd.)
2. Advanced Inorganic Chemistry–Satyaprakash, Basu, Tuli
3. Inorganic Chemistry–J.D.Lee
4. Basic Inorganic chemistry–Cotton and Wilkinson
5. Physical Chemistry--Atkins, P.W. & Paula, J.
6. Physical Chemistry, Castellan G.W., Narosa Publishing
7. Physical Chemistry–P.W.Atkins,Oxford UniversityPress
8. Advanced Physical Chemistry–J.N. Gurta & H. Snehi, Pragati Prakashan
9. OrganicChemistry–M.K.Jain, S.Chand & Co.
10. A Text Book of Organic Chemistry (Vol.I&II)–B.K. Sharma, G.P. Pokhriji and S.K. Sharma, (S. Chand & Co.)
11. Organic Chemistry–I.L.Finar,Vol.I&II,ELBS
12. Organic Chemistry, R.I.Morrison & R.N.Boyd,S.K. Bhattacharjee
13. Organic Chemistry–Vol.I & II, Mukherjee and Kapoor
14. Organic Chemistry (Oxford)-Clayden, Warren, Greeves and Wothers.
15. Organic Reactions and their Mechanisms (NewAgeInternational Private Limited)-P.S.Kalsi.

FYUGP
DETAILED SYLLABUS OF 2nd SEMESTER

Title of the Course	**:**	**Fundamentals of Chemistry-2**
Course Code	**:**	**MIN-202**
Nature of the Course	**:**	**CHEMISTRY MINOR**
Total Credits	**:**	**3**
Distribution of Marks	**:**	**45 (End Sem) + 40 (In-Sem)**

COURSE OBJECTIVES: Understanding the basic knowledge of atomic structure, chemical bonding. To emphasize on different states of matter & their mechanical treatment.To gain preliminary knowledge in basic organic chemistry, hydrocarbons, stereochemistry & conformational analysis etc.

UNITS	CONTENTS	L	T	P	Total Hours
I	**Chemical Bonding and Molecular Structure-2** Covalent Bonding: VB Approach-Concept of hybridization, sp, sp^2, sp^3, sp^3d, sp^3d^2 and dsp^2 VSEPR Theory. Resonance and Resonance energy: Study of some inorganic and organic compounds (O_3,NO_3^-,CO_3^{2-},SO^{2-},$RCOO^-$,C_6H_6). Molecular OrbitalApproach: LCAO method, bonding and antibonding MOs and their characteristics for s-s, s-p and p-p combination of atomic orbitals, non-bonding combination of orbitals,MO treatment of homonuclear diatomic molecules and heteronuclear diatomic molecules such as CO, NO and NO^+	**08**	**0**	**-**	**08**
	Chemistry of non-metals: Boron: Preparation, structure and bonding of diborane Silicon: Structure, properties and use of siliconcarbide and silicon polymers (linear). Nitrogen: Hydroxylamine, Hydrazine, Hydrazoic acid; preparation, properties, uses and electronic structure. Raregases: Xenon compounds. Phosphorous: Structures of oxides andoxyacids.	**08**	**0**	**-**	**08**
II	**Solids** Forms of solids, unit cells, crystal systems, Bravais lattice, types and identification of lattice planes. Miller and Weiss indices. Laws of crystallography-Law of constancy of interfacial angles. Law of rational indices. X-Ray diffraction by crystals. Bragg's law. Structure of NaCl, KCl and CsCl (qualitative treatment only). Defects in crystals. Liquid crystals. **Ionic Equilibria:** Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree ofionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale,	**09** **06**	**0** **0**	**-** **-**	**09** **06**

	common ion effect. Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions. Solubility and solubility product ofsparingly soluble salts – applications of solubility product principle.				
III	**Stereochemistry:** Conformation with respect to ethane, butane and cyclohexane. Interconversion of WedgeFormula, Newmann, Sawhorse and Fischer representations. Concept of chirality (uptotwocarbon atoms). Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso Compounds. Threo and erythro; D and L; Cis-trans nomenclature; CIP Rules.	**07**	**0**	**-**	**07**
	AliphaticHydrocarbons-2 **Alkenes:**(up to 5 carbons): *Preparation*: Elimination reactions: Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's rule). *Reactions*: cis-addition (*alk*. $KMnO_4$) and trans-addition (bromine), Addition of HX(Markownikoff's and anti-Markownikoff's addition), Hydration, Ozonolysis. **Alkynes:**(up to 5carbons): *Preparation*: Acetylene from CaC_2 and conversion into higher alkynes by dehalogenation of tetra halides and dehydrohalogenation of vicinal dihalides. *Reactions*: formation of metal acetylides, addition of bromine and alkaline $KMnO_4$, Ozonolysis and oxidation with hot alk. $KMnO_4$.	**07**	**0**	**-**	**07**

Where, ***L:Lectures*** ***T:Tutorials*** ***P:Practicals***

MODES OF IN-SEMESTER ASSESSMENT: **40 Marks**

- Two Internal Examination - **20 Marks**
- Others (Anyone) - **20 Marks**
  - Home Assignment
  - Seminar presentation on any of the relevant topics

FYUGP

DETAILED SYLLABUS OF 2ND SEMESTER

Title of the Course : Fundamentals of Chemistry-2 Lab
Course Code : MIN-202 Lab
Nature of the Course : CHEMISTRY MINOR
Total Credits : 1
Distribution of Marks : 15

Sl No	Experimental Work	Marks
I	**(Any one experiment)** Inorganic Preparation (Any one) i. Potashalum ii. Chromealum iii. Potassiumtrioxalato chromate Potassiumtrioxalato ferrate	**12**
II	**Viva -Voce**	**03**

COURSE OUTCOMES:

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

CO1: Apply the concepts of Werner's theory, isomerism in coordination compounds and Valence Bond and Crystal Field theories, to understand and solve problems related to the structure and function of coordination compounds.

CO2: Evaluate the bonding and structural properties of various inorganic and organic compounds by applying concepts of covalent bonding theories, including hybridization, VSEPR, resonance and MO.

CO3: Understand coordination chemistry, including its theories, naming rules, and types of ligands.

CO4: Learn about chemical bonding, molecular structures, and the basics of solid-state chemistry.

CO5: Understand stereochemistry and thechemistry of aliphatic hydrocarbons, including how they react and how they are prepared.

CO6: Gain practical skills to prepare sone inorganic coordination compounds and enhance analytical and problem solving abilities.

Cognitive map of course outcomes with Bloom's Taxonomy:

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual		CO3				
Conceptual	CO4	CO5	CO1			
Procedural					CO2, CO6	
Metacognitive						

TEXT BOOKS:

1. Inorganic Chemistry–J.E. Huheey, E. A. Keiter, R. L. Keiter and O.K. Medhi; (Pearson), 4th Edition, 2006.
2. Inorganic Chemistry–Puri, Sharma and Kalia (Milestone), 1st Edition, 2007-2008.
3. Principles of Physical Chemistry, Puri, Sharma, Pathania (Vishal), 47th Edition, 2018.
4. A Text Book of Physical Chemistry–Negi &S.C.Anand, (New Age), 2nd Edition, 2005.
5. Organic Chemistry–B.S.Bahl and, A. Bahl (Vol. I&II) (S Chand), 2nd Edition, 2015.
6. Advanced General Organic Chemistry (Part I and Part II)-S. C.Ghosh (NCBA) 3rd Edition, 2019.

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1. Selected Topics in InorganicChemistry—Wahid U. Malik, G.D.Tuli and R.D.Madan. (S. Chand & Co. Ltd.)
2. Advanced Inorganic Chemistry–Satyaprakash, Basu, Tuli
3. Inorganic Chemistry–J.D.Lee
4. Basic Inorganic chemistry–Cotton and Wilkinson
5. Physical Chemistry--Atkins, P.W. & Paula, J.
6. Physical Chemistry, Castellan G.W., Narosa Publishing
7. Physical Chemistry–P.W.Atkins,Oxford UniversityPress
8. Advanced Physical Chemistry–J.N. Gurta & H. Snehi, Pragati Prakashan
9. OrganicChemistry–M.K.Jain, S.Chand & Co.
10. A Text Book of Organic Chemistry (Vol.I&II)–B.K. Sharma, G.P. Pokhriji and S.K. Sharma, (S. Chand & Co.)
11. Organic Chemistry–I.L.Finar,Vol.I&II,ELBS
12. Organic Chemistry, R.I.Morrison & R.N.Boyd,S.K. Bhattacharjee
13. Organic Chemistry–Vol.I & II, Mukherjee and Kapoor
14. Organic Chemistry (Oxford)-Clayden, Warren, Greeves and Wothers.
15. Organic Reactions and their Mechanisms (NewAgeInternational Private Limited)-P.S.Kalsi.

FYUGP
DETAILED SYLLABUS OF 2nd SEMESTER

Title of the Course : Chemistry in Daily Life-2
Course Code : MDC-202
Nature of the Course : CHEMISTRY MDC
Total Credits : 3
Distribution of Marks : 60 (EndSem) + 40 (In-Sem)

COURSE OBJECTIVES: To provide the basic knowledge of some biomolecules and their importance in human body.

UNITS	CONTENTS	L	T	P	Total Hours
I	**Vitamins**: Classification and Nomenclature. Sources, deficiency diseases, and structures of Vitamin A, Vitamin B, Vitamin C, Vitamin D, Vitamin E & Vitamin K.	12	0	-	12
II	**Oils and fats:** Composition of edible oils, detection of purity, rancidity of fats and oil. Tests for adulterants like argemone oil and mineral oils. Soaps & Detergents: Definition, classification, manufacturing of soaps and detergents, composition and uses.	10	0	-	10
III	**Proteins:** Sources, Composition and Biologicalvaluesof protein, Elementary ideas of proteins and amino acids, Essential and Non-essential amino acids. Peptide bonds, Polypeptides, Qualitative ideas of structure of proteins (Primary, secondary, Tertiary and Quaternary structure), Denaturation and coagulation of proteins; Factors contributing to denaturation and coagulationof proteins.	12	0	-	12
IV	**Nucleic Acids:** Nucleic acids and their Chemical composition. Classification, functions and structure of nucleic acids. Concept of DNA fingerprinting and its applications.	11	0	-	11
	Total	45	0	0	45

Where, L: Lectures T: Tutorials P:Practicals

MODES OF IN-SEMESTER ASSESSMENT: 30 Marks

- Two Internal Examination - **20 Marks**
- Others (Anyone) - **10 Marks**
    - Home Assignment
    - Seminar presentation on any of the relevant topics

COURSE OUTCOMES:

By the completion of this course, students will be able to-

CO1: Understand vitamins, including their sources, deficiency diseases, and chemical structures.

CO2: Aquire the knowledge of oils and fats, including detection of purity, rancidity, and the manufacturing and uses of soaps and detergents.

CO3: Understand the composition, structure, and biological significance of proteins and amino acids.

CO4: Gain idea about nucleic acids, their chemical composition, classification, functions, and applications such as DNA fingerprinting.

Cognitive map of course outcomes with Bloom's Taxonomy:

Knowledge Dimension	**Remember**	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Create**
Factual	CO1, CO2					
Conceptual		CO3,CO4				
Procedural						
Metacognitive						

TEXT BOOKS:

1. Organic Chemistry–B.S.Bahl and, A. Bahl (Vol. I&II) (S Chand), 2nd Edition, 2015.

2. Berg, J.M.; Tymoczko, J.L.; Stryer, L. (2006), Biochemistry. W.H. Freeman and Co.

3. Nelson, D.L.; Cox, M.M.; Lehninger, A.L. (2009), Principles of Biochemistry.W.H. Freeman and Co.

4. Murray, R.K., Granner, D.K., Mayes, P.A.; Rodwell, V.W. (2009), Harper's

REFERENCE BOOKS:

1. Illustrated Biochemistry. Lange Medical Books/McGraw-Hill.
2. Brown, T.A. (2018) Biochemistry, (First Indian addition 2018) VivaBooks.
3. Kumar, A.; Garg, S.; Garg, N. (2012), Biochemical Tests: Principles and Protocols. Viva Books.
4. Finar, I.L. (2008), Organic Chemistry, Volume 2, 5th Edition, Pearson Education.

FYUGP
DETAILED SYLLABUS OF 2nd SEMESTER

Title of the Course : Basic Analytical Chemistry-2
Course Code : SEC-202
Nature of the Course : CHEMISTRY SEC
Total Credits : 2
Distribution of Marks : 45 (End Sem) +40 (In-Sem)

COURSE OBJECTIVES:

- The course aims to provide students with a basic scientific and technical understanding of the production, behaviour and handling of hydrocarbon fuels, petrochemicals and lubricants. This will enable them to be industry-readyto contribute effectivelyin the field of petroleum chemistry and technology.

UNITS	CONTENTS	L	T	P	Total Hours
I	**Review of energy sources** (renewable and non-renewable). Classification of fuels and their calorific value.	03	0	-	03
	Coal: Uses of coal (fuel and nonfuel) in various industries, its composition, carbonization of coal.Coal gas, producer gas and water gas, composition and uses. Fractionation of coal tar, Uses of coal tar based chemicals.	06	0	-	06
II	**Petroleum and Petrochemical Industry**: Compositionof crude petroleum; Different types of petroleum products and their applications. Principle and process of fractional distillation, Cracking - Thermal and catalytic cracking; Qualitative treatment of non- petroleum fuels -LPG, CNG, LNG, bio-gas, fuels derivedfrombiomass,fuelfromwaste;syntheticfuels -gaseousandliquids.	09	0	-	09
	Petrochemical*s:* Vinyl acetate, Propylene oxide, Isoprene, Butadiene, Toluene and its derivatives Xylene.	06	0	-	06
III	**Lubricants:** Classification of lubricants, lubricating oils (conducting and non-conducting), Solid and semisolid lubricants, synthetic lubricants. Propertiesoflubricants – viscosity index, cloud point, pore point.	06	0	-	06

Where, L: Lectures T: Tutorials P: Practicals

MODES OF IN-SEMESTER ASSESSMENT: 30 Marks

- Two Internal Examination - **20 Marks**
- Others (Anyone) - **10 Marks**
  - Home Assignment
  - Seminar presentation on anyof the relevant topics

FYUGP
DETAILED SYLLABUS OF 2nd SEMESTER

Title of the Course : Basic Analytical Chemistry-2 Lab
Course Code : SEC- 202 Lab
Nature of the Course : CHEMISTRY SEC
Total Credits : 1
Distribution of Marks : 15

Unit	Experimental Work	Marks
I	Any one experiment: (i) To determinetheAnilinepointofagiven lubricating oil. (ii) To determinetheacidvalueof a given oil. (iii) To determinetheenthalpyofcombustionof liquid fuels using spirit / alcohol burner. (iv) To perform the proximateanalysis of coal Toperformtheultimateanalysisofthecoal sample.	12
II	**Viva-Voce**	3

COURSE OUTCOMES:
At the end of this course, students will be able to-

CO1: Developathoroughunderstandingofenergysources, their classification, and the calorific value of fuels.
CO2: Gain comprehensive knowledge of coal, itsindustrial uses, and the production and applications of its derivatives.
CO3: Learn about the petroleum and petrochemical industry, including the composition and processing of crude petroleum, and the significance of various petrochemicals.
CO4: Understandtheclassification, properties, and applications of lubricants.
CO5: Acquire hands-on experience in conducting experiments related to lubricants and fuel analysis, enhancing problem-solving and technical skills in analytical techniques.

Cognitivemapof course outcomes with Bloom's Taxonomy:

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual		CO1				
Conceptual		CO2,CO3	CO4			
Procedural				CO5		
Metacognitive						

TEXT BOOKS:

1. E.Stocchi (1990) IndustrialChemistry, Vol -I, Ellis Horwood Ltd. UK.
2. P.C. Jain, M.Jain: EngineeringChemistry, Dhanpat Rai &Sons, Delhi.
3. B.K.Sharma: Industrial Chemistry, Goel PublishingHouse, Meerut.
4. B. Saikia, Fuel Chemistry (Mahaveer), 1st Edition, 2021.

FYUGP
DETAILED SYLLABUS OF 3rd SEMESTER

Title of the Course : Chemistry C3: Inorganic+Physical+Organic
Course Code : C-303
Nature of the Course : CHEMISTRY MAJOR
Total Credits : 3
DistributionofMarks : 45 (End Sem) + 40 (In-Sem)

COURSEOBJECTIVES:

- To develop the basicknowledge of chemistry inrelation to *d* and *f* block elements and coordination compounds
- To develop the basic knowledge of chemistry in relation to chemical thermodynamics and ionic equilibrium
- To develop the basic knowledge of chemistry inrelation to cycloalkanes and conformational analysis and chemistry of halogenated hydrocarbons.

UNITS	CONTENTS	L	T	P	Total Hours
I	***d* and *f* blockelements**: General group trends with special reference to electronic configuration, colour, variable valency, magnetic and catalytic properties and ability to form complexes.Electronic configuration, oxidation states, colour, spectral and magnetic properties of lanthanides and actinides. Lanthanide contraction, separation of lanthanides (ion-exchange method only).	**06**	**0**	**-**	**06**
	Coordination compounds: Types of ligands: monodentate, bidentate, ambidentate, polydentate and macro cyclic ligand. Effective atomic number (EAN) rule, valence bond theory (VBT), crystal field theory (CFT), MOT and introduction to ligand field theories and their applications. *Magnetic properties:* paramagnetism, diamagnetism, magnetic properties of octahedral complexes, ferromagnetism, antiferromagnetism and ferrimagnetism.	**09**	**0**	**-**	**09**
II	**Chemical Thermodynamics II:** Second law of thermodynamics, Carnot's theorem, Carnot cycle, efficiency of heat engines, thermodynamic scale of temperature, concept of entropy, entropy change in a cyclic, reversible, irreversible processes, calculation of entropy changes of an ideal gas with change in P,V,T, entropy change in physical transformation, entropy of mixing. Helmholtz free energy (A) and Gibb's free	**10**	**0**	**-**	**10**

	Energy (G), Variation of A and G with P, V, T, criteria for spontaneity and equilibrium, Maxwell's relationship, Gibb's–Helmholtz equation. Nernst heat theorem- consequence of the theorem, third law of thermodynamics, and its verification.Determinationof absolute entropies of pure substance. **Ionic equilibrium:** Strong and weak electrolyte with modern classification of electrolytes (true and potential electrolyte), degreeof ionization, factors affecting degree of ionization, ionization constant, ionic product of water, ionization of weak acids and bases, pH scale, common ion effect. Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts, buffer solution, derivation of Henderson equation and its applications, buffer capacity, buffer range, buffer action. Solubility and solubility product of sparingly soluble salts-application of solubility product principle in salt analysis. Qualitative treatment of acid-base titration curves. Theory of acids- base indicators, selection of indicators and their limitations.	**06**	**0**		**06**
III	**Cycloalkanes and conformational analysis:** Synthesis and reactions of three, four, five and six membered cycloalkanes, Their relative stability, Baeyer strain theory. Conformational analysis of Alkanes: (ethane & butane) Relative stability, Energy diagram.Cyclohexane: Chair, Boatand Twist boat forms, Relative stability with energy diagram, axial an equatorial bonds including perspective representation and Newman projections. Conformation & conformational analysis of monosubstituted cyclohexane derivative.	**07**	**0**	**-**	**07**
	Chemistry of Halogenated Hydrocarbons Alkyl halides: Methods of preparation including Hunsdiecker reaction from silver or lead (IV) salts of carboxylic Acid). Nucleophilic substitution reactions: SN_1, SN_2, and SN_i Mechanisms with stereochemical aspects and effect of solvent. Nucleophilic substitution vs elimination. Haloform reaction. Aryl halides: Preparation from diazonium salts. Nucleophilic Aromatic Substitution SN_{Ar}, Benzyne intermediates. Relative reactivity of alkyl, allyl, benzyl,vinyl and aryl halides towards Nucleophilic substitution reactions.	**07**	**0**	**-**	**07**

Where, ***L: Lectures*** ***T: Tutorials*** ***P: Practicals***

MODES OF IN-SEMESTER ASSESSMENT: **40 Marks**

- Two Internal Examination - **20 Marks**
- Others (Anyone) - **20 Marks**
    - Home Assignment
    - Seminar presentation on any of the relevant topics

FYUGP
DETAILED SYLLABUS OF 3rd SEMESTER

Title of the Course : Chemistry C 3: Lab
Course code : C-303 Lab
Nature of the Course : CHEMISTRY MAJOR
Total Credits : 1
DistributionofMarks : 15

Sl No	EXPERIMENTAL WORK	Marks
I	**(Any one)** i) Purification of organic compounds by crystallization Using the following solvents: a.Water b. Alcohol c. Alcohol-water And determination of the melting points of above compounds (Kjeldahl method and electrically heated melting point apparatus) ii) Separation of a mixture of o- and p-nitrophenol or o- and p-aminophenol by thin layer chromatography (TLC).	**12**
II	**Viva-Voce**	**03**

COURSE OUTCOMES:
Atthe endof thisprogramme, students willbeable to-

CO1: Develop a solid understanding of the properties and behaviors of d and f block elements and coordination compounds.
CO2: Gain comprehensive knowledge of chemical thermodynamics and ionic equilibrium.
CO3: Learn the concepts and applications of cycloalkanes, conformational analysis, and halogenated hydrocarbons.
CO4: Acquire practical laboratory skills in the purification and analysis of organic compounds, enhancing problem-solving abilities and technical expertise in analytical techniques.

Cognitive map of course outcomes with Bloom's Taxonomy:

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual	CO1	CO2, CO3				
Procedural					CO4	
Metacognitive						

TEXT BOOKS:

1. Inorganic Chemistry–J.E. Huheey, E. A. Keiter, R. L. Keiter and O.K. Medhi; (Pearson), 4th Edition, 2006.
2. Inorganic Chemistry–Puri, Sharma and Kalia (Milestone), 1st Edition, 2007-2008.
3. Principles of Physical Chemistry, Puri, Sharma, Pathania (Vishal), 47th Edition, 2018.
4. A Text Book of Physical Chemistry–Negi &S.C.Anand, (New Age), 2nd Edition, 2005.
5. Organic Chemistry–B.S.Bahl and, A. Bahl (Vol. I&II) (S Chand), 2nd Edition, 2015.
6. Advanced General Organic Chemistry (Part I and Part II)-S. C.Ghosh (NCBA) 3rd Edition, 2019.

REFERENCE BOOKS:

1. Selected Topics in InorganicChemistry—Wahid U. Malik, G.D.Tuli and R.D.Madan. (S. Chand & Co. Ltd.)
2. Advanced Inorganic Chemistry–Satyaprakash, Basu, Tuli
3. Inorganic Chemistry–J.D.Lee
4. Basic Inorganic chemistry–Cotton and Wilkinson
5. Physical Chemistry--Atkins, P.W. & Paula, J.
6. Physical Chemistry, Castellan G.W., Narosa Publishing
7. Physical Chemistry–P.W.Atkins,Oxford UniversityPress
8. Advanced Physical Chemistry–J.N. Gurta & H. Snehi, Pragati Prakashan
9. OrganicChemistry–M.K.Jain, S.Chand & Co.
10. A Text Book of Organic Chemistry (Vol.I&II)–B.K. Sharma, G.P. Pokhriji and S.K. Sharma, (S. Chand & Co.)
11. Organic Chemistry–I.L.Finar,Vol.I&II,ELBS
12. Organic Chemistry, R.I.Morrison & R.N.Boyd,S.K. Bhattacharjee
13. Organic Chemistry–Vol.I & II, Mukherjee and Kapoor
14. Organic Chemistry (Oxford)-Clayden, Warren, Greeves and Wothers.
15. Organic Reactions and their Mechanisms (NewAgeInternational Private Limited)-P.S.Kalsi.

FYUGP
DETAILED SYLLABUS OF 3rd SEMESTER

Title of the Course	**:**	**Chemistry C4: Inorganic+Physical+Organic**
Course Code	**:**	**C-304**
Nature of the Course	**:**	**CHEMISTRY MAJOR**
Total Credits	**:**	**3**
Distribution of Marks	**:**	**45 (EndSem) + 40 (In-Sem)**

COURSE OBJECTIVES:

- To understand the concepts of acids and bases, including Brönsted-Lowry and Lewis theories, and the application of HSAB principles.
- To learn about inorganic reaction mechanisms, conductance, and electrochemistry, including substitution reactions in complexes, conductometric titrations, and the principles of electrochemical cells.
- To explore aromatic hydrocarbons, electrophilic aromatic substitution, and the chemistry of C-O bonds in alcohols, phenols, ethers, and epoxides,
- To conduct experimental work in conductometry, thermochemistry, and qualitative organic analysis.

UNITS	CONTENTS	L	T	P	Total Hours
I	**Acids and Bases:** Brönsted-Lowry concept of acid-base reactions, solvated proton, relative strength of acids, types of acid-base reactions, levelling solvents, Lewis acid-base concept, classification of Lewis acids, hard and soft acids and bases (HSAB). Application of HSAB principle.	**06**	**0**	**-**	**06**
	Inorganic reaction mechanism: Introduction to inorganic reaction mechanism, inert and labile complexes, association, dissociation and concerted paths. Acid and base hydrolysis (with reference to cobalt complexes only). Substitution reaction in octahedral and square planar complexes. Trans effect, Irving-William series.	**10**	**0**	**-**	**10**
II	**Conductance:** Arrhenius theory of electrolytic dissociation, conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes, molar conductivity at infinite dilution, Kohlrausch law of independent migration of ions, Debye-Huckel - Onsagar equation, Wien effect,Debye-Falkenhagen effect, Walden's rule. Ionic mobilities and their determinations, transference numbers and their relation to ionic mobilities, DeterminationoftransferencenumbersusingHittorfand moving boundary methods (principle only, calculations	**06**	**0**	**-**	**06**

	not required), anomalous transference number, application of conductance measurement: i) degree of dissociation of weak electrolytes ii) ionic productofwater iii) solubility and solubility product of sparingly soluble salts iv) Hydrolysis constant of aniline hydrochloride, v) Conductometric titration (Acid-Base and precipitation).				
	Electrochemistry: Quantitative aspects of Faraday's laws of electrolysis, rules of oxidation/reduction of ions based on half-cell potentials, applications of electrolysis in metallurgy and industry. Electrochemical cells, reversible and irreversible cells with examples. Electromotive force of a cell and its measurement, Nernst equation; Standard electrode (reduction) potential and its application to different kinds of half-cells. Application of EMF measurements in determining (i) free energy,enthalpy and Entropy of a cell reaction, (ii) equilibrium constants, and (iii) pH values, using hydrogen, quinone-hydroquinone, glass and SbO/Sb_2O_3 electrodes. Concentration cells with and without transference, liquid junction potential; determination of activity coefficients and transference numbers. Qualitative discussion of potentiometric titrations (acid-base, redox, precipitation)	**07**	**0**		**07**
III	**Aromatic Hydrocarbons** Aromaticity: Huckel's rule, aromatic characters of arenes, benzenoid, non-benzenoid- aromatic compounds and heterocyclic and polynuclear hydrocarbons with suitable examples Synthesis and properties of naphthalene and anthracene. Antiaromaticity and nonaromaticity Electrophilic Aromatic Substitution: Halogenation, nitration, sulphonation and Friedel-craft's alkylation/ acylation with their mechanism. Activation/deactivation of aromatic ring and directing effects of groups. Partial rate factor (O/P ratio)	**8**	**0**	**-**	**8**
	Chemistry of Alcohols: Preparation and properties of Glycol: Oxidation by OsO_4, alkaline $KMnO_4$, periodic acid and lead tetracetate. Pinacol Pinacolone rearrangement with mechanism. ***Trihydric alcohol:*** Glycerol: preparation & properties. ***Phenols:*** Preparation and properties:- acidity-comparison with alcohol. Substitution reaction, Reimer- Tiemann and Kolbe-Schmidt reaction, Fries rearrangement with mechanism. **Other aromatic Hydroxy compounds:** Cresol, nitrophenols, picric acid, benzyl alcohol, dihydric phenols. Ethers and Epoxides: Preparation and reactions with acids	**8**	**0**	**-**	**8**

Where, ***L: Lectures*** ***T: Tutorials*** ***P:Practicals***

MODES OF IN-SEMESTER ASSESSMENT: **40 Marks**

- Two Internal Examination - **20 Marks**
- Others (Anyone) - **20 Marks**
    - Home Assignment
    - Seminar presentation on anyof the relevant topics

FYUGP
DETAILED SYLLABUS OF 3rd SEMESTER

Title of the Course : Chemistry C4: Lab
Course Code : C-304 Lab
Nature of the Course : CHEMISTRY MAJOR
Total Credits : 1
Distribution of Marks : 15

Sl No	EXPERIMENTALWORK:	Marks
I	Inorganic Preparation(Any one) **i.** Potashalum **ii.** Chromealum **iii.** Potassiumtrioxalatochromate **iv.** Potassiumtrioxalatoferrate	**12**
	Viva-Voce	**03**

COURSE OUTCOMES:
At the end of this programme, students will be able to-

CO1: Develop a solid understanding of the properties and behaviors of acids, bases, and inorganic reaction mechanisms.

CO2: Gain comprehensive knowledge of conductance, electrochemistry, aromatic hydrocarbons, and the chemistry of the C-O bond.

CO3: Learn the concepts and applications of theoretical principles inpractical contexts.

CO4: Acquire practical laboratory skills in inorganic synthesis, enhancing analytical and problem-solving abilities.

Cognitivemapof course outcomes with Bloom's Taxonomy:

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1, CO2		CO3		
Procedural					CO4	
Metacognitive						

TEXT BOOKS:

1. Inorganic Chemistry–J.E. Huheey, E. A. Keiter, R. L. Keiter and O.K. Medhi; (Pearson), 4th Edition, 2006.
2. Inorganic Chemistry–Puri, Sharma and Kalia (Milestone), 1st Edition, 2007-2008.
3. Principles of Physical Chemistry, Puri, Sharma, Pathania (Vishal), 47th Edition, 2018.
4. A Text Book of Physical Chemistry–Negi & S.C.Anand, (New Age), 2nd Edition, 2005.
5. Organic Chemistry–B.S.Bahl and, A. Bahl (Vol. I&II) (S Chand), 2nd Edition, 2015.
6. Advanced General Organic Chemistry (Part I and Part II)-S. C.Ghosh (NCBA) 3rd Edition, 2019.

REFERENCE BOOKS:

1. Selected Topics in Inorganic Chemistry—Wahid U. Malik, G.D.Tuli and R.D.Madan. (S. Chand & Co. Ltd.)
2. Advanced Inorganic Chemistry–Satyaprakash, Basu, Tuli
3. Inorganic Chemistry–J.D.Lee
4. Basic Inorganic chemistry–Cotton and Wilkinson
5. Physical Chemistry--Atkins, P.W. & Paula, J.
6. Physical Chemistry, Castellan G.W., Narosa Publishing
7. Physical Chemistry–P.W.Atkins,Oxford UniversityPress
8. Advanced Physical Chemistry–J.N. Gurta & H. Snehi, Pragati Prakashan
9. OrganicChemistry–M.K.Jain, S.Chand & Co.
10. A Text Book of Organic Chemistry (Vol.I&II)–B.K. Sharma, G.P. Pokhriji and S.K. Sharma, (S. Chand & Co.)
11. Organic Chemistry–I.L.Finar,Vol.I&II,ELBS
12. Organic Chemistry, R.I.Morrison & R.N.Boyd, S.K. Bhattacharjee
13. Organic Chemistry–Vol.I & II, Mukherjee and Kapoor
14. Organic Chemistry (Oxford)-Clayden, Warren, Greeves and Wothers.
15. Organic Reactions and their Mechanisms (New Age International Private Limited)-P.S. Kalsi.

FYUGP
DETAILED SYLLABUS OF 3rd SEMESTER

Title of the Course	**:**	**Fundamentals of Chemistry-3**
Course Code	**:**	**MIN-303**
Nature of the Course	**:**	**CHEMISTRY MINOR**
Total Credits	**:**	**3**
Distribution of Marks	**:**	**45 (End Sem) + 40 (In-Sem)**

COURSE OBJECTIVES:

- To give the concept of physico-chemical methods involved in metallurgy; first and second law of thermodynamics; aromatic hydrocarbons and reactions involved etc.

UNITS	CONTENTS	L	T	P	Total Hours
I	**Coordination Chemistry:** Review of Werner's theory. Types of ligands, monodentate, bidentate ambidentate and polydentate ligands (including _ Acceptor and macrocyclic ligands. IUPAC nomenclature of Co-ordination compounds. Isomerism of 4-and 6- coordinate compounds. Introduction to Valence Bond and Crystal Field theory. Application of dimethyl glyoxime, EDTA, 8-hydroxy quinoline, 2,2- bipyridyl, and ethylenediamine in analysis**.**	**08**	**0**	**-**	**08**
	General principles of metallurgy: Physico-Chemical methods involved in metallurgy (concentration, calcinations, reduction, roasting, zone refining, solvent extraction, hydrometallurgy and electrochemical methods) with reference to gold, nickel,thorium, uranium and manganese(whichever is applicable).	**07**	**0**	**-**	**07**
II	**a)Chemical Thermodynamics & First law** Thermal equilibrium and zeroth law of thermodynamics- concept of temperature, Mechanical work, SI sign convention.1st law of thermodynamics, internal energy, enthalpy, reversible and irreversible processes,calculation of W, Q, ΔU, ΔH for expansion of ideal gas, isothermal work and enthalpy, relation between enthalpy change, and entropy change, molar heat capacities, relation between Cp and Cv, adiabatic processes- relation between P, V and T, Joule-Thomson effect, liquefication of gases, conversion of heat into work, efficiency of heat engine. Enthalpy of reaction, thermodynamic equation, variation of Enthalpy of reaction with temperature-	**16**	**0**	**-**	**16**

	Kirchhoff'sequation, enthalpy of different processes. Hess law, calculations based on Hess law. **b)Second law of thermodynamics** Second law of thermodynamics, Spontaneous and Non-Spontaneous processes cyclic process- Carnot cycle, Entropy, Entropy change in reversible and irreversible processes and for ideal gas, concept of Work function and free energy.				
III	**AromaticHydrocarbons:** Preparation (only benzene) from phenol by decarboxylation, from acetylene, from benzene sulphonic acid. Reactions- Electrophitic substitution in benzene- nitration, halogenations, sulphonation, Fridel-Craft Alkylation and acylation with mechanism.	**06**	**0**	**-**	**06**
	Alkylhalides Nucleophilic Substitution Reactions (SN_2, SN_1, & SN_i) Preparation: from alkenes and alcohols Reactions: Hydrolysis, nitrite and nitro formation, nitrile and isonitrile formation. Williamson's Synthesis:elimination vs Substitution	**08**	**0**	**-**	**08**

Where, ***L: Lectures*** ***T:Tutorials*** ***P:Practicals***

MODES OF IN-SEMESTER ASSESSMENT: **40 Marks**

- Two Internal Examination - **20 Marks**
- Others (Anyone) - **20 Marks**
  - Home Assignment
  - Seminar presentation on any of the relevant topics

FYUGP
DETAILED SYLLABUS OF 3rd SEMESTER

Title of the Course : Fundamentals of Chemistry-3 Lab
Course Code : MIN-303 Lab
Nature of the Course : CHEMISTRY MINOR
Total Credits : 1
Distribution of Marks : **15**

Sl No	Experimental Work:	Marks
I	**Organic Qualitative Analysis** Detection of elements (nitrogen, sulphur and halogens) and functional groups of organic compound containing one functional group.	**12**
II	**Viva-Voce**	**03**

COURSE OUTCOMES:
At the end of this course, students will be able to-

CO1: Develop a clear andcomprehensiveunderstandingofnon-metalchemistry, metallurgical principles, thermodynamics, and organic chemistry.

CO2: Gain detailed knowledge of the properties, preparation methods, and reactions of important chemical compounds.

CO3: Apply theoretical principles in practical scenarios, including laboratory experiments.

CO4: Acquire practical skills in qualitative analysis, enhancing analytical and problem- solving abilities in chemical investigations.

Cognitive map of course outcomes with Bloom's Taxonomy:

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual		CO1				
Conceptual		CO2				
Procedural				CO3, CO4		
Metacognitive						

TEXT BOOKS:

1. Inorganic Chemistry–J.E. Huheey, E. A. Keiter, R. L. Keiter and O.K. Medhi; (Pearson), 4th Edition, 2006.

2. Inorganic Chemistry–Puri, Sharma and Kalia (Milestone), 1st Edition, 2007-2008.

3. Principles of Physical Chemistry, Puri, Sharma, Pathania (Vishal), 47th Edition, 2018.

4. A Text Book of Physical Chemistry–Negi &S.C.Anand, (New Age), 2nd Edition, 2005.

5. Organic Chemistry–B.S.Bahl and, A. Bahl (Vol. I&II) (S Chand), 2nd Edition, 2015.

6. Advanced General Organic Chemistry (Part I and Part II)-S. C.Ghosh (NCBA) 3rd Edition, 2019.

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2. Advanced Inorganic Chemistry–Satyaprakash, Basu, Tuli
3. Inorganic Chemistry–J.D.Lee
4. Basic Inorganic chemistry–Cotton and Wilkinson
5. Physical Chemistry--Atkins, P.W. & Paula, J.
6. Physical Chemistry, Castellan G.W., Narosa Publishing
7. Physical Chemistry–P.W.Atkins,Oxford UniversityPress
8. Advanced Physical Chemistry–J.N. Gurta & H. Snehi, Pragati Prakashan
9. OrganicChemistry–M.K.Jain, S.Chand & Co.
10. A Text Book of Organic Chemistry (Vol.I&II)–B.K. Sharma, G.P. Pokhriji and S.K. Sharma, (S. Chand & Co.)
11. Organic Chemistry–I.L.Finar,Vol.I&II,ELBS
12. Organic Chemistry, R.I.Morrison & R.N.Boyd,S.K. Bhattacharjee
13. Organic Chemistry–Vol.I & II, Mukherjee and Kapoor
14. Organic Chemistry (Oxford)-Clayden, Warren, Greeves and Wothers.
15. Organic Reactions and their Mechanisms (NewAgeInternational Private Limited)-P.S.Kalsi.

FYUGP
DETAILED SYLLABUS OF 3rd SEMESTER

Title of the Course: Chemistry in Daily Life 3
Course Code: MDC -303
Nature of the Course: CHEMISTRY MDC
Total Credits: 3
Distribution of Marks: 60 (End Sem) + 40 (In-Sem)

COURSE OBJECTIVES:

- To understand the applications of polymers, fertilizers, cosmetics and perfumes in everyday life.

UNITS	CONTENTS	L	T	P	Total Hours
I	**Chemical and Renewable Energy Sources**: Principles and applications of primary & secondary batteries and fuel cells.Basics of solar energy, future Energy storer.	**11**	**0**	**-**	**11**
II	**Polymers:** Basic concept of polymers, classification and characteristics of polymers. Applications of polymers in different fields. Problems of plastic waste management. Strategies for the development of environment-friendly bio-degradable polymers.	**11**	**0**	**-**	**11**
III	**Chemistry of Cosmetics & Perfumes** A general study including preparation and uses of the following: Hair dye, hair spray, shampoo, suntan lotions, face powder, lipsticks, talcum powder, nail enamel, creams (cold, vanishing and shaving creams), antiperspirants and artificial flavours. Essential oils and their importance in cosmetic industries with reference to Eugenol, Geraniol, sandalwood oil, eucalyptus, roseoil, 2-phenylethyl alcohol, Jasmone, Civetone, Muscone.	**12**	**0**	**-**	**12**
IV	**Fertilizers:** Different types of fertilizers. Manufacture of the followingfertilizers: Urea, ammoniumnitrate, calcium ammonium nitrate, ammonium phosphates; polyphosphate, superphosphate, compound and mixed fertilizers, potassium chloride, potassium sulphate.	**11**	**0**	**-**	**11**
	Total	**45**	**0**	**-**	**45**

Where, ***L: Lectures*** ***T: Tutorials*** ***P: Practicals***

MODES OF IN-SEMESTER ASSESSMENT: **30 Marks**

- Two Internal Examination - **20 Marks**
- Others (Anyone) - **10 Marks**
  - Home Assignment
  - Seminar presentation on any of the relevant topics

COURSE OUTCOMES:

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

CO1: Develop a thorough understanding of chemical and renewable energy sources, polymers, cosmetics, perfumes, and fertilizers.

CO2: Gain detailed knowledge of the principles, applications, and manufacturing processes related to each unit's content.

CO3: Apply theoretical knowledge to practical scenarios, such as the development of environmentally friendly polymers and the use of essential oils in cosmetics.

CO4: Acquire practical skills in analyzing and evaluating the environmental and industrial implications of chemical substances and processes.

Cognitive map of course outcomes with Bloom's Taxonomy:

Knowledge Dimension	**Remember**	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Create**
Factual		CO1				
Conceptual	CO2		CO3			
Procedural			CO4			
Metacognitive						

TEXT BOOKS:

1. Barel, A.O.; Paye, M.; Maibach, H.I. (2014), 1st Edition, Handbook of Cosmetic Science and Technology, CRC Press.
2. Garud, A.; Sharma, P. K.; Garud, N. (2012), 1st Edition, Text Book of Cosmetics, Pragati Prakashan.
3. Gupta, P. K.; Gupta, S. K.(2011), 1st Edition, Pharmaceutics and Cosmetics, PragatiPrakashan
4. Carraher, C.E. Jr. (2013), Seymour'sPolymer Chemistry, Marcel Dekker,Inc.

REFERENCE BOOKS:

5. Kumari, R. (2018), Chemistry of Cosmetics, Prestige Publisher.
6. Gopalan, R.Venkappayya, D.; Nagarajan, S. (2004), EngineeringChemistry, Vikas Publications.
7. Sharma, B. K. Engineering Chemistry,Goel Publishing House, Meerut, 2006
8. Ghosh, P. (2001), Polymer Science &Technology,Tata Mcgraw-Hill.

FYUGP
DETAILED SYLLABUS OF 3rd SEMESTER

Title of the Course : Industrial Chemistry of Petrochemicals and Polymer Products Chemistry
Course Code : SEC-303
Nature of the Course : CHEMISTRY SEC
Total Credits : 2
Distribution of Marks : 45 (End Sem) +40 (In-Sem)

COURSE OBJECTIVES:

- To develop awareness among the students about the significant role played by petrochemical and polymer industry in current societal and global issues.
- The students will be able to gain knowledge of fundamentals of petrochemical and polymer industry with enhanced command over scientific methods, techniques and chemical processes equipped with environment safety measures.
- This paper will give a glimpse of petrochemical and polymer industry to the students and help them to choose their career in the field of petrochemical and polymer chemistry.

UNITS	CONTENTS	L	T	P	Total Hours
I	**Petrochemical Industry:** History and Importance of Petrochemical Industry, growth in India, classification of petrochemicals, feedstock of the petrochemicals, Preparation of Feed stock from ethane/ propane and naptha/ gas oil cracking, syn gas. Petrochemicals from C1, C2, C3, C4, syngas and aromatics Chemistry and technology for the production of methanol, formaldehyde,ethyleneoxide, butene and cumene Chemical reactions of hydrocarbons like decomposition (thermal and catalytic) Properties of crude oil, octane number. Distillation (Atmosphericand vacuum distillation), petroleum products and their quality control tests. Value addition of petrochemicals: from feed stock to consumer end products. Gaseous Fuels: Natural gas, Synthetic gas; their composition and properties. Producer gas, water gas, Coal gas, LPG, CNG and Hydrogen as fuel.	12	0	-	12

II	**Polymer Chemistry:** Brief history of macromolecular science, basic concept of polymers, general characteristics of polymer and vcomparison with common organic compounds. Classification of polymers on the basis of structures and applications. Natural and synthetic polymers, organic & inorganic polymers, thermoplastics & thermosetting polymers. Molecular Weight of polymers, Number average, weight average. Types of polymerizations – addition, condensation, mechanism of polymerization–free radical, ionic (anionic and cationic), co-ordination polymerization, initiators, inhibitors. Chemistry of commercial polymers- General methods of preparation, properties and uses of the following - Teflon, polyethylene, polypropylene, polystyrene, polyesters, poly amides, polycarbonates and PVC. Phenol formal dehyde resins (Bakelite, Novolac), polyurethanes, polydienes, polycarbonates, conducting polymers [poly acetylene, polyaniline, poly (p-phenylenesulphide), polypyrrole, polythiophene]. Advances in polymers; Bio-Polymers, biomaterials, polymer in gas medical field, High temperature and fire resistant polymers – Silicones.	13	0	-	13

III	**Chemical Safety and Ethical Handling of Chemicals:** Safe working practices and protective environment, protective apparel, emergency procedure and first aid, laboratory ventilation. Safe storage and use of hazardous chemicals, Flammable or explosive ehazards, Procedures for working with hazardous substances, Procedures for working with gases at pressures above or below atmospheric level. Safe storage and disposal of waste chemicals. Recovery, recycling and reuse of laboratory chemicals. Procedure for laboratory disposal of explosives. Identification, verification and segregation of laboratory waste. Disposal of chemicals in the sanitary sewer system. Incineration and transportation of hazardous chemicals.	7	0	-	7

FYUGP
DETAILED SYLLABUS OF 3rd SEMESTER

Title of the Course: Industrial Chemistry of Petrochemicals and polymer Products: Lab

Course Code : SEC-303 Lab

Nature of the Course : SKILL ENHANCEMENT COURSE

Total Credits : 1

Distribution of Marks : 15

Sl No	Experimental Work	Marks
I	***Any one experiment:*** (i) Determination of saponification value of petroleum sample. (ii) Determination of density of fuelsample. (iii) Preparation of urea-formaldehyde resin. (iv) Preparationsof novalac resin/resol resin. (v) Determination of molecular weight of different polymers in water by viscometry.	**12**
	Viva-voce	**03**

COURSE OUTCOMES: (CO)

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

- **CO1***:* Understand the relevance of petrochemical industry and getin-depth knowledge of petroleum industries in India.
- **CO2**: Understand the basic petrochemical feed stocks and recognize the primary raw materials for various petrochemicals
- **CO3**: Understand the role of hydrocarbons as starting materials for manufacture of various petrochemicals, feedstock, and consumer commodities.
- **CO4**: Learn various test methods used to qualify different types of petrochemicals.
- **CO5**: Know about the history of polymeric materials and their classification
- **CO6**: Learn about different mechanisms of polymerization, properties and applications of various useful polymers in our daily life.
- **CO7**: Evaluate environmental issues pertaining to the chemical industry and get familiar with the safe working practices in chemistry laboratory.

Cognitive map of course outcomes with Bloom's Taxonomy:

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual			CO2			
Conceptual		CO1	CO4	CO3		
Procedural					CO5	
Metacognitive						

TEXT BOOKS:

1. E.Stocchi: Industrial Chemistry, 1st Edition, 2018, Vol-I, Ellis Horwood Ltd.UK.
2. N. B. Singh, S. S. Das, An Introduction to Polymer science and Technology, 1st Edition, 2005, New Age Internal Publisher, New Delhi
3. F.W.Billmeyer, Text book of Polymer Science, 1st Edition, 2020, John Wiley & Sons, NewYork
4. B.K.Sharma, Polymer Chemistry, Goel Publishing House, 2nd Edition, 2019.

REFERENCE BOOKS:

1. J.A.Kent: Riegel's Handbook of Industrial Chemistry, 1st Edition, 2006, CBS Publishers, NewDelhi.
2. P.C.Jain, M.Jain: Engineering Chemistry, 3rd Edition, 2009, Dhanpat Rai & Sons, Delhi.

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FYUGP
DETAILED SYLLABUS OF 4thSEMESTER

Title of the Course : Chemistry C5: Inorganic
Course Code : C-405
Nature of the Course : CHEMISTRY MAJOR
Total Credits : 3
DistributionofMarks : 45 (End Sem) + 40 (In-Sem)

OBJECTIVES:

- To develop the knowledge of chemistry inrelation to nuclear chemistry.
- To develop the knowledge of chemistry inrelation to various statistical methods of analysis
- To develop the preliminary idea on organometallic chemistry
- To introduce various organic reagents and their applications in inorganic analysis

UNITS	CONTENTS	L	T	P	Total Hours
I	**Nuclear Chemistry**: Nuclear structure, mass defect, binding energyand stabilityof nuclei, nuclear transmutations and artificial radioactivity, fundamentals of radioactive decay, nuclear reactions including fission and fusion reactions, nuclear reactor and its components, measurement of radioactivity, analytical applications of nuclear reactions and radioactive tracers - in studying reaction mechanism, in diagnosis and treatment of diseases, in industry, in agriculture, in analytical chemistry, in determination of the age of the earth by rock dating methodand determination of the age of recent objects by radio carbon dating method.	**16**	**-**	**-**	**16**
II	**Statistical Methods of Analysis**: Accuracy, precession, deviation, standard deviation, classification of errors, minimization of errors, significant figures. Indicators: choice of indicators in neutralization, redox, adsorption and complexometric reactions.	**10**	**-**	**-**	**10**
III	**Organometallic Chemistry-I:** Definition and classification of organometallic compounds on the basis of bond type. Concept of hapticity of organic ligands. Metal carbonyls: 18-electron rule, electron count of mononuclear, polynuclear and substituted metal carbonyls of3*d* series. Structures of mononuclear and binuclear carbonyls of Cr, Mn, Fe, Co and Ni using VBT. Oxidative addition and reductive elimination reaction, π-acceptor behaviour of CO (MO diagram of CO to be discussed), synergic effect and use of IR data to explain extent	**11**	**-**	**-**	**11**

	of back bonding. Zeise's salt: preparation and structure, evidences of synergic effect and comparison of synergic effect with that in carbonyls.				
IV	**Organic Reagents in Inorganic Analysis**: Cupferron, dithizone, benzoin-α-oxime, 1-nitroso-2- naphthol, diphenyl carbazide, diphenyl carbazone, salicylaldoxime, 1,10-phenanthroline, magneson, thiourea, zinc uranyl acetate, oxine.	**08**	**-**	**-**	**08**

Where,

L: Lectures ***T: Tutorials*** ***P: Practical***

MODES OF IN-SEMESTER ASSESSMENT: **40 Marks**

- **Two Internal Examination-** **20 Marks**
- **Others -** **20 Marks**
  - Assignment/Seminar
  - Lab notebook/Attendance
  - Group Discussion

FYUGP
DETAILED SYLLABUS OF 4th SEMESTER

Title of the Course : Chemistry C5: Inorganic
Lab Course Code : C-405 Lab
Nature of the Course : CHEMISTRY MAJOR
Total Credits : 1
DistributionofMarks : 15

Sl No	**Experimental Work**:	Marks
I	(Any One) A. Estimation of Ca^{2+} and $Mg^{2+}$by EDTA B. Estimation of Cu^{2+} by iodometric method	12
II	**Viva-Voce**	**03**

COURSE OUTCOMES:
By the end of this programme, students will be able to-

CO1: To define mass defect, binding energy, accuracy, precession, etc.

CO2: To identify different organic reagents in inorganic analysis
CO3: Todistinguishnuclearfissionandfusionreactions
CO4: To explain18 electron rule
CO5: To elucidate the structures of mononuclear and binuclear carbonyls using VBT
CO6: To apply organic reagents in inorganic analysis
CO7: To estimate Ca^{2+}andMg^{2+} by EDTAand $Cu^{2+}$by iodometric method

Cognitive map of course outcomes with Bloom's Taxonomy:

Knowledge Dimension	**Remember**	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Create**
Factual	CO1					
Conceptual		CO2,CO3	CO4, CO5, CO6			
Procedural					CO7	
Metacognitive						

TEXT BOOKS:

1. Inorganic Chemistry–J.E. Huheey, E. A. Keiter, R. L. Keiter and O.K. Medhi; (Pearson), 4th Edition, 2006.
2. Inorganic Chemistry–Puri, Sharma and Kalia (Milestone), 1st Edition, 2007-2008.
3. Advanced Inorganic Chemistry by S Prakash, G D Tuli, SK Basu, RD Madan (S Chand), 26th Edition, 2016.

REFERENCE BOOKS:

1. Selected Topics in InorganicChemistry—Wahid U. Malik, G.D.Tuli and R.D.Madan. (S. Chand & Co. Ltd.)
2. Advanced Inorganic Chemistry–Satyaprakash, Basu, Tuli
3. Inorganic Chemistry–J.D.Lee
4. Basic Inorganic chemistry–Cotton and Wilkinson

FYUGP
DETAILED SYLLABUS OF 4th SEMESTER

Title of the Course	**:**	**Chemistry C6: Physical Chemistry**
Course Code	**:**	**C-406**
Nature of the Course	:	**CHEMISTRY MAJOR**
Total Credits	:	3
Distribution of Marks	**:**	**45 (EndSem) + 40 (In-Sem)**

COURSE OBJECTIVES:

- To gain detailed knowledge on chemical kinetics, catalysis and surface chemistry.

UNITS	CONTENTS	L	T	P	Total Hours
I	**Chemical Kinetics:** Order and Molecularity of a reaction, elementary and complex reactions rate laws, differential and integral forms of rate equations of zero,1st, 2nd order reactions, half life periods of 1st and 2nd order reactions, determination of order of reaction by method of integration, half life period, differential method, isolation method, evaluation of rate constant, integrated equation method, graphical method, Guggenheim method (1st order reaction), rate laws and mechanism, steady state approximation. Rate equation of first order, opposite, parallel, consecutive reaction, chain reactions, chain branching, explosion limit, Hydrogen – Bromine thermal reaction. Temperature dependence of reaction rates, Arrhenius equation, energy of activation, collision theory of bimolecular reactions, its limitation. Introduction to activated complex theory, Lindeman's theory of unimolecular gas phase reaction.	**20**	**0**	**-**	**20**
II	**Surface Chemistry** Physical and chemical adsorption of gases on solid surface, adsorption isotherms, types of adsorption isotherm, Freundlich equation, Langmuir adsorption equation. Determination of surface area. Gibbs adsorption equation, application of adsorption in chemical analysis and in industry.	**15**	**0**	**-**	**15**

Where, L: Lectures T: Tutorials P: Practical

MODES OF IN-SEMESTER ASSESSMENT: **40 Marks**

- **Two Internal Examination-** **20 Marks**
- **Others -** **20 Marks**
    - Assignment/Seminar
    - Lab notebook/Attendance
    - Group Discussion

FYUGP
DETAILED SYLLABUS OF 4th SEMESTER

Title of the Course : Chemistry C6: Physical
Lab Course Code : C-406 Lab
Nature of the Course : CHEMISTRY MAJOR
Total Credits : 1
Distribution of Marks : 15

Sl No	EXPERIMENTAL WORK	Marks
I	**(Any one)** a) To determine the rate constant of hydrolysis of methyl acetate catalyzed by hydrogen ion concentration at room temperature. b) To determine the rate constant of Saponification of ethyl acetate. c) Compare the strengths of HCl and $H_2SO_4$by studying kinetics of hydrolysis of methyl acetate. d) To study the kinetics of iodination of propanone in acidic medium. e) To study the rate constant of the hydrolysis of Sucrose by polarimeter.	**12**
II	**Viva-Voce**	**03**

COURSE OUTCOMES:
After the completion of this course, the learner will be able to:

CO1: Develop a comprehensive understanding of chemical kinetics, surface chemistry, and catalysis principles and their applications.

CO2: Apply theoretical knowledge and experimental techniques to analyze reaction mechanisms, rate laws, and surface phenomena.

CO3: Evaluate the factors influencing reaction rates, adsorption processes, and catalytic mechanisms using kinetic data and experimental results.

CO4: Apply critical thinking skills to design experiments, interpret experimental data, andsolve problems related to reaction kinetics and surface chemistry.

Cognitive map of course outcomes with Bloom's Taxonomy:

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual	CO1					
Conceptual			CO2,CO3			
Procedural					CO4	
Metacognitive						

TEXT BOOKS:

1. Principles of Physical Chemistry, Puri, Sharma, Pathania (Vishal), 47th Edition, 2018.
2. A Text Book of Physical Chemistry–Negi &S.C.Anand, (New Age), 2nd Edition, 2005.

REFERENCE BOOKS:

1. Physical Chemistry--Atkins, P.W. & Paula, J.
2. Physical Chemistry, Castellan G.W., Narosa Publishing
3. Physical Chemistry–P.W.Atkins,Oxford UniversityPress
4. Advanced Physical Chemistry–J.N. Gurta & H. Snehi, Pragati Prakashan

FYUGP
DETAILED SYLLABUS OF 4th SEMESTER

Title of the Course	**:**	**Chemistry C7: Organic Chemistry**
Course Code	**:**	**C-407**
Nature of the Course	**:**	**CHEMISTRY MAJOR**
Total Credits	**:**	**3**
Distribution of Marks	**:**	**45 (EndSem) + 40 (In-Sem)**

OBJECTIVES:

- To make the students familiar about chemistry of carbonylcompounds, carboxylic acids, thiols and amines.
- To provide knowledge about natural as well as synthetic polymers.

UNITS	CONTENTS	L	T	P	Total Hours
I	**Carbonyl Compounds:(AliphaticandAromatic)** **Part A:** Structure, reactivity and preparation;Nucleophilic additions, Nucleophilic addition-elimination reactions with ammoniaderivatives with mechanism; Mechanisms of Aldol and Benzoin condensation, Knoevenagelcondensation, Claisen-Schmidt, Perkin, Cannizzaro and Wittig reaction, Clemmensen, Wolff-Kishner, MPV reduction. Addition reactions of unsaturated carbonyl compounds: Michael addition.Unsaturated Aldehydes (Acrolein, Crotonaldehyde, Cinnamaldehyde) Unsaturated Ketone (MVK)	**10**	**0**	**-**	**10**
	PartB Active methylene compounds: Keto-enol tautomerism. Preparation and synthetic applications of diethyl malonate and ethyl acetoacetate, malanonitrile.	**04**	**0**	**-**	**04**
II	**Carboxylic Acids and their Derivatives:(Aliphatic and Aromatic):** Preparation, physical properties, and reactions of monocarboxylic acids (Acidity and factors affecting it): Preparation and reactions of acid chlorides, anhydrides, esters and amides; Comparative study of nucleophilic substitution at acyl group-Mechanism of acidic and alkaline hydrolysis of esters, Claisen condensation, Dieckmann and Reformatsky reactions, Hofmann-bromamide degradation Dicarboxylic acids: Oxalic acid, malonic acid, and	**10**	**0**		**10**

	succinic acid Hydroxy acids: lactic acid, tartaric acid, citric acid and salicylic acid.				
III	**Sulphur containing compounds:** Preparation and reactions of thiols, Thio ethers and sulphonic acids.	**03**	**0**	**-**	**03**
IV	**Nitrogen Containing Functional Groups (Aromatic and Aliphatic)** Preparation and important reactions of nitro compounds, nitriles and isonitriles Amines: Effect of substituent and solvent on basicity; Preparation and properties: Gabriel phthalimide synthesis, Carbylamine reaction, Mannich reaction, Hoffmann's exhaustive methylation, Hofmann-elimination reaction; Distinction between 1°, 2° and 3° amines with Hinsberg reagent and nitrous acid. Diazonium Salts: Preparation and their synthetic applications. Diazomethane & Diazoacetic Ester with Synthetic application.	**10**	**-**	**0**	**10**
V	**Polymers** Introduction and classification of polymers; Polymerisation reactions -Addition and condensation - Mechanism of cationic, anionic and free radical addition polymerization; Ziegler-Natta polymerisation of alkenes; Preparation and applications of plastics – thermosetting (phenol-formaldehyde, Polyurethanes) and thermosoftening (PVC, polythene); Fabrics – natural and synthetic (acrylic, polyamido, polyester); Rubbers – natural and synthetic: Buna-S, Chloroprene and Neoprene; Vulcanization;Polymeradditives; Biodegradable polymers with examples.	**08**	**-**	**-**	**08**

Where, ***L: Lectures*** ***T: Tutorials*** ***P: Practicals***

MODES OF IN-SEMESTER ASSESSMENT: **40 Marks**

- Two Internal Examination - **20 Marks**
- Others (Anyone) - **20 Marks**
  - Home Assignment
  - Seminar presentation on any of the relevant topics

FYUGP
DETAILED SYLLABUS OF 4th SEMESTER

Title of the Course : Chemistry C7: Organic Lab
Course Code : C-407 Lab
Nature of the Course : CHEMISTRY MAJOR
Total Credits : 1
Distribution of Marks : 15

Sl No	EXPERIMENTAL WORK	Marks
I	**(Any one)** Systematic qualitative analysis of organi ccompounds having -OH, $-NH_2$,$-NO_2$, $-CONH_2$, -CHO, -COOH, $-CONH_2$groups.	12
II	Viva-Voce	03

COURSE OUTCOMES:

By the end of this course students will be able to

CO1: gain knowledge about the preparation and properties of aldehyde, ketone, carboxylic acid, thiols, amines, etc.

CO2: Understand and analyze the mechanisms of key name reactions involving organic compounds, such as Aldol condensation, Cannizzaro reaction, and Hofmann rearrangement.

CO3: Develop skills on systematic qualitative analysis of organic compounds containing functional groups such as -OH, -NH2, -NO2, -CONH2, -CHO, and -COOH.

Cognitive map of course outcomes with Bloom'sTaxonomy:

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual	CO1		CO2			
Procedural					CO3	
Metacognitive						

TEXT BOOKS:

1. Organic Chemistry–B.S.Bahl and, A. Bahl (Vol. I&II) (S Chand), 2nd Edition, 2015.
2. Advanced General Organic Chemistry (Part I and Part II)-S. C.Ghosh (NCBA) 3rd Edition, 2019.

REFERENCE BOOKS:

1. Organic Chemistry–M.K.Jain, S.Chand & Co.
2. A Text Book of Organic Chemistry (Vol.I&II)–B.K. Sharma, G.P. Pokhriji and S.K. Sharma, (S. Chand & Co.)
3. Organic Chemistry–I.L.Finar,Vol.I&II,ELBS

4. Organic Chemistry, R.I.Morrison & R.N.Boyd,S.K. Bhattacharjee
5. Organic Chemistry–Vol.I & II, Mukherjee and Kapoor
6. Organic Chemistry (Oxford)-Clayden, Warren, Greeves and Wothers.
7. Organic Reactions and their Mechanisms (New Age International Private Limited)-P.S.Kalsi.

FYUGP
DETAILED SYLLABUS OF 4th SEMESTER

Title of the Course: Chemistry C8: Symmetry & Quantum Chemistry
Course Code : C -408
Nature of the Course : CHEMISTRY MAJOR
Total Credits : 3
DistributionofMarks : 45 (End Sem) + 40 (In-Sem)

COURSEOBJECTIVES:

- To make the students familiar with symmetry elements & point groups and thevarious aspects of basic quantum mechanics with specialreference to classical mechanics.

UNITS	CONTENTS	L	T	P	Total Hours
I	**Symmetry&GroupTheory-I** Symmetry elements and symmetry operations. Definition of group, symmetry group, point group. Perspective sketch and point group of some common molecules (H_2, HF, CO_2, C_2H_2, C_2H_4, $CHCl_3$, PCl_5, NH_3, BF_3, $[PtCl_4]^{2-}$, BrF_5). Symmetry and mathematical tools, matrix algebra, reducible and irreducible representation, great orthogonality theorem (deduction not necessary), Character table for C_{2v} and C_{3v} point groups.	**15**	**0**	**-**	**15**
II	**QuantumChemistry-I** Background of quantum mechanics; Black body radiation – Planck's hypothesis, photoelectric effect, de Broglie hypothesis and Heisenberg's uncertainty principle. Postulates of quantum mechanics, quantum mechanical operators (Linear and Hermitian operators), Wave functions, Normalized and Orthogonal Wave Functions. Schrödinger equation and its application to free particle and "particle-in-a-box" (rigorous treatment), quantization of energy levels, zero-point energy; wave functions, probability distribution functions, nodal properties, separation of variables, two- and three-dimensional boxes, degeneracy. Qualitative treatment of simple harmonic oscillator model of vibrational motion: Setting up of Schrödinger equation and discussion of solution and wavefunctions. Vibrational energy of diatomic molecules and zero-point energy. Angular momentum: Commutation rules, quantization of square of total angular momentum and z-component. Rigid rotator model of rotation of diatomic molecule: Schrödinger equation and its solution.	**30**	**0**	**-**	**30**

	Qualitative treatment of hydrogen atom and hydrogen-like ions: setting up of Schrödinger equation in spherical polar coordinates, radial part, energy (only final energy expression).Average and most probable distances. Setting up of Schrödinger equation for many- electron atoms (He, Li). Need for approximation methods. Statement of variation theorem and application to simple systems (particle-in-a-box, harmonic oscillator, hydrogenatom).				

Where, ***L: Lectures*** ***T: Tutorials*** ***P: Practicals***

MODES OFIN-SEMESTERASSESSMENT: **40 Marks**

- Two Internal Examination - **20 Marks**
- Others(Anyone) - **20 Marks**
    - Home Assignment
    - Seminar presentation on any of the relevant topics

FYUGP
DETAILEDSYLLABUSOF4th SEMESTER

Title of the Course : Chemistry C8: Symmetry & Quantum Chemistry Lab
Course Code : C – 408 Lab
Nature of the Course : CHEMISTRY MAJOR
Total Credits : 1
Distribution of Marks : 15

Sl No	EXPERIMENTAL WORK:	Marks-
I	**pH-metry and Polarimetry(Any one experiment)** (i) pH metric titration (a) strong acid vs.strong base (b) weak acid vs. strong base (c) strong acid vs.weak base (ii) Preparation of buffer solutions of different pH (a) Sodium acetate-acetic acid (b) Ammonium chloride-ammonium hydroxide (c) Determination of dissociation constant of weak acid (CH_3COOH) / base (NH_4OH) (iii) To determine the concentration of an optically active substance by polarimetric method.	**12**
II	**Viva-Voce**	**03**

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

CO1: To underst and of symmetry and group theory principles, quantum mechanics foundations, and experimental techniques in analytical chemistry.

CO2: Apply theoretical knowledge and experimental skills to identify molecular symmetries, analyze quantum mechanical systems, and conduct analytical experiments.

CO3: Evaluate molecular structures, wave functions, and experimental data to assess symmetry elements, energy levels, and chemical concentrations.

CO4: Apply critical thinking skills to solve problems related to molecular symmetry, quantum mechanics, and experimental analysis in chemistry.

CO5: Perform pH metric titrations; prepare buffer solutions to analyze the interaction between different types of acids and bases, including strong acid vs.strong base, weak acid vs. strong base, and strong acid vs. weak base.

CO6: Determine the concentration of optically active substances through polarimetric methods, enhancing the understanding of optical activity and its applications in chemical analysis.

Cognitive map of course outcomes with Bloom'sTaxonomy:

Knowledge Dimension	**Remember**	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Create**
Factual		CO1			CO3	
Conceptual			CO2, CO4			
Procedural		CO5,	CO6			
Metacognitive						

Text Books:

1. Quantum Chemistry– Ira N. Levine, PHI, New Delhi, 7th Edition, 2013 (Pearson)
2. Quantum Chemistry– R.K. Prasad, 2nd Edition (New Age), 2001.
3. Chemical Applications of GroupTheory-F.A.Cotton, (Wiley Eastern Ltd., New Delhi), 3rd Edition, 1989.

Ref. Books:

1. Quantum Chemistry, A.K.Chandra, Tata-McGraw, 1st Edition, 1974.
2. Quantum Chemistry, B. K.Sen, 5th Edition 2020, (Kalyani)

FYUGP
DETAILED SYLLABUS OF 4th SEMESTER

Title of the Course	**:**	**Fundamentals of Chemistry-4**
Course Code	**:**	**MINOR-404**
Nature of the Course	**:**	**CHEMISTRY MINOR**
Total Credits	**:**	**3**
DistributionofMarks	**:**	**45 (EndSem) + 40 (In-Sem)**

COURSE OBJECTIVES:

- To develop the knowledge about industrial chemistry like-glass, ceramics and cements.
- To develop the knowledge about nuclear chemistry.
- To study the principles of chemical kinetics and the properties of different types of solutions.
- To study the preparations and the properties of arylhalides, alcohols, phenols and ethers.

UNITS	CONTENTS	L	T	P	Total Hours
I	**Introduction toIndustrial Chemistry:** **Glass**: Glassy state and its properties, classification (silicate and nonsilicateglasses). Manufacture and processing of glass. Composition and properties ofthe following types of glasses: Sodalimeglass, lead glass, safety glass, borosilicate glass, coloured glass, **Ceramics**: Important clays and feldspar, ceramic, their types and manufacture. Fullerenes carbon nanotubes and carbon fibre. **Cements**: Classification of cement, ingredients and theirrole, Manufacture of Cement and the setting process,quick settingcements	**07**	**0**	**-**	**07**
	Nuclear Chemistry: Nuclear structure, Mass defect, Binding energy and stability of nuclei, Nuclear transmutations and Artificial radioactivity, Fundamentals of radioactive decay, Nuclear reactions including fission and fusion reactions, Analytical applications of Nuclear Reactions and Radioactive tracers	**06**	**0**	**-**	**06**
II	**Chemical Kinetics** The concept of reaction rates. Effect of temperature, pressure, catalyst and other factors on reaction rates. Order and molecularity of a reaction. Derivation of integrated rate equations for zero, first and second order reactions. Half–life of a reaction. General methods for determination of order of a reaction. Concept of activation energy and its calculation from the Arrhenius equation. Theories of Reaction Rates:	**08**			**08**

	Collision theory and Activated Complex Theory of Bimolecular Reactions. Comparison of the two theories (qualitative treatment only).				
	Solutions Types of solutions, concentration units, Solution of gases in liquids-Henry's law. Solution of liquids in liquids: Thermodynamics of ideal solutions: Ideal solutions and Raoult's law, deviations from Raoult's law – non-ideal solutions. Vapour pressure-composition and temperature composition curves of ideal and non-ideal solutions. Distillation of solutions. Lever rule, Azeotropes. Partial miscibility of liquids: Critical solution temperature; effect of impurity on partial miscibilityof liquids. Immiscibility of liquids-Principle of steam distillation. Nernst distribution law and its applications, solvent extraction. Solutions of solids in liquids: the solubility curves.	07			07
III	**Aryl Halides**: Preparation (Chloro, Bromo&Iodo benzene only): From phenol, Sandmeyer and Gattermann reaction. Reactions: (Chlorobenzene) Aromatic Nucleophilic substitution (replacement by – OH) and effect of Nitro Substituent Reactivity and relative strength of Carbon-halogen Bond in alkyl, allyl, vinyl and Aryl Halide.	**08**			**08**
	Alcohols,Phenolsand Ethers: Alcohols: Preparation: Preparation of 1°, 2° and 3° alcohols: using Grignard reagent, Ester hydrolysis, Reduction of aldehydes, ketones, carboxylic acid and esters. Reactions: With sodium, HX (Lucas test), esterification, oxidation (with PCC, alk. $KMnO_4$, acidic dichromate, conc. HNO_3). Diols: oxidation of diols. Pinacol-Pinacolone rearrangement. Phenols: Preparation: Cumenehydroperoxidemethod, from diazonium salts. Reactions: Electrophilic substitution: Nitration, halogenation and sulphonation. Reimer-Tiemann Reaction Ethers (aliphaticandaromatic): Cleavage of ethers With HI.	**09**			**09**

Where, ***L:Lectures*** ***T:Tutorials*** ***P:Practicals***

MODES OFIN-SEMESTERASSESSMENT: **40 Marks**

- Two Internal Examination - **20 Marks**
- Others(Anyone) - **20 Marks**
    - Home Assignment
    - Seminar presentation on any of the relevant topics

FYUGP
DETAILED SYLLABUS OF 4th SEMESTER

Title of the Course : Fundamentals of Chemistry-4 Lab
Course Code : MINOR -404 Lab
Nature of the Course : CHEMISTRY MINOR
Total Credits : 1
Distribution of Marks : 15

Sl No	Experimental Work:	Marks
I	**Inorganic VolumetricAnalysis: (any one)** i. Estimation of Fe (II) ions by titrating it with $K_2Cr_2O_7$ using internal indicator. ii. Estimationofoxalicacidbytitratingitwith $KMnO_4$ iii. Estimation of water of crystallizationin Mohr's salt by titrating with $KMnO_4$ iv. Estimation of Fe (II) ions bytitratingitwith $KMnO_4$. v. Estimation of Cu(II) ions iodo metrically using $Na_2S_2O_3$	**12**
II	**Viva-Voce**	03

COURSE OUTCOMES:

By the end of this course, studentswill be ableto-

CO1: Recall key concepts in industrial chemistry, nuclear chemistry, chemical kinetics, and solution chemistry.

CO2: Develop a comprehensive understanding of the principles underly ingindustrial chemistry, nuclear chemistry, chemical kinetics, and solution chemistry.

CO3: Apply theoretical knowledge and experimental skills to analyze and solve problems related to industrial processes, reaction kinetics, and solution behavior.

CO4: Analyze reaction mechanisms, solution properties and experimental data to draw conclusions and make predictions.

CO5: Evaluate the effectiveness of reaction mechanisms, solution properties and experimental procedures to assess their reliability and accuracy.

CO6: Design experiments, propose solutions, and develop new methodologies to address challenges in chemistry and enhance understanding of chemical phenomena.

Cognitive map of course outcomes with Bloom'sTaxonomy:

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual	CO1		CO3	CO4		
Conceptual		CO2			CO5	
Procedural					CO6	
Metacognitive						

TEXT BOOKS:

1. Inorganic Chemistry–J.E. Huheey, E. A. Keiter, R. L. Keiter and O.K. Medhi; (Pearson), 4th Edition, 2006.
2. Inorganic Chemistry–Puri, Sharma and Kalia (Milestone), 1st Edition, 2007-2008.
3. Principles of Physical Chemistry, Puri, Sharma, Pathania (Vishal), 47th Edition, 2018.
4. A Text Book of Physical Chemistry–Negi & S.C.Anand, (New Age), 2nd Edition, 2005.
5. Organic Chemistry–B.S.Bahl and, A. Bahl (Vol. I & II) (S Chand), 2nd Edition, 2015.
6. Advanced General Organic Chemistry (Part I and Part II)-S. C.Ghosh (NCBA) 3rd Edition, 2019.

REFERENCE BOOKS:

1. Selected Topics in InorganicChemistry—Wahid U. Malik, G.D.Tuli and R.D.Madan. (S. Chand & Co. Ltd.)
2. Advanced Inorganic Chemistry–Satyaprakash, Basu, Tuli
3. Inorganic Chemistry–J.D.Lee
4. Basic Inorganic chemistry–Cotton and Wilkinson
5. Physical Chemistry--Atkins, P.W. & Paula, J.
6. Physical Chemistry, Castellan G.W., Narosa Publishing
7. Physical Chemistry–P.W.Atkins,Oxford UniversityPress
8. Advanced Physical Chemistry–J.N. Gurta & H. Snehi, Pragati Prakashan
9. OrganicChemistry–M.K.Jain, S.Chand & Co.
10. A Text Book of Organic Chemistry (Vol.I&II)–B.K. Sharma, G.P. Pokhriji and S.K. Sharma, (S. Chand & Co.)
11. Organic Chemistry–I.L.Finar,Vol.I&II,ELBS
12. Organic Chemistry, R.I.Morrison & R.N.Boyd,S.K. Bhattacharjee
13. Organic Chemistry–Vol.I & II, Mukherjee and Kapoor
14. Organic Chemistry (Oxford)-Clayden, Warren, Greeves and Wothers.
15. Organic Reactions and their Mechanisms (NewAgeInternational Private Limited)-P.S.Kalsi.