Department of Chemistry

Scheme of Integrated B.Sc. (Physical Sciences) – M.Sc. Chemistry Programme

Under Multiple Entry and Exit, Internship and

CBCS-LOCF as per NEP-2020

***w.e.f.* session 2024-25**

Guru Jambheshwar University of Science &Technology
Hisar-125001, Haryana

(A$^+$ NAAC Accredited State Govt. University)

Guru Jambheshwar University of Science and Technology
Hisar-125001, Haryana
('A+' NAAC Accredited State Govt. University)

Scheme of Examination for UTD for the session 2024-25
As per Scheme-A for UTD
Name of the Programme: Integrated B.Sc. (Physical Sciences)-M.Sc. Chemistry
According to National Education Policy-2020

FIRST YEAR

SEMESTER-I

Type of Course	Course Code	Nomenclature of Paper/Course	Credits	Contact Hours	Internal Marks	External Marks	Total Marks	Duration of Exam (Hrs)
Discipline Specific Course	24CHE0101T	Chemistry-I	3	3	20	50	70	2.5
	24CHE0101P	Chemistry-I Lab	1	2	10	20	30	3
	24PHY0101T	Mechanics	3	3	20	50	70	2.5
	24PHY0101P	Mechanics Lab	1	2	10	20	30	3
	24MAT0101T	Basic Algebra and Number Theory	4	4	30	70	100	3
Minor Course/ Vocational Course		To be opted from the Pool of MIC	2	2	15	35	50	2
Multidisciplinary Course		To be opted from the Pool of MDC	3	3	25	50	75	2.5
			OR					
		To be opted from the Pool of MDC	2	2	15	35	50	2
			1	2	10	15	25	3
Ability Enhancement Course	24AEC0101T	English for Effective Communication-I	2	2	15	35	50	2
Skill Enhancement Course	24SEC0107P	Practical Approach to Chemical Analysis	3	6	25	50	75	4.5
Value Added Course	24VAC0101T	Environmental Studies-I	2	2	15	35	50	2
			24				600	

SEMESTER-II

Type of Course	Course Code	Nomenclature of Paper/Course	Credits	Contact Hours	Internal Marks	External Marks	Total Marks	Duration of Exam (Hrs)
Discipline Specific Course	24CHE0201T	Chemistry-II	3	3	20	50	70	2.5
	24CHE0201P	Chemistry-II Lab	1	2	10	20	30	3
	24PHY0201T	Heat and Thermodynamics	3	3	20	50	70	2.5
	24PHY0201P	Heat and Thermodynamics Lab	1	2	10	20	30	3
	24MAT0201T	Calculus	4	4	30	70	100	3
Minor Course/ Vocational Course		To be opted from the Pool of MIC	2	2	15	35	50	2
Multidisciplinary Course		To be opted from the Pool of MDC	3	3	25	50	75	2.5
			OR					
		To be opted from the Pool of MDC	2	2	15	35	50	2
			1	2	10	15	25	3
Ability Enhancement Course	24AEC0102T	हिन्दी का व्याकरणिक ज्ञान	2	2	15	35	50	2
Skill Enhancement Course	24SEC0207P	Purification and Analytical Techniques	3	6	25	50	75	4.5
Value Added Course	24VAC.....	To be opted from the Pool of VAC	2	2	15	35	50	2
			24				600	

SEMESTER - III

pe of Course	Course Code	Nomenclature	Credits	Hours/Week	Marks			Exam Hrs
					External	Internal	Total	
scipline Specific urse (DSC)	24CHE0301T	Chemistry - III	3	3	50	20	70	2.5
	24CHE0301P	Chemistry – III Lab	1	2	20	10	30	3
scipline Specific urse (DSC)	24PHY0301T	To be opted Discipline Specific Course (DSC)T	3	3	50	20	70	2.5
	24PHY0301T	Discipline Specific Course (DSC)P	1	2	20	10	30	3
cipline Specific urse (DSC)	24MAT0301T	To be opted Discipline Specific Course (DSC)T	4	4	70	30	100	3
nor Course (MIC)		*To be opted from the Pool of* Minor Course *(MIC)*	4	4	70	30	100	3
ltidisciplinary urse (MDC)		*To be opted from the Pool of Multidisciplinary Courses (MDC)*	3	3	50	25	75	2.5
ill Enhancement urse (SEC)		*To be opted from the Pool of Skill Enhancement Courses (SEC)*	3	3	50	25	75	2.5
ility Enhancement urse (AEC)		*To be opted from Pool of Ability Enhancement Courses (AEC)*	2	2	35	15	50	2
			24	**26**	**415**	**185**	**600**	

SEMESTER - IV

pe of Course	Course Code	Nomenclature	Credits	Hours/Week	Marks			Exam Hrs
					External	Internal	Total	
cipline Specific urse (DSC)	24CHE0401T	Chemistry - IV	3	3	50	20	70	2.5
	24CHE0401P	Chemistry – IV Lab	1	2	20	10	30	3
cipline Specific urse (DSC)	24PHY0401T	*To be opted from the Pool of Discipline Specific Courses (DSC)*	3	3	50	20	70	2.5
	24PHY0401P	*To be opted from the Pool of Discipline Specific Courses (DSC)*	1	2	20	10	30	3
cipline Specific urse (DSC)	24MAT0401T	*To be opted from the Pool of Discipline Specific Courses (DSC)*	4	4	70	30	100	4
nor Course cational) (MIC) OC)		*To be opted from the Pool of Minor Courses (Vocational) (MIC) (VOC)T*	2	2	35	15	50	2
		To be opted from the Pool of Minor Courses (Vocational) (MIC) (VOC)P	2	4	35	15	50	2
ue Added Course C)		*To be opted from the Pool of Value Added Courses (VAC)*	2	2	35	15	50	2
ity Enhancement rse (AEC)		*To be opted from Pool of Ability Enhancement Courses (AEC)*	2	2	35	15	50	2
			20	**24**	**350**	**150**	**500**	

16/4/25 16/4/25 16/4/25 16/4/25 16/4/25 16/4/25 16/4/25

(ii) Students exiting the programme after second semester and securing 52 credits including 4 credits of summer internship will be awarded UG certificate in the relevant Discipline/ Subject.

(iii) Students exiting the programme after fourth semester and securing 96 credits including 4 credits of summer internship will be awarded UG Diploma in the relevant Discipline/ Subject.

(iv) Students will be awarded 3-year UG Degree in the relevant Discipline/ Subject upon securing 132 credits including 4 credits of summer internship.

(v) Four credits of internship earned by a student during summer internship after 2nd semester or 4th semester will be counted in 5th semester of a student who pursue 3-year UG Programme without taking exit option.

(vi) The internship will be governed by the prevailing rules of the University from time to time.

Guru Jambheshwar University of Science and Technology
Hisar-125001, Haryana
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Scheme and Syllabus of courses offered
by
Department of Chemistry
w.e.f. Session 2024-25
1st Year

SEMESTER - I

Type of Course	Course Code	Nomenclature	Credits	Hours/Week	Marks			Exam Hours
					External	Internal	Total	
Discipline Specific Course (DSC)	24CHE0101T	Chemistry - I	3	3	50	20	70	2.5
	24CHE0101P	Chemistry – I Lab	1	2	20	10	30	3
Minor Course (MIC)	24MIC0120T	Periodic Properties of Elements	2	2	35	15	50	2
Multidisciplinary Course (MDC)	24MDC0107T	Analytical Methods in Chemistry	3	3	50	25	75	2.5
Skill Enhancement Course (SEC)	24SEC0107P	Practical Approach to Chemical Analysis	3	6	50	25	75	4.5
Value Added Course (VAC)	24VAC0112T	Role of Chemistry in Society	2	2	35	15	50	2

SEMESTER - II

Type of Course	Course Code	Nomenclature	Credits	Hours/Week	Marks			Exam Hours
					External	Internal	Total	
Discipline Specific Course (DSC)	24CHE0201T	Chemistry - II	3	3	50	20	70	2.5
	24CHE0201P	Chemistry – II Lab	1	2	20	10	30	3
Minor Course (MIC)	24MIC0220T	Fundamentals of Organic Chemistry	2	2	35	15	50	2
Multidisciplinary Course (MDC)	24MDC0207T	Pharmaceutical Chemistry	3	3	50	25	75	2.5
Skill Enhancement Course (SEC)	24SEC0207P	Purification and Analytical Techniques	3	3	50	25	75	4.5
Value Added Course (VAC)	24VAC0112T	Role of Chemistry in Society	2	2	35	15	50	2

ote: Students exiting the programme after second semester and securing 52 credits including 4 credits of summer internship ill be awarded UG certificate in the relevant Discipline/ Subject.

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Integrated B.Sc. (Physical Sciences) – M.Sc. Chemistry Programme

Scheme and Syllabus of courses offered
by
Department of Chemistry
w.e.f. Session 2024-25
2nd and 3rd Year

Subject: Chemistry

SEMESTER - III

Type of Course	Course Code	Nomenclature	Credits	Hours/Week	Marks			Exam Hours
					External	Internal	Total	
Discipline Specific Course (DSC)	24CHE0301T	Chemistry – III	3	3	50	20	70	2.5
	24CHE0301P	Chemistry – III Lab	1	2	20	10	30	3
Minor Course (MIC)	24MIC0320T	Phase and Ionic Equilibria	4	4	70	30	100	3
Multidisciplinary Course (MDC)	24MDC0307T	Chemical Technology and Society	3	3	50	25	75	2.5
Skill Enhancement Course (SEC)	24SEC0307P	Basic Skills for Organic Chemists	3	6	50	25	75	4

SEMESTER - IV

Type of Course	Course Code	Nomenclature	Credits	Hours/Week	Marks			Exam Hours
					External	Internal	Total	
Discipline Specific Course (DSC)	24CHE0401T	Chemistry - IV	3	3	50	20	70	2.5
	24CHE0401P	Chemistry – IV Lab	1	2	20	10	30	3
Minor Course (Vocational) (MIC) (VOC)	24VOC0420T	Functional Group Chemistry	2	2	35	15	50	2
	24VOC0420P	Functional Group Chemistry Lab	2	4	35	15	50	3
Value Added Course (VAC)	24VAC0312T	Chemistry of food	2	2	35	15	50	2

SEMESTER - V

Type of Course	Course Code	Nomenclature	Credits	Hours/Week	Marks			Exam Hours
					External	Internal	Total	
Discipline Specific Course (DSC)	24CHE0501T	Chemistry - V	3	3	50	20	70	2.5
	24CHE0501P	Chemistry – V Lab	1	2	20	10	30	3
Minor Course (Vocational) (MIC) (VOC)	24VOC0520T	Analytical Techniques	2	2	35	15	50	2
	24VOC0520P	Analytical Techniques Lab	2	4	35	15	50	3
SEC/ Internship	24CHE0502-I	Internship	4	4 Weeks (Total 120 Hrs)	----	100	100	---

SEMESTER - VI

Type of Course	Course Code	Nomenclature	Credits	Hours/Week	Marks			Exam Hours
					External	Internal	Total	
Discipline Specific Course (DSC)	24CHE0601T	Chemistry - VI	3	3	50	20	70	2.5
	24CHE0601P	Chemistry – VI Lab	1	2	20	10	30	3
Minor Course (MIC)	24MIC0620T	Biomolecules	4	4	70	30	100	3
Minor Course (Vocational) (MIC) (VOC)	24VOC0620T	Introduction to Biomolecules	3	3	35	15	50	2
	24VOC0620P	Introduction to Biomolecules Lab.	2	4	35	25	50	3

Note: Every student for the UG/UG-PG Programme shall be required to undergo 4 credits internship of minimum of 4 weeks duration before taking an exit or completing the degree programme.

(i) A student for the UG/UG-PG Programme shall be required to undergo internship during summenr vacation either after the second semester examination or after the fourth semester examination. If she/he opts to exit with Undrgraduate Certificate in the discipline, then it shall be obligatory to complete the internship after second semester examination. Howerver, for those students who have taken lateral entry into the third semester and have completed internship of minimum of 4 weeks duration during first year, the internship in not required after the fourth semester examination.

(ii) Students exiting the programme after second semester and securing 52 credits including 4 credits of summer internship will be awarded UG certificate in the relevant Discipline/ Subject.

(iii) Students exiting the programme after fourth semester and securing 96 credits including 4 credits of summer internship will be awarded UG Diploma in the relevant Discipline/ Subject.

(iv) Students will be awarded 3-year UG Degree in the relevant Discipline/ Subject upon securing 132 credits including 4 credits of summer internship.

(v) Four credits of internship earned by a student during summer internship after 2nd semester or 4th semester will be counted in 5th semester of a student who pursue 3-year UG Programme without taking exit option.

(vi) The internship will be governed by the prevailing rules of the University from time to time.

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GURU JAMBHESHWAR UNIVERSITY OF SCIENCE & TECHNOLOGY, HISAR

Minor Courses (MIC), Multidisciplinary Courses (MDC), Skill Enhancement Courses (SEC), and Value-Added Courses (VAC)

offered by

Department of Chemistry

Minor Courses (MIC)

Semester	Course Code	Nomenclature	Credits	Hours/ Week	Marks			Exam Hours
					External	Internal	Total	
Semester - I	24MIC0120T	Periodic Properties of Elements	2	2	35	15	50	2
Semester - II	24MIC0220T	Fundamentals of Organic Chemistry	2	2	35	15	50	2

Multidisciplinary Courses (MDC)

Semester	Course Code	Nomenclature	Credits	Hours/ Week	Marks			Exam Hours
					External	Internal	Total	
Semester - I	24MDC0107T	Analytical Methods in Chemistry	3	3	50	25	75	2.5
Semester - II	24MDC0207T	Pharmaceutical Chemistry	3	3	50	25	75	2.5

Skill Enhancement Courses (SEC)

Semester	Course Code	Nomenclature	Credits	Hours/ Week	Marks			Exam Hours
					External	Internal	Total	
Semester - I	24SEC0107P	Practical Approach to Chemical Analysis	3	6	50	25	75	4.5
Semester - II	24SEC0207P	Purification and Analytical Techniques	3	6	50	25	75	4.5

Value-Added Courses (VAC)

Semester	Course Code	Nomenclature	Credits	Hours/ Week	Marks			Exam Hours
					External	Internal	Total	
Semester - I	24VAC0112T	Role of Chemistry in Society	2	2	35	15	50	2
Semester - II	24VAC0112T	Role of Chemistry in Society	2	2	35	15	50	2

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Minor Courses (MIC), Multidisciplinary Courses (MDC), Skill Enhancement Courses (SEC), and Value-Added Courses (VAC)
offered by
Department of Chemistry
w.e.f. **Session 2024-25**
2nd and 3rd Year

Minor Courses (MIC)

Semester	Course Code	Nomenclature	Credits	Hours/ Week	Marks			Exam Hours
					External	Internal	Total	
nester - III	24MIC0320T	Phase and Ionic Equilibria	4	4	70	30	100	3
nester - VI	24MIC0620T	Biomolecules	4	4	70	30	100	3

Multidisciplinary Courses (MDC)

ıester	Course Code	Nomenclature	Credits	Hours/ Week	Marks			Exam Hours
					External	Internal	Total	
ıester - III	24MDC0307T	Chemical Technology and Society	3	3	50	25	75	2.5

Skill Enhancement Courses (SEC)

ıester	Course Code	Nomenclature	Credits	Hours/ Week	Marks			Exam Hours
					External	Internal	Total	
nester - III	24SEC0307P	Basic Skills for Organic Chemists	3	6	50	25	75	4

Value-Added Courses (VAC)

ıester	Course Code	Nomenclature	Credits	Hours/ Week	Marks			Exam Hours
					External	Internal	Total	
ıester - IV	24VAC0312T	Chemistry of food	2	2	35	15	50	2

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Minor Courses (Vocational) (MIC) (VOC)

Semester	Course Code	Nomenclature	Credits	Hours/ Week	Marks			Exam Hours
					External	Internal	Total	
Semester - IV	24VOC0420T	Functional Group Chemistry	2	2	35	15	50	2
	24VOC0420P	Functional Group Chemistry Lab	2	4	35	15	50	3
Semester - V	24VOC0520T	Analytical Techniques	2	2	35	15	50	2
	24VOC0520P	Analytical Techniques Lab	2	4	35	15	50	3
Semester - VI	24VOC0620T	Introduction to Biomolecules	2	2	35	15	50	2
	24VOC0620P	Introduction to Biomolecules Lab	2	4	35	15	50	3

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Discipline Specific Course
CHEMISTRY-I

Paper code: 24CHE0101T
45 Hrs (3Hrs /week)
Credits: 3
Time: 2.5 Hrs

Marks for Major Test (External): 50
Marks for Internal Exam: 20
Total Marks: 70

Note: The examiner is required to set seven questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 2.5 marks each. In addition to this, six more questions (each question may be of 2-3 parts) will be set consisting of two questions from each unit. The student/candidate is required to attempt four questions in all, selecting one from each unit and the compulsory Question No. 1. All questions carry equal marks.

Objective: This paper deals with the concepts of chemical bonding and molecular structure, basics of organic reactions, spatial arrangement of molecules and chemical thermodynamics.

UNIT-I **15 Hrs**

Chemical Bonding and Molecular Structure

Introduction to Ionic Bonding: General characteristics of ionic bonding. Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Lande equation for calculation of lattice energy, polarizing power and polarizability

Introduction to Covalent bonding: Shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements.

Ionic Solids: Factors affecting the formation of ionic solids, concept of close packing, radius ratio rule and coordination number. Calculation of limiting radius ratio for tetrahedral and octahedral sites. Structures of some common ionic solids NaCl, ZnS (zinc blende and wurtzite).

UNIT-II **15 Hrs**

Basics of Organic Chemistry-I

Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation.

Cleavage of Bonds: Homolysis and Heterolysis.

Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles.

Reactive Intermediates: Carbocations, Carbanions and free radicals.

Introduction to types of organic reactions and their mechanism: Addition, Elimination and Substitution reactions.

Stereochemistry: Conformations of cyclohexane. Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds.

UNIT-III **15 Hrs**

Chemical Thermodynamics

Introduction, Objectives and limitations of Chemical Thermodynamics, state functions, thermodynamic equilibrium, work, heat, internal energy, enthalpy. First Law of Thermodynamics: First law of thermodynamics for open, closed and isolated systems. Reversible isothermal and adiabatic expansion/compression of an ideal gas. Irreversible isothermal and adiabatic expansion. Enthalpy change and its measurement, standard heats of formation and absolute enthalpies.

Second and Third Law of thermodynamics.
Entropy change with change in P, V, and T for an ideal gas. Free energy and work functions. Gibbs-Helmholtz Equation, Criteria of spontaneity in terms of changes in free energy. Introduction to Third law of thermodynamics.

CHEMISTRY-I Lab

Paper code: 24CHE0101P
30 Hrs (3Hrs /week)
Credits: 1
Time: 3Hrs

Marks for Major Test (External): 20
Marks for Internal Exam: 10
Total Marks: 30

Objective: Hands on practice on preparation of solutions, titration experiments, determination of melting and boiling points, viscosity determination, preparation of organic and inorganic compounds.

1. Preparation of standard solutions.
2. Acid/Base titration: Determination of strength of acid/base.
3. Determination of melting point organic solids and boiling point of organic solvents.
4. Determination of the viscosity of at least two liquids using Ostwald's viscometer (excluding organic solvents)
5. Preparation (One step)
   (i) Preparation of *m*-Dinitrobenzne from Nitrobenzene.
   (ii) Preparation of Prussian blue.

Note: **Student will perform at least six experiments. The examiner will allot one practical at the time of end term examination. Candidates are required to obtain minimum passing marks separately in practical component and theory as per the University rules.**

Books Suggested:

1. Cotton F.A. and Wilkinson G., Murillo C.A., Bochmann M., *Advanced Inorg. Chemistry*, 6th Ed., John Wiley & Sons. Inc., 1999.
2. Lee J.D., *Concise Inorganic Chemistry*, 4th Ed., ELBS, 1991.
3. Huheey J.E., Keiter E.A., Keiter R.L., *Inorganic Chemistry: Principles of Structures and Reactivity*, 4th Edition, Pubs: Harper Collins, 1993.
4. Morrison, R. N. & Boyd, R. N., *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), 7th Ed., 2010.
5. Finar, I. L., *Organic Chemistry (Volume 1)*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), 6th Ed., 2002.
6. Finar, I. L., *Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products)*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), 5th Ed., 2002.
7. Kalsi, P. S., *Stereochemistry Conformation and Mechanism*, New Age International, 11th Ed., 2022.
8. Eliel, E. L. &Wilen, S. H., *Stereochemistry of Organic Compounds*, Wiley: London, 1994.
9. Puri B.R., Sharma L. R. and Pathania M. S., *Principles of Physical Chemistry*, Vishal Publishing Company, 49th Ed., 2020.
10. Atkins, P.W. & Paula J., *Physical Chemistry*, 10th Ed., Oxford University Press, 2014.
11. Castellan, G.W., *Physical Chemistry*, Narosa Publishers, 3rd Ed., 2004.
12. Kapoor, K. L., *A Text Book of Physical Chemistry*, McGraw Hill Publication, 6th Ed. 2020
13. Vogel, A.I., *Vogel's Textbook of Practical Organic Chemistry*, 5th Ed., Longman Scientific & Technical, 1989.
14. Vogel, A.I., *Vogel's Textbook of Quantitative Chemical Analysis*, 6th Ed., Longman Scientific & Technical, 1989
15. Pavia D.L., Lampanana G.M., Kriz G.S. Jr., *Introduction to Organic Laboratory Techniques*, 3rd Edn., Thomson Books/Cole,2005.
16. Yadav J. B., *Advanced Practical Physical Chemistry*, Krishna Prakashan Media, 2016.

Course outcomes:

At the end of the course, the students would be able to:

CO1 Understand the atomic structure and bonding concepts.

CO2 Acquaint with the mechanistic approach for chemical reactions.

CO3 Understand the spatial arrangement and orientation of atoms in the molecules.

CO4 Get the knowledge of Kinetic theory of gases (Real & Ideal) and Maxwell distribution law.

CO5 Apply the concepts of Chemistry in the preparation of solutions and compounds.

CO6 Perform experiments, evaluate the results and defend viva-voce

Minor Course
Periodic Properties of Elements

Paper code: 24MIC0120T
30 Hrs (2Hrs /week)
Credits: 2
Time: 2Hrs

Marks for Major Test (External):35
Marks for Internal Exam: 15
Total Marks: 50

Note: The examiner is required to set five questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 3 marks each. In addition to this, four more questions (each question may be of 2-3 parts) will be set consisting of two questions from each unit. The student/candidate is required to attempt three questions in all, selecting one from each unit in consisting of 10 marks and the compulsory Question No.1.

***Objective**: This paper deals with s and p block elements including their general properties and chemistry of compunds of s and p block elements.*

15 Hrs

UNIT-I

_s_- and _p_-Block Elements

General characterstics of s- and *p*-Block Elements

Introduction, Inert pair effect, Relative stability of different oxidation states, diagonal relationship and anomalous behaviour of first member of each group. Allotropy and catenation. Complex formation tendency of *s* and *p* block elements.

Chemistry of Compunds of s-Block Elements

Hydrides and their classification ionic, covalent and interstitial. Basic beryllium acetate and nitrate.

15 Hrs

UNIT-II

Chemistry of Compunds of _p_-Block Elements

Study of the following compounds with emphasis on structure, bonding, preparation, properties and uses: Boric acid and borates, boron nitrides, borohydrides (diborane) carboranes and graphitic compounds, silanes, Oxides and oxoacids of nitrogen, Phosphorus and chlorine. Peroxo acids of sulphur, interhalogen compounds, polyhalide ions, pseudohalogens and basic properties of halogens.

Books Suggested:

1. Lee, J.D., *Concise Inorganic Chemistry*, ELBS, 1991.
2. Douglas, B.E; Mc Daniel, D.H. & Alexander, J.J., *Concepts & Models of Inorganic Chemistry*, 3rdEd., John Wiley Sons, N.Y. 1994.
3. Greenwood, N.N. & Earnshaw., *Chemistry of the Elements*, Butterworth-Heinemann, 1997.
4. Cotton, F.A. & Wilkinson, G., *Advanced Inorganic Chemistry*, Wiley, VCH, 1999.
5. Atkin, P. *Shriver & Atkins' Inorganic Chemistry*, 5th Ed., Oxford University Press, 2010.

Course outcomes:

At the end of the course, the students would be able to:

CO1 Understand the chracterstic properties of *s* and *p*-block elements.
CO2 Describe the chemistry of compounds of *s* block elements.
CO3 Illustrate the chemistry of compounds of *p* block elements.

Multidisciplinary Course
Analytical Methods in Chemistry

Paper code: 24MDC0107T
45Hrs (3Hrs /week) **Marks for Major Test (External): 50**
Credits: 3 **Marks for Internal Exam: 25**
Time: 2.5 Hrs **Total Marks: 75**

Note: The examiner is required to set seven questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 2.5 marks each. In addition to this, six more questions (each question may be of 2-3 parts) will be set consisting of two questions from each unit. The student/candidate is required to attempt four questions in all, selecting one from each unit and the compulsory Question No.1.All questions carry equal marks.

Objective: This paper deals with different spectrometric, thermal, elecroanalytical and chromatographic techniques for the charcterization and analysis of materials.

UNIT-I 15 Hrs

UV-Visible Spectrometry

Basic principles of instrumentation (choice of source, monochromator and detector) for single and double beam instrument.

Infrared Spectrometry

Basic principles of instrumentation (choice of source, monochromator & detector) for single and double beam instrument; sampling techniques. Structural illustration through interpretation of data, Effect and importance of isotope substitution.

Flame Atomic Absorption and Emission Spectrometry

Basic principles of instrumentation (choice of source, monochromator, detector, choice of flame and Burner designs. Techniques of atomization and sample introduction; Method of background correction, sources of chemical interferences and their method of removal. Techniques for the quantitative estimation of trace level of metal ions from water samples.

UNIT-II 15 Hrs

Thermal methods of analysis

Basic principles and instrumentation of TG, DTA and DSC. Quantitative estimation of Ca and Mg from their mixture.

Electroanalytical methods

Classification of electroanalytical methods, basic principles of pH metric, potentiometric and conductometric titrations. Techniques used for the determination of equivalence points and pK_a values.

UNIT-III 15 Hrs

Chromatographic techniques

Introduction, Classification, Mechanism of Chromatography separation: adsorption, partition & ion exchange.

Development of chromatograms: frontal, elution and displacement methods.

Qualitative and quantitative aspects of chromatographic methods of analysis Paper and thin layer chromatography, liquid chromatography and ion-exchange chromatography.

Books Suggested:

1. R. Silverstein, F. X. Webster, *Spectrometric Identification of Organic Compounds.*, John Wiley and Sons, 8th edition.
2. D.L. Pavia, G. M. Lampman, *Introduction to Spectroscopy*, Brooks/Cole learning, 5th Ed., 2014

3. Willard, H.H. *et al.*, *Instrumental Methods of Analysis*, 7th Ed. Wardsworth Publishing Company, Belmont, California, USA, 1988.
4. Harris, D.C., *Exploring Chemical Analysis*, 9th Ed. New York, W.H. Freeman, 2016.
5. Khopkar, S.M., *Basic Concepts of Analytical Chemistry*, New Age International Publisher, 2009.
6. Skoog, D.A. Holler F.J. & Nieman, T.A., *Principles of Instrumental Analysis*, Cengage Learning India, 7th Ed. 2020.
7. Mikes, O., *Laboratory Hand Book of Chromatographic & Allied Methods*, Elles Harwood Series on Analytical Chemistry, John Wiley & Sons, 1979.
8. Mendham, J., *A. I. Vogel's Quantitative Chemical Analysis*, 6th Ed., Pearson, 2009.

Course Outcomes:

At the end of the course, the students would be able to:

CO1 Learn the basic principle and applications of UV-VIS, IR, Flame atomic absorption and emmission spectrometry.

CO2 Learn about the methodology of thermo gravimetric analysis (TGA), differential thermal analysis (DTA) and differential scanning calorimetry (DSC) and electroanalytic analysis.

CO3 Explain the classification, principle, instrumentation and application of chromatographic methods.

Skill Enhancement Course
Practical Approach to Chemical Analysis

Paper code: 24SEC0107P
90 Hrs (6Hrs /week)
Credits: 3
Time: 4.5 Hrs

Marks for Major Test (External):50
Marks for Internal Exam: 25
Total Marks:75

Objective: Hands on practice on preparation of solutions, titration experiments, sublimation, purification and preparation of organic/ inorganic compounds.

1. Preparation of reference solutions.
2. Redox titrations: Determination of Fe^{2+}, $C_2O_4^{2-}$ (using $KMnO_4$, $K_2Cr_2O_7$)
3. Iodometic titrations: Determination of Cu^{2+} (using standard hypo solution).
4. To study the process of sublimation of camphor and phthalic acid
5. Preparation and ascertaining their purity through melting point or boiling point
   (i) Iodoform from ethanol (or acetone)
   (ii) *p*-Bromoacetanilide from acetanilide
6. Qualitative analysis of Acidic Radicals
7. Qualitative analysis of Basic Radicals.

Books Suggested:

1. Vogel A. I., Tatchell A.R., Furnis B.S., Hannaford A.J., Smith P.W.G., *Vogel's Text Book of Practical Organic Chemistry*,5th Ed., ELBS, 1989.
2. Pavia D.L., Lampanana G.M., Kriz G.S. Jr., *Introduction to Organic Laboratory Techniques*, 3rd Ed., Thomson Brooks/Cole,2005.
3. Mann F.G., Saunders. P.C., *Practical Organic Chemistry*, Green& Co. Ltd., London, 1978.
4. Svehla, G., *Vogel's Qualitative Inorganic Analysis (revised);* 7th Ed., Orient Longman, 1996.
5. Bassett, J., Denney, R.C., Jeffery, G.H., Mendham, J., *Vogel's Textbook of Quantitative Inorganic Analysis (revised)*; 4th Ed., Orient Longman, 1978.
6. Yadav J. B., *Advanced Practical Physical Chemistry,* Krishna Prakashan Media, 2016.

Course Outcomes:

At the end of the course, the students would be able to:

CO1 Prepare reference solutions.
CO2 Performa redox and iodometric titarion experiments.
CO3 Study the process of sublimation.
CO4 Prepare organic compounds and to acertain the purotythrough melting or boiling points.
CO5 Analyse acidic and basic radicals.

Value Added Course
Role of Chemistry in Society

Paper code: 24VAC0112T
30 Hrs (2Hrs /week)
Credits: 2
Time: 2Hrs

Marks for Major Test (External):35
Marks for Internal Exam: 15
Total Marks: 50

Note: The examiner is required to set five questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 3 marks each. In addition to this, four more questions (each question may be of 2-3 parts) will be set consisting of two questions from each unit. The student candidate is required to attempt three questions in all, selecting one from each unit in consisting of 10 marks and the compulsory Question No.1.

Objective: *This paper deals with analysis of soil and water, preparation and use of various dyes and cosmetics.*

15 Hrs

UNIT-I

Analysis of soil: Composition of soil, Concept of pH and pH measurement of soil, Complexometric titrations, Chelation, Chelating agents, use of indicators, Estimation of Calcium and Magnesium ions in soil.

Analysis of water: Definition of pure water, sources responsible for contaminating water, water sampling methods, water purification methods. Determination of pH, acidity, alkalinity and dissolved oxygen of a water sample.

15 Hrs

UNIT-II

Dyes and Cosmetics: A general study including preparation and uses of the following: Hair dye, soap, shampoo, suntan lotions, face powder, lipsticks, talcum powder, nail enamel, creams (cold, vanishing and shaving creams), antiperspirants and artificial flavours.

Books Suggested:

1. Willard, H. H., *Instrumental Methods of Analysis*, CBS Publishers, 7th Ed., 1988.
2. Skoog, D.A. and Leary, J.J., *Instrumental Methods of Analysis*, Saunders College Publications, New York, 4th Ed., 1992.
3. Skoog, D.A.; West, D.M. and Holler, F.J., *Fundamentals of Analytical Chemistry*, 6th Ed., Saunders College Publishing, Fort Worth, 1992.
4. Harris, D. C., *Quantitative Chemical Analysis,* 7th Ed., W. H. Freeman and Co., New York, 2007.
5. Dean, J. A., *Analytical Chemistry Handbook*, McGraw Hill, 2nd Ed., 2004.

Course outcomes:

At the end of the course, the students would be able to:

CO1 Understand the chemistry of soil and perform soil analysis.
CO2 Understand and perform the water analysis
CO3 Get expertise for the preparation, properties and uses of dyes and useful compounds.

SEMESTER – II

Discipline Specific Course
CHEMISTRY-II

Paper code: 24CHE0201T
45 Hrs (3Hrs /week)
Credits: 3
Time: 2.5 Hrs

Marks for Major Test (External): 50
Marks for Internal Exam: 20
Total Marks: 70

Note: The examiner is required to set seven questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 2.5 marks each. In addition to this, six more questions (each question may be of 2-3 parts) will be set consisting of two questions from each unit. The student candidate is required to attempt four questions in all, selecting one from each unit and the compulsory Question No.1. All questions carry equal marks.

***Objective**: This paper deals with the concepts of coordination chemistry, nomenclature and spatial arrangement of coordination compounds, basics of organic chemistry, aromatic hydrocarbons and electrochemistry.*

UNIT-I — 15 Hrs

Coordination Chemistry

Werner's theory, valence bond theory (inner and outer orbital complexes), electroneutrality principle and back bonding. Crystal field theory, measurement of 10 Dq (Δo), CFSE in weak and strong fields, pairing energies, factors affecting the magnitude of 10 Dq (Δo, Δt). Octahedral vs. tetrahedral coordination, tetragonal distortions from octahedral geometry Jahn-Teller theorem, square planar geometry. Qualitative aspect of Ligand field and MO Theory.

IUPAC nomenclature of coordination compounds, isomerism in coordination compounds. Stereochemistry of complexes with 4 and 6 coordination numbers. Chelate effect, polynuclear complexes, Labile and inert complexes- Thermodynamic & Kinetic stability.

UNIT-II — 15 Hrs

Basics of Organic Chemistry-II and **Aromatic Hydrocarbons**

Classification, and Nomenclature, Hybridization, Shapes of molecules, Influence of hybridization on bond properties of Organic Compounds.

Dipole moment; Organic acids and bases; their relative strength, Nucleophlicity and basicity.

Aromatic Hydrocarbons:

Aromatic, Anti-aromatic and Non-aromatic compounds, *Huckel's* rule, aromatic character of arenes, cyclic carbocations/carbanions and heterocyclic compounds with suitable examples. Electrophilic aromatic substitution: halogenation, nitration, sulphonation and Friedel-Craft's alkylation/acylation with their mechanism. Directing effects of the groups.

UNIT-III — 15 Hrs

Electrochemistry

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.

Ionic velocities, mobilities and their determinations, transference numbers and their relation to ionic mobilities.

Applications of conductance to measure degree of dissociation of weak electrolytes.

Quantitative aspects of Faraday's laws of electrolysis, rules of oxidation/reduction of ions based on half-

cell potentials. Nernst equation. Standard electrode (reduction) potential.

CHEMISTRY-II Lab

Paper code: 24CHE0201P
30 Hrs (3Hrs /week)
Credits: 1
***Time:* 3 Hrs**

Marks for Major Test (External): 20
Marks for Internal Exam: 10
Total Marks: 30

Objective: *Hands on practice on hardness and softness of water, determination of surface tension, purification techniques, preparation of organic and inorganic compounds.*

1. Determination of hardness of water samples.
2. To determine the surface tension of at least two liquids using stalagmometer by drop no. and drop weight methods (Excluding organic solvents).
3. Purification techniques
   (i) Distillation (Simple and fractional distillation).
   (ii) Crystallization
4. Preparations:
   (i) Preparation of tetraammine copper (II) sulphate monohydrate.
   (ii) Preparation of dibenzalacetone.

Note: Student will perform at least six experiments. The examiner will allot one practical at the time of end term examination. Candidates are required to obtain minimum passing marks separately in practical component and theory as per the University rules.

Books Suggested:

1. Cotton F.A. and Wilkinson G., Murillo C.A., Bochmann M., *Advanced Inorg. Chemistry*, 6th Ed., John Wiley & Sons. Inc., 1999.
2. Lee J.D., *Concise Inorganic Chemistry*, 4th Ed., ELBS, 1991.
3. Huheey J.E., Keiter E.A., Keiter R.L., *Inorganic Chemistry: Principles of Structures and Reactivity*, 4th Edition, Pubs: Harper Collins, 1993.
4. Morrison, R. N. & Boyd, R. N., *Organic Chemistry,* Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), 7th Ed., 2010.
5. Finar, I. L., *Organic Chemistry (Volume 1),* Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), 6th Ed., 2002.
6. Finar, I. L., *Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products),* Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), 5th Ed., 2002.
7. Samuel Glasstone, *An Introduction to Electrochemistry*, East West Press Pvt. Ltd. 2006.
8. Puri B.R., Sharma L. R. and Pathania M. S., *Principles of Physical Chemistry*, Vishal Publishing Company, 49th Ed., 2020.
9. Atkins, P.W. & Paula, J., *Physical Chemistry,* 10th Ed., Oxford University Press, 2014.
10. Castellan, G.W., *Physical Chemistry*, Narosa Publishers, 3rd Ed., 2004.
11. Kapoor, K. L., *A Text Book of Physical Chemistry*, McGraw Hill Publication, 6th Ed. 2020
12. Vogel, A.I., *Vogel's Textbook of Practical Organic Chemistry*, 5th Ed., Longman Scientific & Technical, 1989.
13. Vogel, A.I., *Vogel's Textbook of Quantitative Chemical Analysis*, 6th Ed., Longman Scientific & Technical, 1989
14. Pavia D.L., Lampanana G.M., Kriz G.S. Jr., *Introduction to Organic Laboratory Techniques,* 3rd Edn., Thomson Books/Cole, 2005.
15. Yadav J. B., *Advanced Practical Physical Chemistry,* Krishna Prakashan Media, 2016.

Course outcomes:

At the end of the course, the students would be able to:

CO1 Understand the chemistry of coordination compounds including various theories and their steriochemistry.
CO2 Aquinted with the basics of organic chemistry, aromaticity and reactions of aromatic hydrocarbons.
CO3 Understand the basics and applications of electrochemistry.

CO4 Get practical knowledge of water analysis.
CO5 Perform experiments of surface chemistry.
CO6 Get practical knowledge of purification techaniques like distillation and recrysallization.
CO7 Apply the concepts of Chemistry in the preparation of inorganic and organic compounds.
CO8 Perform experiments, evaluate the results and defend viva-voce.

Minor Course
Fundamentals of Organic Chemistry

Paper code: 24MIC0220T
30 Hrs (2Hrs /week)
Credits: 2
Time: 2Hrs

Marks for Major Test (External):35
Marks for Internal Exam: 15
Total Marks: 50

Note: The examiner is required to set five questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 3 marks each. In addition to this, four more questions (each question may be of 2-3 parts) will be set consisting of two questions from each unit. The student/candidate is required to attempt three questions in all, selecting one from each unit consisting of 10 marks and the compulsory Question No.1.

***Objective**: This paper deals with the fundamentals of organic chemistry, organic intermediates streochemical aspects of organic compounds, and aromatic hydrocarbons and their reactions.*

15 Hrs

UNIT-I

Fundamentals of Organic Chemistry-I

Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation.

Cleavage of Bonds: Homolysis and Heterolysis.

Structure, shape and reactivity of organic intermediates:

Nucleophiles and electrophiles.

Reactive Intermediates: Carbocations, Carbanions and free radicals.

Introduction to types of organic reactions and their mechanism: Addition, Elimination and Substitution reactions.

Stereochemistry

Conformations of cyclohexane. Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds.

UNIT-II

15 Hrs

Fundamentals of Organic Chemistry- I and Aromatic Hydrocarbons

Classification, and Nomenclature, Hybridization, Shapes of molecules, Influence of hybridization on bond properties of Organic Compounds.

Dipole moment; Organic acids and bases; their relative strength, Nucleophlicity and basicity.

Aromatic Hydrocarbons

Aromatic, Anti-aromatic and Non-aromatic compounds, *Huckel's* rule, aromatic character of arenes, cyclic carbocations/carbanions and heterocyclic compounds with suitable examples. Electrophilic aromatic substitution: halogenation, nitration, sulphonation and Friedel-Craft's alkylation/acylation with their mechanism. Directing effects of the groups.

Books Suggested:

1. Morrison, R. N. & Boyd, R. N., *Organic Chemistry,* Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), 7th Ed., 2010.
2. Finar, I. L., *Organic Chemistry (Volume 1),* Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), 6th Ed., 2002.
3. Finar, I. L., *Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products),* Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), 5th Ed., 2002.

4. Eliel, E. L. &Wilen, S. H., *Stereochemistry of Organic Compounds,* Wiley: London, 1994.

Course outcomes:

At the end of the course, the students would be able to:

CO1 Understand the basic concepts of organic chemistry.

CO2 Get acquainted with the structure, shape and reactivity of organic intermediates for understanding mechanistic approach for chemical reactions.

CO3 Understand the spatial arrangement and orientation of atoms in the molecules.

CO4 Get the basic knowledge of aomaticity.

CO5 Understand the reaction related to aromatic compounds.

Multidisciplinary Course
Pharmaceutical Chemistry

Paper code: 24MDC0207T
45Hrs (3Hrs /week)
Credits: 3
Time: 2.5 Hrs

Marks for Major Test (External): 50
Marks for Internal Exam: 25
Total Marks: 75

Note: *The examiner is required to set seven questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 2.5 marks each. In addition to this, six more questions (each question may be of 2-3 parts) will be set consisting of two questions from each unit. The student/candidate is required to attempt four questions in all, selecting one from each unit and the compulsory Question No.1. All questions carry equal marks.*

Objective*: This paper deals with the physiological and streochemical aspects of drud action, structures and therapeutic uses of of drug molecules of dferent categories.*

15 Hrs

UNIT-I

Physiochemical aspects of Drug action- Stereochemical aspects of drug action (Optical, geometric and bioisoterism of drug molecules with biological action), conformational isomerism, solubility and partition coefficient, chemical bonding. Drug receptor, Drug receptor interactions, receptor- effector theories, types of receptor and their action including transduction mechanism and G proteins. Principles of drug design (Theoretical aspects).

15 Hrs

UNIT-II

Classification, structure and therapeutic uses of antipyretics:
Paracetamol (with synthesis), Analgesics: Ibuprofen (with synthesis), Antimalarials: Chloroquine (with synthesis).
An elementary treatment of Antibiotics and detailed study of chloramphenicol, and antacid (ranitidine). Antibacterial and antifungal agents (Sulphonamides, Sulphanethoxazol, Sulphacetamide, Trimethoprim). Medicinal values of curcumin (haldi), azadirachtin (neem).

UNIT-III **15 Hrs**

Synthesis of the representative drugs of the following classes: Central Nervous System agents (Phenobarbital, Diazepam), Cardiovascular (Glyceryltrinitrate), antilaprosy (Dapsone), HIV-AIDS related drugs (AZT- Zidovudine), antiviral agents (Acyclovir).

Books Suggested:

1. Patrick, G. L., *Introduction to Medicinal Chemistry*, Oxford University Press, UK, 5th Ed., 2013.
2. Singh, H. & Kapoor, V.K., *Medicinal and Pharmaceutical Chemistry*, Vallabh Prakashan, Pitampura, New Delhi, 3rd Ed., 2012.
3. Foye, W.O., Lemke, T.L. & William, D.A., *Principles of Medicinal Chemistry*, B.I. Waverly Pvt. Ltd. New Delhi,. 7th Ed., 2012

Course outcomes:
At the end of the course, the students would be able to:
CO1 Understand the Theoretical aspects of drug design, physiological and streochemical aspects of drud action.
CO2 Accomplish with drug receptors and drug-receptor interactions.
CO3 Get acquainted with structures and therapeutic uses of of drug molecules of dferent categories.
CO4 Familiar with the applications of ingradients obtained from naturally occurining plants like curcumin (haldi), azadirachtin (neem).

Skill Enhancement Course
Purification and Analytical Techniques

Paper code: 24SEC0207P
90Hrs (6Hrs /week)
Credits: 3
Time: 4.5 Hrs

Marks for Major Test (External): 50
Marks for Internal Exam: 25
Total Marks: 75

Objective: Hands on practice on preparation of solutions, complexometric titrations, paper chromatography, specific refractivity, chemical kinetics, condutometry, preliminary examination and detection of extra elements and monitoring of reactions through TLC.

1. Complexometric titrations: Determination of Mg^{2+}, Zn^{2+} by EDTA.
2. Paper Chromatography: Qualitative Analysis of any one of the following Inorganic cations and anions by paper chromatography (Pb^{2+}, Cu^{2+}, Ca^{2+}, Ni^{2+}, Cl^-, Br^-, I^- and PO_4^{3-} and NO_3^-).
3. To determine the specific refractivity of at least two liquids.
4. Determine rate constant of acid catalysed hydrolysis of methyl acetate.
5. Determination of conductance of electrolytes
6. The preliminary examination of physical and chemical characteristics (physical state, colour, odour and ignition test), extra element detection (N, S, Cl, Br and I).
7. To check the purity of compounds or monitoring of reactions through TLC.

Books Suggested:

1. Vogel A. I., Tatchell A.R., Furnis B.S., Hannaford A.J., Smith P.W.G., *Vogel's Text Book of Practical Organic Chemistry*, 5th Edn., ELBS, 1989.
2. Pavia D.L., Lampanana G.M., Kriz G.S. Jr., *Introduction to Organic Laboratory Techniques*, 3rd Ed., Thomson Brooks/Cole, 2005.
3. Mann F.G., Saunders. P.C., *Practical Organic Chemistry*, Pearson Education, 4th Ed., 2009.
4. Svehla, G., *Vogel's Qualitative Inorganic Analysis (revised);* Pearson Education, 7th Ed., 2012.
5. Bassett, J., Denney, R.C., Jeffery, G.H., Mendham, J., *Vogel's Textbook of Quantitative Inorganic Analysis (revised)*, Orient Longman, 4th Ed., 1980.
6. Das R.C. & Behra B., *Experimental Physical Chemistry*, McGraw Hill, 1984.
7. Shoemaker & Gailand, *Experiments in Physical Chemistry*, McGraw Hill, 8th Ed., 2008.

Course Outcomes:

At the end of the course, the students would be able to:

CO1 Perform experiments on complexometric titrations.
CO2 Performa experiments on paper chromatopgraphy.
CO3 Determine specific refractivity and determination of rate constant of hydrolysis reacions.
CO4 Perform conductometric experiments.
CO5 Apply the concepts of chemistry for preliminary examination and detection of extraelements and moniteroing of reactions through TLC.
CO6 Perform experiments, evaluate the results and defend viva-voce.

Value Added Course
Role of Chemistry in Society

Paper code: 24VAC0112T
30 Hrs (2Hrs /week)
Credits: 2
Time: 2Hrs

Marks for Major Test (External):35
Marks for Internal Exam: 15
Total Marks: 50

Note: The examiner is required to set five questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 3 marks each. In addition to this, four more questions (each question may be of 2-3 parts) will be set consisting of two questions from each unit. The student/candidate is required to attempt three questions in all, selecting one from each unit in consisting of 10 marks and the compulsory Question No.1.

Objective: *This paper deals with analysis of soil and water, preparation and use of various dyes and cosmetics.*

UNIT-I

15 Hrs

Analysis of soil: Composition of soil, Concept of pH and pH measurement of soil, Complexometric titrations, Chelation, Chelating agents, use of indicators, Estimation of Calcium and Magnesium ions in soil.

Analysis of water: Definition of pure water, sources responsible for contaminating water, water sampling methods, water purification methods. Determination of pH, acidity, alkalinity and dissolved oxygen of a water sample.

UNIT-II

15 Hrs

Dyes and Cosmetics: A general study including preparation and uses of the following: Hair dye, soap, shampoo, suntan lotions, face powder, lipsticks, talcum powder, nail enamel, creams (cold, vanishing and shaving creams), antiperspirants and artificial flavours.

Books Suggested:

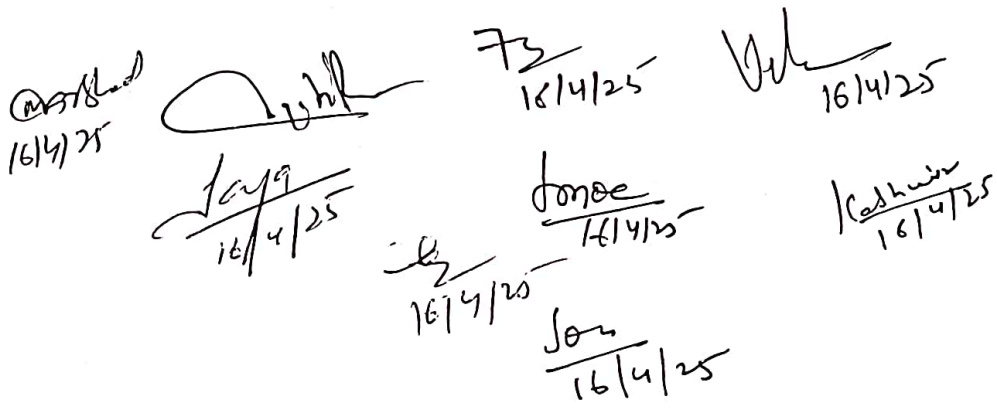
1. Willard, H. H., *Instrumental Methods of Analysis*, CBS Publishers, 7th Ed., 1986.
2. Skoog, D.A. and Leary, J.J., *Instrumental Methods of Analysis*, Saunders College, Publications, New York, 4th Ed..1992.
3. Skoog. D.A.; West, D.M. and Holler, F.J. *Fundamentals of Analytical Chemistry*, Saunders College Publishing, Fort Worth, 6th Ed., 1992.
4. Harris, D. C. *Quantitative Chemical Analysis* 7th Ed., W. H. Freeman and Co., New York, 2007
5. Dean, J. A., *Analytical Chemistry Handbook*, McGraw Hill, 2nd Ed., 2004.

Course outcomes:

At the end of the course, the students would be able to:

CO1 Understand the chemistry of soil and perform soil analysis.
CO2 Understand and perform the water analysis
CO2 Understand the preparation, properties and uses of dyes and useful compounds.

SEMESTER – III



Discipline Specific Course (DSC)
CHEMISTRY-III

Paper code: 24CHE0301T
45 Hrs (3Hrs /week)
Credits: 3
Time: 2.5 Hrs

Marks for Major Test (External): 50
Marks for Internal Exam: 20
Total Marks: 70

Note: The examiner is required to set seven questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 2.5 marks each. In addition to this, six more questions (each question may be of 2-3 parts) will be set consisting of two questions from each unit. The student/candidate is required to attempt four questions in all, selecting one from each unit and the compulsory Question No.1. All questions carry equal marks.

Objective: This paper deals with the chemistry of *s* and *p* block elements, noble gases, chemistry of C-C π-bond containing compounds (alkenes and alkynes), and liquid and gaseous states of matter.

UNIT-I

Chemistry of *s* and *p* Block Elements **10 Hrs**

Relative stability of different oxidation states, diagonal relationship and anomalous behaviour of first member of each group. Inert pair effect. Complex formation tendency of *s* and *p* block elements. Study of the following compounds with emphasis on structure, bonding, preparation, properties and uses. Boric acid and borates, borohydrides (diborane) carboranes and graphitic compounds, silanes, Oxides and oxoacids of nitrogen, phosphorus and chlorine. Peroxo acids of sulphur, interhalogen compounds, pseudohalogens and basic properties of halogens.

Noble Gases **5 Hrs**

Occurrence and uses, rationalization of inertness of noble gases, preparation and properties of XeF_2, XeF_4 and XeF_6; Nature of bonding in noble gas compounds (Valence bond treatment and MO treatment for XeF_2). Molecular shapes of noble gas compounds (VSEPR theory).

UNIT-II

15 Hrs

Carbon-Carbon π-bonds:

Formation of alkenes and alkynes by elimination reactions, Mechanism of E1, E2, E1cb reactions. Saytzeff and Hofmann eliminations.

Reactions of alkenes: Electrophilic additions and their mechanisms (Markownikoff/ Anti Markownikoff addition), mechanism of oxymercuration-demercuration, hydroboration-oxidation, ozonolysis, reduction (catalytic and chemical), syn/ and *anti*-hydroxylation (oxidation). 1,2-and 1,4-addition reactions in conjugated dienes, and Diels-Alder reaction; Allylic and benzylic bromination and mechanism *e.g.* propene, 1-butene, toluene, ethyl benzene.

Reactions of alkynes: Acidity, Electrophilic and Nucleophilic additions. Hydration to form carbonyl compounds, Alkylation of terminal alkynes.

UNIT-III

5 Hrs

Liquid state

Qualitative treatment of the structure of the liquid state, physical properties of liquids' vapour pressure, surface tension and coefficient of viscosity, and their determination. Factors effecting surface tension and viscosity.

10 Hrs

Gaseous state

Kinetic molecular model of a gas: derivation of the kinetic gas equation; collision frequency and diameter; mean free path and viscosity of gases, temperature and pressure dependence, relation between mean free path and coefficient of viscosity.

Maxwell distribution and its use in evaluating molecular velocities (average, root mean square and most probable) and average kinetic energy, law of equipartition of energy, degrees of freedom and molecular basis of heat capacities.

Behaviour of real gases: Deviations from ideal gas behaviour, compressibility factor, and its variation with pressure. Van der Waals equation of state and application in explaining real gas behaviour. Isotherms of real gases and their comparison with Van der Waals isotherms.

CHEMISTRY-III Lab

Paper code: 24CHE0301P

30 Hrs (3Hrs /week)

Credits: 1

Time: 3Hrs

Marks for Major Test (External): 20

Marks for Internal Exam: 10

Total Marks: 30

Objective: Hands on practice on chemical analysis of inorganic substances, preparation of organic compounds by conventional method and using green approach, molecular weight of the volatile liquids, and determination of viscosity and surface tension of liquids.

1. Analysis of mixtures containing one anion and one cation. The following radicals are suggested: CO_3^{2-}, NO_2^-, S^{2-}, SO_3^{2-}, CH_3COO^-, F^-, Cl^-, Br^-, I^-, NO_3^-, PO_4^{3-}, NH_4^+, Pb^{2+}, Cu^{2+}, Cd^{2+}, Bi^{3+}, Fe^{3+}, Al^{3+}, Cr^{3+}, Zn^{2+}, Mn^{2+}, Co^{2+}, Ni^{2+}, Ba^{2+}, Sr^{2+}, Ca^{2+}, Mg^{2+}.
2. Acetylation of one of the following compounds: amines (aniline, *o*-, *m*-, *p*-toluidines and *o*-, *m*-, *p*-anisidine) by any one method:

(a) Using conventional method.

(b). Using green approach

3. Determination of molecular weight of the volatile liquid (chloroform, acetone, methanol) by Victor Meyer's method.
4. Determination of viscosity and surface tension of liquid samples.

Note: **The examiner will allot one practical at the time of end term examination. Candidates are required to obtain minimum passing marks separately in practical component and theory as per the University rules.**

Books Suggested:

1. Cotton F.A., Wilkinson G., Murillo C.A., Bochmann M., *Advanced Inorg. Chemistry*, John Wiley & Sons. Inc., 6th Ed., 1999.
2. Lee J.D., *Concise Inorganic Chemistry*, ELBS. 4th Ed., 1991.
3. Huheey J.E., Keiter E.A., Keiter R.L., *Inorganic Chemistry: Principles of Structures and Reactivity*; Pubs: Harper Collins. 4th Ed., 1993.

4. Douglas B.E, Mc Daniel D.H., Alexander J.J., *Concepts & Models of Inorganic Chemistry*, John Wiley Sons, N.Y. 3rd Ed., 1994.
5. Greenwood N.N., Earnshaw, *Chemistry of the Elements*, Butterworth-Heinemann, 1997.
6. Rodger G.E., *Inorganic and Solid-State Chemistry*, Cengage Learning India, 1st Ed, 2008.
6. Miessler G.L., Donald A. Tarr., *Inorganic Chemistry*, Pearson, 4th Ed., 2010.
7. Shriver & Atkins' Inorganic Chemistry, Oxford University Press 5th Ed, 2010.
8. Morrison R.N., Boyd, R.N., *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), 7th Ed., 2010.
9. Finar I.L., *Organic Chemistry (Volume 1)*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), 6th Ed., 2002.
10. Finar I.L., *Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products)*, Dorling Kindersley (India) Pvt. Ltd., Pearson Education, 5th Ed., 2002.
11. Ball D.W., *Physical Chemistry* Thomson Press, India, 2nd Ed., 2017.
12. Castellan G.W., *Physical Chemistry*, Narosa Publishers, 3rd Ed., 2004.
13. Mortimer R.G., *Physical Chemistry*, Elsevier: NOIDA, UP, 3rd Ed., 2009.
14. Engel T., Reid P., *Physical Chemistry*, Pearson, 3rd Ed., 2013.
15. Puri B.R., Sharma L.R., Pathania M.S., *Principles of Physical Chemistry*, Vishal Publishing Company, 49th Ed., 2020.
16. Atkins P.W., Paula J., *Physical Chemistry*, Oxford University Press, 10th Ed., 2014.
17.. Mendham J., *A. I. Vogel's Quantitative Chemical Analysis*, Pearson, 6th Ed., 2009.
18.. Vogel's *Qualitative Inorganic Analysis*, Revised by G. Svehla. Pearson Education, 2000.
19. Marr G., Rockett B.W. , *Practical Inorganic Chemistry*, Van Nostrand Reinhold Company, 1st Ed., 1972.
20. Mann F.G., Saunders B.C., *Practical Organic Chemistry*, Pearson Education India, 4th Ed., 2009.
21. Kapoor, K. L., *A Text Book of Physical Chemistry*, McGraw Hill Publication, 6th Ed., 2020.
22. Ahluwalia V.K., Aggarwal R., Ahluwalia V.K., *Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis*, Sangam Books Ltd., 2001.
23. Ahluwalia V.K., Dhingra S., *Comprehensive Practical Organic Chemistry: QualitativeAnalysis*, University Press, 2000.
24. Vogel A.I., *Vogel's Textbook of Practical Organic Chemistry*, Longman Scientific & Technical, 5th Ed., 1989.
25. Vogel A.I., *Vogel's Textbook of Quantitative Chemical Analysis*, Longman Scientific & Technical, 6th Ed., 1989
26. Pavia D.L., Lampanana G.M., Kriz G.S. Jr., *Introduction to Organic Laboratory Techniques*, Thomson Books/Cole, 3rd Edn., 2005.
27. Furniss B.S., Hannaford A.J., Smith P.W.G., Tatchell A.R., *Practical OrganicChemistry*, Pearson, 5th Ed., 2012.
28. Yadav J. B., *Advanced Practical Physical Chemistry*, Krishna Prakashan Media, 36th Ed., 2016.

Course outcomes:

At the end of the course, the students would be able to:

CO1. Understand the chemistry of s and p block elements.
CO2. Get familiar with the chemistry of noble gases.
CO3. Acquaint with the chemistry of Carbon-Carbon π-bond containing compounds *viz.* alkenes and alkynes and mechanistic approach for chemical reactions related them.
CO4. Be aquinted with liquid and gaseous states of matter including kinetic molecular model of a gas, Maxwell distribution, and real gases.
CO5. Apply the concepts of chemical analysis techniques for determination of acid and basic radicals in inorganic salts.
CO6. Get practice in preparation of organic compounds by conventional method and using green approach.
CO7. Determine molecular weight of the volatile liquids, and viscosity and surface tension of liquids.
CO8. Perform experiments, evaluate the results and defend *viva-voce.*

Minor Course (MIC)
Phase and Ionic Equilibria

Paper code: 24MIC0320T
60 Hrs (4Hrs /week)
Credits: 4
Time: 3Hrs

Marks for Major Test (External): 70
Marks for Internal Exam: 30
Total Marks: 100

Note: The examiner is required to set nine questions in all. The first question will be compulsory consisting of seven short questions covering the entire syllabus consisting of 2 marks each. In addition to this, eight more questions (each question may be of 2-3 parts) will be set consisting of two questions from each unit. The student/candidate is required to attempt five questions in all, selecting one from each unit consisting of 14 marks and the compulsory Question No. 1.

Objective: This paper deals with ionic and phase equilibria, electrolytes, acids-bases and their qualitative treatment.

UNIT-I

15 Hrs

Ionic equilibria-I

Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect; dissociation constants of mono-, di-and triprotic acids (exact treatment). Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts.

UNIT-II

Ionic equilibria-II **15 Hrs**

Buffer solutions; derivation of Henderson equation and its applications; buffer capacity, buffer range, buffer action and applications of buffers in analytical chemistry and biochemical processes in the human body. Theory of acid-base indicators; selection of indicators and their limitations Qualitative treatment of acid - base titration curves (calculation of pH at various stages).
Solubility and solubility product of sparingly soluble salts - applications of solubility product principle.

UNIT-III

Phase Equilibria-I **15 Hrs**

Concept of phases, components and degrees of freedom, derivation of Gibbs Phase Rule for nonreactive and reactive systems; Clausius-Clapeyron equation and its applications to solid-liquid, liquid-vapour and solid-vapour equilibria, phase diagram for one component systems, with applications. Phase diagrams for systems of solid-liquid equilibria involving eutectic, congruent and incongruent melting points,

UNIT-IV

Phase Equilibria-II **15 Hrs**

Three component systems, water-chloroform-acetic acid system, triangular plots.
Binary solutions: Gibbs-Duhem-Margules equation, its derivation and applications to fractional distillation of binary miscible liquids (ideal and nonideal), azeotropes, lever rule, partial miscibility of liquids, CST, miscible pairs, steam distillation.
Nernst distribution law: its derivation and applications.

Books Suggested:

1. Atkins P., Paula J.D., *Physical Chemistry*, Oxford University Press, 10th Ed., 2014.
2. Castellan G.W., *Physical Chemistry*, Narosa, 4th Ed., 2004.
3. Engel T., Reid, P., *Physical Chemistry*, Prentice-Hall, 3rd Ed., 2012.
4. Zundhal S.S., *Chemistry concepts and applications*, Cengage India ,2011.
5. Ball D.W., *Physical Chemistry*, Cengage India, 2nd Ed., 2012.
6. Mortimer R.G., *Physical Chemistry*, Elsevier, NOIDA, UP, 3rd Ed., 2009.
7. Metz C.R., *Physical Chemistry*, Tata McGraw-Hill, 2nd Ed.,2009.

Course outcomes:

At the end of the course, the students would be able to:

CO1. Understand the electrolytes and various factors on their ionization.

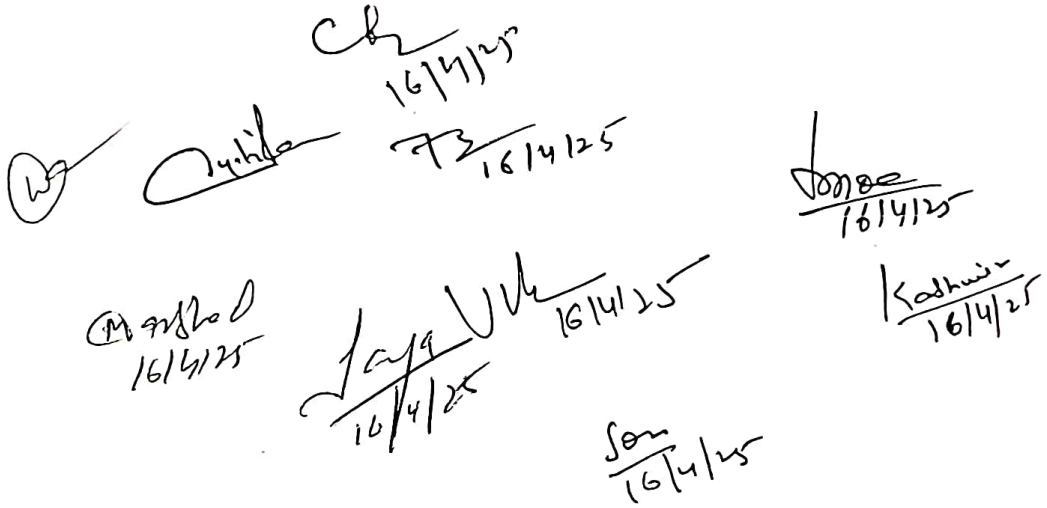
CO2. Get familiar with salt hydrolysis and pH of different salts.

CO3. Get acquainted with the chemistry of buffers and their applications in analytical chemistry and biochemical processes in the human body.

CO4. Understand the concept of phases and phase rule.

CO5. Understand Clausius-Clapeyron equation and its applications to solid-liquid, liquid-vapour and solid-vapour equilibria.

CO6. Get knowledge of eutectic, congruent and incongruent systems.



Multidisciplinary Course (MDC)
Chemical Technology and Society

Paper code: 24MDC03 CHT | **Marks for Major Test (External): 50**

45 Hrs (3Hrs /week) | **Marks for Internal Exam: 25**

Credits: 3 | **Total Marks: 75**

Time: 2.5Hrs

Note: The examiner is required to set seven questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 2.5 marks each. In addition to this, six more questions (each question may be of 2-3 parts) will be set consisting of two questions from each unit. The student/candidate is required to attempt four questions in all, selecting one from each unit and the compulsory Question No.1. All questions carry equal marks.

Objective: Basic principles of chemical technology, energy from natural resources, chemistry and society.

UNIT-I

15 Hrs

Basic Chemical Technology

Basic principles of distillation, solvent extraction, solid-liquid leaching and liquid-liquid extraction, separation by absorption and adsorption. An introduction into the scope of different types of equipment needed in chemical technology, including reactors, distillation columns, extruders, pumps, mills, emulgators. Scaling up operations in chemical industry. Introduction to clean technology.

UNIT-II

15 Hrs

Societal and Technological Issues

Exploration of societal and technological issues from a chemical perspective. Chemical and scientific literacy as a means to better understand topics like air and water (and the trace materials found in them that are referred to as pollutants); energy from natural sources (i.e. solar and renewable forms).

UNIT-III

Fossil fuels, Materials and Manufacturing **15 Hrs**

Energy from fossil fuels and from nuclear fission; materials like plastics and polymers and their natural analogues, proteins and nucleic acids, and molecular reactivity and interconversions from simple examples like combustion to complex instances like genetic engineering and the manufacture of drugs.

Books Suggested:

1. Hill J.W., McCreary T.W., Kolb D.K., *Chemistry for changing times*, Prentice-Hall, 13th Ed. 2011.
2. Cassedy E.S., Grossman P.Z., *Introduction to Energy: Resources, Technology, and Society*, Cambridge University Press, 3rd Ed., 2017.
3. Johnson D.G., Wetmore J.M., *Technology and Society: Building our sociotehnical future*, MIT Press, 2nd Ed., 2021.
4. Hocking M.B., *Handbook of Chemical Technology and Pollution Control*, Academic Press, Elsevier, 3rd Ed., 2005.
5. Knapp F., *Chemical Technology, Vol.2 or Chemistry, applied to the Arts and to Manufactures* (Classic Reprint), Forgotton Books, 2018.

Course outcomes:

At the end of the course, the students would be able to:

CO1. Understand the basic concepts of distillation, solvent extraction, solid-liquid leaching and liquid-liquid extraction, and separation by absorption and adsorption.
CO2. Get the knowledge of scaling up operations in chemical industry, and clean technology.
CO3. Be familiar with the societal and technological issues from chemical point of view.
CO4. Acquaint with energy resources including fossile fuels and study of materials like plastics and their analogs.
CO5. Understand the concept of genetic engineering and manufacturing of drugs.

Skill Enhancement Course (SEC)
Basic Skills for Organic Chemists

Paper code: 24SEC0307P | **Marks for Major Test (External): 50**

90 Hrs (6Hrs /week) | **Marks for Internal Exam: 25**

Credits: 3 | **Total Marks: 75**

Time: 4 Hrs

Objective: Hands on practice on separation of organic substances by employing paper and thin layer chromatography, and preparation of organic compounds by conventional method and using green approaches and their purification

1. Chromatography
    a. Separation of a mixture of two amino acids by ascending and horizontal paper chromatography
    b. Separation of a mixture of two sugars by ascending paper chromatography
    c. Separation of a mixture of *o*-and *p*-nitrophenol or *o*-and *p*-aminophenol by thin layer chromatography (TLC)

2. Organic preparations:

i. Acetylation of one of the following compounds: amines (aniline, *o*-, *m*-, *p*-toluidines and *o*-, *m*-, *p*-anisidine) and phenols (*β*-naphthol, vanillin, salicylic acid) by any one method:
    a. Using conventional method.
    b. Using green approach

ii. Nitration of any one of the following:

a. Acetanilide/nitrobenzene by conventional method

b. Salicylic acid by green approach (using ceric ammonium nitrate).

iii. Aldol condensation using either conventional or green method.

The above derivatives should be prepared using 0.5-1g of the organic compound. The solid samples must be collected and may be used for recrystallization, melting point determination and TLC.

Books Suggested:

1. Mann F.G., Saunders B.C., *Practical Organic Chemistry,* Pearson Education India, 4th Ed., 2009.
2. Furniss B.S., Hannaford A.J., Smith P.W.G., Tatchell A.R., *Practical OrganicChemistry,* Pearson, 5th Ed., 2012.
3. Ahluwalia V.K., Aggarwal R. *Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis,* University Press, 2000.
4. Ahluwalia V.K., Dhingra, S. *Comprehensive Practical Organic Chemistry: Qualitative Analysis,* University Press 2000.

Course outcomes:

At the end of the course, the students would be able to:

CO1. Apply the concepts of chromatographic (paper and TLC) techniques for the separation of mixture of amino acids, sugars and other organic components.

CO2. Get practice in preparation of organic compounds by conventional methods and using green approach.

CO4. Get familiar with purification techniques.

CO3. Develop the skill of performing experiments, compilation of experimental information, evaluation of results presentation of the findings in the form of lab record and defend *viva-voce*.

16/4/25 16/4/25 16/4/25 16/4/25 16/4/25 16/4/25 16/4/25

SEMESTER - IV

Discipline Specific Course (DSC)
CHEMISTRY-IV

Paper code: 24CHE0401T
45 Hrs (3Hrs /week) **Marks for Major Test (External): 50**
Credits: 3 **Marks for Internal Exam: 20**
Time: 2.5 Hrs **Total Marks: 70**

Note: The examiner is required to set seven questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 2.5 marks each. In addition to this, six more questions (each question may be of 2-3 parts) will be set consisting of two questions from each unit. The student/candidate is required to attempt four questions in all, selecting one from each unit and the compulsory Question No.1. All questions carry equal marks.

Objective: This paper deals with the transition elements, chemistry of organic compounds containg alhohols, phenols, ethers, epoxides and carboxylic acids, and solid-state chemistry and chemical kinetics.

UNIT-I

Chemistry of Transition Elements **8 Hrs**

General group trends with special reference to electronic configuration, colour, variable valency, magnetic and catalytic properties, and ability to form complexes. Stability of various oxidation states, Difference between the first, second and third transition series. Chemistry of Ti, V, Cr Mn, Fe and Co in various oxidation states (excluding their metallurgy).

Lanthanides and Actinides **7 Hrs**

Electronic configuration, oxidation states, colour, spectral and magnetic properties, lanthanide and actinide contraction, separation of lanthanides (ion-exchange method only).

UNIT-II

Alcohols, Phenols, Ethers and Epoxides **8 Hrs**

Alcohols: preparation, properties and relative reactivity of 1°, 2°, 3° alcohols, Bouvaelt-Blanc Reduction; Preparation and properties of glycols: Oxidation by periodic acid and lead tetraacetate, Pinacol-Pinacolone rearrangement.

Phenols: Preparation and properties; Acidity and factors effecting, Ring substitution reactions, Reimer-Tiemann and Kolbe's-Schmidt Reactions, Fries and Claisen rearrangements with mechanism.

Carboxylic Acid Derivatives **7 Hrs**

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 and Curtius rearrangement.

UNIT-III

Solid state **7 Hrs**

Nature of the solid state, law of constancy of interfacial angles, law of rational indices, Miller indices, elementary ideas of symmetry, symmetry elements and symmetry operations, qualitative idea of point and space groups, seven crystal systems and fourteen Bravais lattices; X-ray

diffraction, Bragg's law, a simple account of rotating crystal method and powder pattern method. Analysis of powder diffraction patterns of NaCl, CsCl and KCl. Defects in crystals. Glasses and liquid crystals.

8 Hrs

Chemical Kinetics

Rate laws in terms of the advancement of a reaction, differential and integrated form of rate expressions up to second order reactions, experimental methods of the determination of rate laws, kinetics of complex reactions (integrated rate expressions up to first order only). (i) Opposing reactions (ii) parallel reactions and (iii) consecutive reactions and their differential rate equations (steady-state approximation in reaction mechanisms) (iv) chain reactions.

CHEMISTRY-IV Lab

Paper code: 24CHE0401P
30 Hrs (3Hrs /week)
Credits: 1
Time: 3Hrs

Marks for Major Test (External): 20
Marks for Internal Exam: 10
Total Marks: 30

Objective: Hands on practice on inorganic preparations, qualitative analysis of unknown organic compounds and preparation of their solid derivatives, and study of kinetics of reactions.

1. Inorganic preparation and gravimetric estimations
(a). Cuprous chloride, Cu_2Cl_2
(b). Estimation of nickel (II) using Dimethylglyoxime (DMG).
(c). Estimation of copper as CuSCN
2. Qualitative analysis of unknown organic compounds containing following functional groups: alcohol, phenol, ester, carboxylic acid, carbonyl, and carbohydrate groups. Preparation of solid derivatives of the compounds analysed.
3. Initial rate method: Iodide-persulphate reaction
4. Integrated rate method: Saponification of ethyl acetate.
5. Compare the strengths of HCl and H_2SO_4 by studying kinetics of hydrolysis of methylacetate.

Note: **The examiner will allot one practical at the time of end term examination. Candidates are required to obtain minimum passing marks separately in practical component and theory as per the University rules.**

Books Suggested:

1. Cotton F.A., Wilkinson G., Murillo C.A., Bochmann M., *Advanced Inorg. Chemistry*, John Wiley & Sons. Inc., 6th Ed., 1999.
2. Lee J.D., *Concise Inorganic Chemistry*, ELBS, 4th Ed., 1991.
3. Huheey J.E., Keiter E.A., Keiter R.L., *Inorganic Chemistry: Principles of Structures and Reactivity*, Pubs: Harper Collins, 4th Ed., 1993.
4. Douglas B.E, Mc Daniel D.H., Alexander J.J., *Concepts & Models of Inorganic Chemistry*, John Wiley Sons. N.Y. 3rd Ed., 1994.

5. Greenwood N.N., Earnshaw, *Chemistry of the Elements*, Butterworth-Heinemann, Butterworth-Heinemann Oxford, 2nd Edition, 1997.
6. Rodger G.E., *Inorganic and Solid-State Chemistry*, Cengage Learning India, 1st Ed, 2008.
6. Miessler G.L., Donald A. Tarr., *Inorganic Chemistry*, Pearson, 4th Ed., 2010.
7. Shriver & Atkins' Inorganic Chemistry, Oxford University Press 5th Ed, 2010.
8. Morrison R.N., Boyd, R.N., *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), 7th Ed., 2010.
9. Finar I.L., *Organic Chemistry (Volume 1)*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), 6th Ed., 2002.
10. Finar I.L., *Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products)*, Dorling Kindersley (India) Pvt. Ltd., Pearson Education, 5th Ed., 2002.
11. Ball D.W., *Physical Chemistry* Thomson Press, India, 2nd Ed., 2017.
12. Castellan G.W., *Physical Chemistry*, Narosa Publishers, 3rd Ed., 2004.
13. Mortimer R.G., *Physical Chemistry*, Elsevier: Noida, UP, 3rd Ed., 2009.
14. Engel T., Reid P., *Physical Chemistry*, Pearson, 3rd Ed., 2013.
15. Puri B.R., Sharma L.R., Pathania M.S., *Principles of Physical Chemistry*, Vishal Publishing Company, 49th Ed., 2020.
16. Atkins P.W., Paula J., *Physical Chemistry*, Oxford University Press, 10th Ed., 2014.
17. Mendham J., *A. I. Vogel's Quantitative Chemical Analysis*, Pearson, 6th Ed., 2009.
18. Vogel's *Qualitative Inorganic Analysis*, Revised by G. Svehla. Pearson Education, 7th Edition, 2009.
19. Marr G., Rockett B.W. , *Practical Inorganic Chemistry*, Van Nostrand Reinhold Company, 1st Ed., 1972.
20. Mann F.G., Saunders B.C., *Practical Organic Chemistry*, Pearson Education India, 4th Ed., 2009.
21. Kapoor, K. L., *A Text Book of Physical Chemistry*, McGraw Hill Publication, 6th Ed., 2020.
22. Ahluwalia V.K., Aggarwal R., Ahluwalia V.K., *Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis*, Sangam Books Ltd., 2001.
23. Ahluwalia V.K., Dhingra S., *Comprehensive Practical Organic Chemistry: QualitativeAnalysis*, University Press, 2000.
24. Vogel A.I., *Vogel's Textbook of Practical Organic Chemistry*, Longman Scientific & Technical, 5th Ed., 1989.
25. Vogel A.I., *Vogel's Textbook of Quantitative Chemical Analysis*, Longman Scientific & Technical, 6th Ed., 1989.
26. Pavia D.L., Lampanana G.M., Kriz G.S. Jr., *Introduction to Organic Laboratory Techniques*, Thomson Books/Cole, 3rd Ed., 2005.
27. Furniss B.S., Hannaford A.J., Smith P.W.G., Tatchell A.R., *Practical OrganicChemistry*, Pearson, 5th Ed., 2012.
28. Yadav J. B., *Advanced Practical Physical Chemistry*, Krishna Prakashan Media, 36th Ed., 2016.

Course outcomes:

At the end of the course, the students would be able to:

CO1. Understand the chemistry of transition elements, lanthanides and actinides.
CO2. Get the knowledge of organic compounds *viz.* alcohols, phenols, ethers and epoxides nd their chemical proprties.
CO3. Get acquinted with solid state chemistry.
CO4. Familiar with chemical kinetics of reactions.
CO5. Practical knowledge of stretegies of inorganic preparations and gravimetric estimations of metal ions.
CO6. Analyse unknown organic compounds Qualitatively alongwith prepararion of their derivatives.
CO7. Get practical knowledge of chemical kinetics of reactions.
CO8. Develop the skill of performing experiments, compilation of experimental information, evaluation of results presentation of the findings in the form of lab record and defend *viva-voce*.

Minor Course (Vocational) (MIC) (VOC)
Functional Group Chemistry

Paper code: 24VOC0420T | **Marks for Major Test (External): 35**
30 Hrs (2Hrs /week) | **Marks for Internal Exam: 15**
Credits: 2 | **Total Marks: 50**
Time: 2 Hrs

Note: The examiner is required to set five questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 3 marks each. In addition to this, four more questions (each question may be of 2-3 parts) will be set consisting of two questions from each unit. The student/candidate is required to attempt three questions in all, selecting one from each unit consisting of 10 marks and the compulsory Question No. 1.

Objective: This paper deals with the chemistry of functional groups present in organic compounds.

UNIT-I

15 Hrs

Alcohols, Phenols, Ethers and Epoxides

Alcohols: Preparation, properties and relative reactivity of 1°, 2°, 3° alcohols, Bouvaelt-Blanc Reduction; Oxidation by periodic acid and lead tetraacetate, Pinacol-Pinacolone rearrangement.

Phenols: Acidity and factors effecting, Ring substitution reactions, Reimer-Tiemann and Kolbe's-Schmidt Reactions, Fries and Claisen rearrangements with their mechanisms.

Ethers: Preparations, properties and chemical reactions.

Carboxylic Acids and their derivatives: Preparation, physical properties and reactions of monocarboxylic acids, acid chlorides, anhydrides, esters and amides. Mechanism of acidic and alkaline hydrolysis of esters, Claisen condensation, Dieckmann and Reformatsky reactions, Hofmann-bromamide degradation and Curtius rearrangement.

UNIT-II

Carbonyl Compounds **15 Hrs**

Nucleophilic additions, Nucleophilic addition-elimination reactions with ammonia derivatives with mechanism; Mechanisms of Aldol and Benzoin condensation, Knoevenagel condensation, Claisen-Schmidt, Perkin, Cannizzaro and Wittig reaction, Beckman. Addition reactions of unsaturated carbonyl compounds: Michael addition, Active methylene compounds: Keto-enol tautomerism.

Sulphur containing compounds: Preparation and reactions of thiols and thioethers.

Nitrogen containing functional groups

Amines: Effect of substituents 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.

Minor Course (Vocational) (MIC) (VOC)
Functional Group Chemistry Lab

Paper code: 24VOC0420P
60 Hrs (4Hrs /week)
Credits: 2
Time: 3 Hrs

Marks for Major Test (External): 35
Marks for Internal Exam: 15
Total Marks: 50

Objective: Hands on practice on detection of extra elements, qualitative analysis of unknown organic compounds and preparation of their solid derivatives.

Practicals:

1. Detection of extra elements (N, S, Halogens) in an organic compound.
2. Qualitative analysis of unknown organic compounds (solid/liquid) containing following functional groups: alcohol, phenol, ester, carboxylic acid, carbonyl, carbohydrate, amine, nitro, amide, sulphur and halogens.
3. Preparation of solid derivatives of the compounds analysed.

Note: **The examiner will allot one practical at the time of end term examination. Candidates are required to obtain minimum passing marks separately in practical component and theory as per the University rules.**

BOOKS SUGGESTED:

1. Morrison, R. T., Boyd, R. N. &Bhattacharjee S. K. *Organic Chemistry,* Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Finar, I. L. *Organic Chemistry (Volume* 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3. Graham Solomons, T.W. *Organic Chemistry,* John Wiley & Sons, Inc.
4. McMurry, J.E. *Fundamentals of Organic Chemistry,* 7th Ed. Cengage Learning India Edition, (2013).
5. Carey, F. A.&Sundberg R. J. *Advanced Prganic Chemistry, Part A: Structure and Mechanism,* Springer.
6. Carey, F. A.&Sundberg R. J. *Advanced Prganic Chemistry, Part B: Reactions and Synthesis,* Springer.
7. Mann F.G., Saunders B.C., *Practical Organic Chemistry,* Pearson Education India, 4th Ed., 2009.
8. Furniss B.S., Hannaford A.J., Smith P.W.G., Tatchell A.R., *Practical OrganicChemistry,* Pearson, 5th Ed., 2012.
9. Ahluwalia V.K., Aggarwal R. *Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis,* University Press, 2000.
10. Ahluwalia V.K., Dhingra, S. *Comprehensive Practical Organic Chemistry: Qualitative Analysis,* University Press 2000.

Course outcomes:

At the end of the course, the students would be able to:

CO1. Get the knowledge functional group chemustry containing alcohols, phenols, ethers, carboxylic acids and their derivatives and carbonyl compounds and their related rearrangments.
CO2. Get equented with the chemistry of nitrogen containig functional groups like amines and diazonium salts.
CO3. Get practice of detection of extra elements.
CO4. Get familiar with qualitative analysis of unknown organic compounds and preparation of their solid derivatives.
CO5. Develop the skill of performing experiments, compilation of experimental information, evaluation of results presentation of the findings in the form of lab record and defend *viva-voce*.

Value Aided Course (VAC)
Chemistry of Food

Paper code: 24VAC0312T
30 Hrs (2Hrs /week)
Credits: 2
Time: 2Hrs

Marks for Major Test (External): 35
Marks for Internal Exam: 15
Total Marks: 50

Note: The examiner is required to set five questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 3 marks each. In addition to this, four more questions (each question may be of 2-3 parts) will be set consisting of two questions from each unit. The student/candidate is required to attempt three questions in all, selecting one from each unit in consisting of 10 marks and the compulsory Question No.1.

Objective: This paper deals with the food chemistry, food preservatives, adultration in common food items and detection of adulterants.

Unit-I **15 Hrs**

Food Preservatives

Elementary idea of natural and synthetic food preservatives, rancidity, uses and properties, Chemicals used in foods Preservatives, coloring agents, sweetening agents, flavoring agents, and antioxidants.

Chemicals used to grow, protect foods and crops: Fertilizers, Fungicides, Herbicides, Insecticides and Pesticides: General introduction and definition, biological control and chemical control: natural and synthetic pesticides, benefits and adverse effects of DDT, BHC, malathion.

Unit-II **15 Hrs**

Adulteration of Common Foods and Methods of Detection

Common Foods subjected to Adulteration– Adulteration Definition– Types; Poisonous substances, Foreign matter, Cheap substitutes, Spoiled parts. Adulteration through Food Additives– Intentional and incidental. General Impact on Human Health.

Methods of Detection Adulterants in the following Foods; Milk, Oil, Grain, Sugar, Spices, Processed food, Fruits and vegetables. Additives and Sweetening agents (at least three methods of detection for each food item).

Books Suggested/ Links:

1. Dhawan S.N., Organic Chemistry. Vol 1. Pardeep Publication.
2. Subbulakshmi G, Food processing and preservation, New Age International Publishers 2nd Ed., 2022.
3. Sathe A.Y., First course in Food Analysis. New Age International(P)Ltd.,1st Ed., 1999.
3. Jones B., Pesticides and Insecticides. Development and Use, 2018.
4. Bhat R.V., Food Safety, case studies, NIN, 1992.
5. https://old.fssai.gov.in/Portals/0/Pdf/Draft_Manuals/Beverages and confectionary.pdf
6. https://cbseportal.com/project/Download-CBSE-XII-Chemistry-Project-Food Adulteration#gsc.tab=0
7. https://www.fssai.gov.in/
8. https://indianlegalsolution.com/laws-on-food-adulteration/
9. https://fssai.gov.in/dart/
10. https://byjus.com/biology/food-adulteration/

Course outcomes:

At the end of the course, the students would be able to:

CO1. Understand the chemistry of natural and synthetic food preservatives, their properties and uses.
CO2. Get the knowledge of various adultrants and their detection protocols.
CO3. Get familiar with the impacts of adultrants on human health.
CO4. Be acquinted with food additives.

SEMESTER – V

Discipline Specific Course (DSC)
CHEMISTRY-V

Paper code: 24CHE0501T
45 Hrs (3Hrs /week)
Credits: 3
Time: 2.5 Hrs

Marks for Major Test (External): 50
Marks for Internal Exam: 20
Total Marks: 70

Note: The examiner is required to set seven questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 2.5 marks each. In addition to this, six more questions (each question may be of 2-3 parts) will be set consisting of two questions from each unit. The student/candidate is required to attempt four questions in all, selecting one from each unit and the compulsory Question No.1. All questions carry equal marks.

Objective: This paper deals with the organometallic compounds, chemistry of organic compounds containg carbonyl and nitrogen containing compounds, chemical equilibrium, solutions and colligative properties.

UNIT-I

Organometallic Compounds-I **15 Hrs**

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 of 3d series. General methods of preparation (direct combination, reductive carbonylation) of mono and binuclear carbonyls of 3d series. Zeise's salt: Preparation and structure, evidences of synergic effect and comparison of synergic effect with that in carbonyls. Role of triethylaluminium in polymerisation of ethene (Ziegler - Natta Catalyst). Ferrocene: Preparation and reactions (acetylation, alkylation, metallation, Mannich Condensation).

UNIT-II

Carbonyl Compounds **8 Hrs**

Nucleophilic additions, Nucleophilic addition-elimination reactions with ammonia derivatives with mechanism; Mechanisms of Aldol and Benzoin condensation, Knoevenagel condensation, Claisen-Schmidt, Perkin, Cannizzaro and Wittig reaction, Beckmann and Benzil-Benzilic acid rearrangements, Haloform reaction and Baeyer Villiger oxidation, oxidations and reductions (Clemmensen, Wolff-Kishner, $LiAlH_4$, $NaBH_4$, MPV, PDC and PGC); Addition reactions of unsaturated carbonyl compounds: Michael addition.
Active methylene compounds: Keto-enol tautomerism. Preparation and synthetic applications of diethyl malonate and ethyl acetoacetate.

Nitrogen Containing Functional Groups **7 Hrs**

Preparation and important reactions of nitro compounds, nitriles and isonitriles
Amines: Effect of substituents 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.

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UNIT-III

8 Hrs

Chemical Equilibrium

Criteria of thermodynamic equilibrium, Concept of chemical equilibria. Thermodynamic derivation of relation between Gibbs free energy of reaction and reaction quotient. Coupling of exoergic and endoergic reactions. Equilibrium constants and their quantitative dependence on temperature, pressure and concentration. Thermodynamic derivation of relations between the various equilibrium constants *Kp, Kc* and *Kx*. *Le* Chatelier principle (quantitative treatment).

7 Hrs

Solutions and Colligative Properties

Dilute solutions, Raoult's and Henry's Laws and their applications. Excess thermodynamic functions. Thermodynamic derivation using chemical potential to derive relations between the four colligative properties [(i) relative lowering of vapour pressure, (ii) elevation of boiling point, (iii) Depression of freezing point, (iv) osmotic pressure] and amount of solute. Applications in calculating molar masses of normal, dissociated and associated solutes in solution.

CHEMISTRY-V Lab

Paper code: 24CHE0501P
30 Hrs (3Hrs /week)
Credits: 1
Time: 3Hrs

Marks for Major Test (External): 20
Marks for Internal Exam: 10
Total Marks: 30

Objective: Hands on practice on inorganic and preparations, and studies of colligative properties.

1. Preparation of the following organometallic compunds
(i) $VO(acac)_2$
(ii) $NH_4[Cr(NH_3)_2(CNS)_4]$
(iii) $Na_3[Co(NO_2)_6]$
2. Photoreduction of benzophenone to benzopinacol in the presence of sunlight
3. Nitration of salicylic acid using calcium nitrate
4. Determination of excess thermodynamic functions of different liquid mixtures.
5. To determine elivation of boiling point for a given solution.
6. To determine depression of freezing point for a given solution.
7. Detemination of relative and absolute viscosity of benzene.

Note: **The examiner will allot one practical at the time of end term examination. Candidates are required to obtain minimum passing marks separately in practical component and theory as per the University rules.**

Books Suggested:

1. Cotton F.A., Wilkinson G., Gaus P.L. *Basic Inorganic Chemistry Wiley* India, 3rd Ed., 2007.
2. Huheey J.E., Keiter E.A., Keiter R.L., *Inorganic Chemistry, Principles of Structure and Reactivity*, Pearson, 4th Ed., 2006.
3. Powell P., *Principles of Organometallic Chemistry*, Chapman and Hall, 2nd Ed., 1988.
4. Shriver D.D., Atkins P., *Inorganic Chemistry*, Oxford University Press, 2nd Ed., 1994.
5. Basolo F. & Pearson, R. *Mechanisms of Inorganic Reactions: Study of Metal Complexes in Solution* John Wiley & Sons Inc. NY 2nd Ed.,
6. Collman J. P. *et al. Principles and Applications of Organotransition Metal Chemistry*. Mill Valley, CA. University Science Books, 2nd Ed., 1987.
7. Crabtree R. H. *The Organometallic Chemistry of the Transition Metals*. New York, NY, John Wiley, 6th Ed.,2000.
8. Morrison R. T., Boyd R. N., Bhattacharjee S. K. *Organic Chemistry*, Pearson Education, 6th Ed., 2018.

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9. Finar I. L. *Organic Chemistry (Volume 1)*, Pearson Education, 6th Ed., 2002.
10. Graham Solomons T.W., Fryhle C. B., Snyder S. A., *Organic Chemistry Global Edition*, John Wiley & Sons, Inc., 12th Ed. 2017.
11. McMurry J.E. *Fundamentals of Organic Chemistry*, Cengage Learning India Edition, 7th Ed., 2013.
12. Carey F. A., Sundberg R. J. *Advanced Prganic Chemistry, Part A: Structure and Mechanism*, Springer, 5th Ed. 2007.
13. Carey F. A., Sundberg R. J. *Advanced Organic Chemistry, Part B: Reactions and Synthesis*, Springer, 5th Ed. 2007.
14. Peter A., Paula, J. de. *Physical Chemistry* Oxford University Press, 10th Ed., 2014.
15. Castellan G. W. *Physical Chemistry* Narosa, 4th Ed., 2004.
16. Engel T., Reid, P. *Physical Chemistry* Prentice-Hall, 3rd Ed., 2012.

Course outcomes:

At the end of the course, the students would be able to:

CO1. Get knowledge of organometallic compounds and their applications.
CO2. Understand the chemistry of carbonyl compounds and related name reactions and their mechanistic details, and chemistry of active methylene compounds.
CO3. Acquaint with the chemistry of nitrogen containing fuctional groups and their synthetic applications.
CO4. Get familiar with chemical equilibrium and relations between various equilibrium constants.
CO5. Understand the thermodynamics of solutions and acquaint with colligative properties.
CO6. Perform experiments on synthesis of organometallic and organic compounds.
CO7. Perform experiments for determination of excess thermodynamic functions, experiments based on colligative properties such as determination of elivation in boiling point, depression of freezing point, and relative and absolute viscosity.
CO8. Develop the skill of performing experiments, compilation of experimental information, presentation of the findings in the form of lab record and defend *viva-voce*.

Minor Courses (Vocational) (MIC) (VOC)
Analytical Techniques

Paper code: 24VOC0520T
30 Hrs (2Hrs /week)
Credits: 2
Time: 2 Hrs

Marks for Major Test (External): 35
Marks for Internal Exam: 15
Total Marks:50

Note: The examiner is required to set five questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 3 marks each. In addition to this, four more questions (each question may be of 2-3 parts) will be set consisting of two questions from each unit. The student/candidate is required to attempt three questions in all, selecting one from each unit consisting of 10 marks and the compulsory Question No.1.

Objective: This paper deals with conductance and electrochemistry and their applications for the qualitative and quantitative studies of various elecrolytes.

UNIT-I

15 Hrs

Conductance

Conductance of electrolytes, Debye-Huckel-Onsager theory, Wien effect, Debye-Falkenhagen effect, Walden rules. Applications of conductance measurement: (i) degree of dissociation of weak electrolytes, (ii) ionic product of water (iii) solubility and solubility product of sparingly soluble salts, (iv) conductometric titrations, and (v) hydrolysis constants of salts.
Reversible and irreversible cells with examples.

UNIT-II

15 Hrs

Electrochemistry

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 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).

Minor Courses (Vocational) (MIC) (VOC)
Analytical Techniques Lab

Paper code: 24VOC0520P
30Hrs (4Hrs /week)
Credits: 2
Time: 3 Hrs

Marks for Major Test (External): 35
Marks for Internal Exam: 15
Total Marks: 50

Objective: This paper deals with hand on practice on analytical techniques related to conductometry and potentiometry.

Practical:

Conductometry

1. Determination of cell constant, equivalent conductance, degree of dissociation and dissociation constant of a weak acid.

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2. Perform the following conductometric titrations:

i. Strong acid vs. strong base,

ii. Weak acid vs. strong base,

iii. Mixture of strong acid and weak acid vs. strong base

iv. Strong acid vs. weak base

Potentiometry

3. Perform the following potentiometric titrations:

i. Strong acid vs. strong base,

ii. Weak acid vs. strong base,

iii. Dibasic acid vs. strong base, iv. Potassium dichromate vs. Mohr's salt.

Note: **The examiner will allot one practical at the time of end term examination. Candidates are required to obtain minimum passing marks separately in practical component and theory as per the University rules.**

Books Suggested:

BOOKS SUGGESTED:

1. Atkins, P.W & Paula, J.D. *Physical Chemistry,* 10th Ed., Oxford University Press (2014).
2. Castellan, G. W. *Physical Chemistry 4th Ed.,* Narosa (2004).
3. Mortimer, R. G. *Physical Chemistry 3rd Ed.,* Elsevier: NOIDA, UP (2009).
4. Barrow, G. M., *Physical Chemistry 5th Ed.,* Tata McGraw Hill: New Delhi (2006).
5. Engel, T. & Reid, P. *Physical Chemistry 3rd Ed.,* Prentice-Hall (2012).
6. Rogers, D. W. *Concise Physical Chemistry* Wiley (2010).
7. Silbey, R. J.; Alberty, R. A. & Bawendi, M. G. *Physical Chemistry 4th Ed.,* John Wiley & Sons, Inc. (2005).
8. James A.M., Pricherd F.E., *Practical Chemistry*, Longman, 3rd Ed. 1974.
9. Levitt B.P., Zindley's, *Practical Physical Chemistry,* Longman, 9th Ed.1973.
10. Palit S.R., De S.K., *Practical Physical Chemistry,* Science Book Agency, 2nd Ed. 1974.
11. Das R.C., Behra B., *Experimental Physical Chemistry,* McGraw Hill, 1st Ed., 1983.
12. Shoemaker D. P., Gailand C. W., *Experiments in Physical Chemistry,* McGraw Hill, 8th Ed., 2008.
13. Khosla B.D., Garg V.C., Gulati A., *Senior Practical Physical Chemistry,* R. Chand & Co. New Delhi, 18th Ed., 2011.
14. Garland C. W. Nibler, J. W., Shoemaker, D. P. *Experiments in Physical Chemistry* McGraw-Hill, New York, 8th Ed. 2003.
15. Halpern A. M., McBane G. C., *Experimental Physical Chemistry* W.H. Freeman & Co. New York, 3rd Ed., 2003.
16. Yadav J. B., *Advanced Practical Physical Chemistry,* Krishna Prakashan Media, 36th Ed., 2016.

Course outcomes:

At the end of the course, the students would be able to:

CO1. Get the knowledge of electrolytes conductance and their applications to measure degree of dissociation, solubility, hydrolysis of salts etc.

CO2. Understand the reversible and irreversible cells, EMF and and applications to various kinds of half cells.

CO3. Gather the practical knowledge of use of instruments concerned with various analytical techniques like Conductometer and potentiometer.

CO4. Perform conductometric, potentiometric titrations for qualitative and quantitative analysis.

CO5. Perform experiments, evaluate the results and defend *viva-voce.*

Skill Enhancement Course
Internship

Paper code: 24CHE0502-1 **Marks for Major Test (External): 100**
120 Hrs (4 Weeks) **Total Marks: 100**
Credits: 4

Note: A student will inform and get approval from the Chairperson of the Department before going for an internship. The internship will involve working with local industry (Government or Private organizations/Institution), business establishments, artists, craft persons, or a professional (individual/organization). Student will submit a copy of the report (a hard copy and a soft copy in PDF) to the Department within 15 days after the completion of internship. A student must submit a certificate of attendance and work done report from the organization/professional where the internship was done. The evaluation of the internship shall be done by a committee comprising of at least two senior teachers appointed by the Chairperson of the Department. Marks will be awarded by the committee out of 100 marks on the basis of the report and viva-voce examination.

Objective: This paper deals with development of skill to carry out a Project.

Books Suggested/ Links:
As per "Internship" topic.

Course Outcomes:
At the end of the course, the students would be able to:
CO1. Get knowlrdge for implementation of a project
CO2 Get self-reliancy, exposure and training for carring out a project.
CO3. Develop the skill of performing experiments, analysing data, compile experimental information, presentation of the findings in the form of a dissertation.
CO4 Acquaint with presentation skills and defend *viva-voce*.

SEMESTER – VI

Discipline Specific Course (DSC)
CHEMISTRY-VI

Paper code: 24CHE0601T
45 Hrs (3Hrs /week)
Credits: 3
Time: 2.5 Hrs

Marks for Major Test (External): 50
Marks for Internal Exam: 20
Total Marks: 70

Note: The examiner is required to set seven questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 2.5 marks each. In addition to this, six more questions (each question may be of 2-3 parts) will be set consisting of two questions from each unit. The student/candidate is required to attempt four questions in all, selecting one from each unit and the compulsory Question No. 1. All questions carry equal marks.

Objective: This paper deals with the concepts of molecular and organic spectroscopic methods and their applications.

UNIT-I

Molecular Spectroscopy-I **15 Hrs**

Interaction of electromagnetic radiation with molecules and various types of spectra; Born-Oppenheimer approximation.

Rotation spectroscopy: Selection rules, intensities of spectral lines, determination of bond lengths of diatomic and linear triatomic molecules, isotopic substitution.

Vibrational spectroscopy: Classical equation of vibration, computation of force constant, amplitude of diatomic molecular vibrations, anharmonicity, Morse potential, dissociation energies, fundamental frequencies, overtones, hot bands, degrees of freedom for polyatomic molecules, modes of vibration, concept of group frequencies. Vibration-rotation spectroscopy: diatomic vibrating rotator, P, Q, R branches.

UNIT-II

Organic Spectroscopy-I **15 Hrs**

General principles Introduction to absorption and emission spectroscopy.

UV Spectroscopy: Types of electronic transitions, λ_{max}, Chromophores and Auxochromes, Bathochromic and Hypsochromic shifts, Intensity of absorption; Application of Woodward Rules for calculation of λ_{max} for the following systems: α, β- unsaturated aldehydes and ketones, carboxylic acids and esters; Conjugated dienes: alicyclic, homoannular and heteroannular; Extended conjugated systems (aldehydes, ketones and dienes); distinction between *cis*- and *trans*- isomers.

IR Spectroscopy: Fundamental and non-fundamental molecular vibrations; IR absorption positions of O, N and S containing functional groups; Effect of H-bonding, conjugation, resonance and ring size on IR absorptions; Fingerprint region and its significance; application in functional group analysis.

UNIT-III

15 Hrs

Organic Spectroscopy-II

NMR Spectroscopy: Basic principles of Proton Magnetic Resonance, chemical shift and factors influencing it; Spin-Spin coupling and coupling constant; Anisotropic effects in alkene, alkyne, aldehydes and aromatics, Interpretation of NMR spectra of simple compounds. Applications of IR, UV and NMR for identification of simple organic molecules (Problems solving with examples)

CHEMISTRY-VI Lab

Paper code: 24CHE0601P
30 Hrs (3Hrs /week)
Credits: 1
Time: 3Hrs

Marks for Major Test (External): 20
Marks for Internal Exam: 10
Total Marks: 30

Objective: Hands on practice on estimation and structural elucidation of compounds by the implication of spectrophotometric/ spectral methods.

1. To determine the strength of Cu (II) using EDTA spectrophotometrically.
2. To determine the strength of Fe (III) using EDTA spectrophotometrically.
3. To determine the concentration of nickel in given solution spectrophotometrically.
4. To determine dye concentration using UV-Visible Spectrophotometer.
5. To apply Beer-Lambert's relationship to an aquous solution containing an absorbing substance and thus, determine its respective concentrations.
6. To identify a compound by an investigation of its Infra Red spectrum.
7. To identify a compound by an investigation of NMR Spectrum.

Note: **The examiner will allot one practical at the time of end term examination. Candidates are required to obtain minimum passing marks separately in practical component and theory as per the University rules.**

Books suggested:

1. Banwell C. N., *Fundamental of molecular spectroscopy*, McGraw-Hill Education (India), 4th Ed., 2017.
2. Clayden J., Greeves, N., Warren S., Wothers P., *Organic Chemistry*, Oxford University Press.
3. Kemp W., *Organic Spectroscopy*, John Wiley.
4. Lampman G.M., Pavia D.L., Kriz G.S., Vyvyan, J.M., *Introduction to spectroscopy*, Cengage Learning.
5. Jag Mohan, *Organic Spectroscopy*, Narosa Publishers, New
6. Silverstein, R., Webster F.X., Kiemle D.J., Bryce D.L., Spectrometric identification of organic compounds, John Wiley
7. Abraham R.J., Fisher J., Loftus P., *Introduction to NMR Spectroscopy*, Wiley
8. Dyer J.R., *Application of Spectroscopy of Organic Compounds*, Prentice Hall.
9. Williams D.H., Fleming I., *Spectroscopic Methods in Organic Chemistry*, Tata McGraw-Hill.
10. Jolly W.L., *Synthesis and Characterization of Inorganic Compounds*. Prentice Hall.
11. Bell C.F., *Synthesis and Physical studies of Inorganic compounds*, Pergamon Press.
12. Vogel A.I., *A Textbook of Quantitative Analysis*, ELBS.

Course Outcomes:

At the end of the course, the students would be able to:

CO1. Explain the interaction of electromagnetic radiation with matter
CO2. Describe the rotational and vibrational motions in molecules, and Rotation and Vibrational spectroscopy.
CO3. Explain the origin of UV-visible bands, electronic transitions, Fieser-Woodward rules and photophysical

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properties of organic molecules.

CO4. Explain the basic principle and instrumentation of IR spectroscopy, characteristic vibrational frequencies of organic molecules.

CO5. Explain the basic principle of NMR spectroscopy, chemical shift, spin-spin interactions and simplification of complex spectra of different compounds.

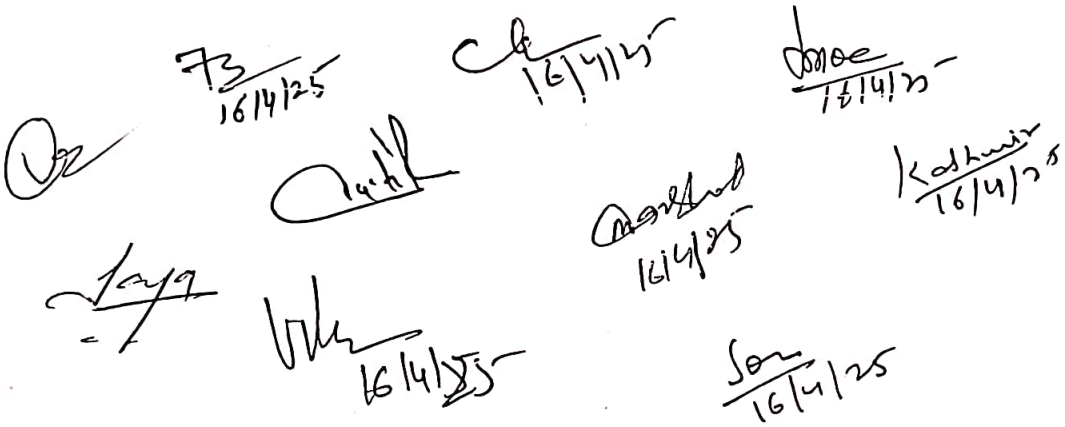
CO6. Apply the knowledge of UV, IR, NMR and Mass spectrometry for structural elucidation of organic compounds.

CO7. Prove Beer-Lambert's relationship and determine the concentrations of unknown aquous solutions.

CO8. Determine the strength of Cu (II), Fe (III) and Ni spectróphotometrically.

CO9. Determine the concentration of a dye spectrophotometrically.

CO10. Develop the skill of performing experiments, analysing data and compile experimental information in the form of lab record, and defend *viva-voce*.



Minor Course (MIC)
Biomolecules

Paper code: 24MIC0620T
30 Hrs (2Hrs /week)
Credits: 4
Time: 3 Hrs

Marks for Major Test (External): 70
Marks for Internal Exam: 30
Total Marks: 100

Note: The examiner is required to set nine questions in all. The first question will be compulsory consisting of seven short questions covering the entire syllabus consisting of 2 marks each. In addition to this, eight more questions (each question may be of 2-3 parts) will be set consisting of two questions from each unit. The student/candidate is required to attempt five questions in all, selecting one from each unit consisting of 14 marks and the compulsory Question No. 1.

Objective: This paper deals with chemistry of biomoecules such as carbohydrates, amino acids, peptides, proteis, nucliec acids, enzymes, lipids, alkaloids and terpinoids.

UNIT-I

Carbohydrates **15 Hrs**

Monosaccharides: Constitution and absolute configuration of glucose and fructose, epimers and anomers, mutarotation, determination of ring size of glucose and fructose, Haworth projections and conformational structures; Interconversions of aldoses and ketoses; Killiani-Fischer synthesis and Ruff degradation.

Disaccharides - Structure elucidation of maltose, lactose and sucrose.

Polysaccharides - Elementary treatment of starch, cellulose and glycogen.

UNIT-II

Amino Acids, Peptides and Proteins **15 Hrs**

α-Amino Acids - Synthesis, ionic properties and reactions.

Study of peptides: Determination of their primary structures-end group analysis, methods of peptide synthesis. Synthesis of peptides using *N*-protecting, *C*-protecting and *C*-activating groups-Solid-phase synthesis. Structure of peptides and proteins, forces responsible for holding of protein structures.

Nucleic Acids

Purine and pyrimidine bases of nucleic acids, base pairing *via H*-bonding. Structure of ribonucleic acids (RNA) and deoxyribonucleic acids (DNA), double helix model of DNA.

UNIT-III

Enzymes **8 Hrs**

Introduction, classification and characteristics of enzymes. Salient features of active site of enzymes. Mechanism of enzyme action (taking trypsin as example), factors affecting enzyme action, coenzymes and cofactors and their role in biological reactions, specificity of enzyme action (including stereospecificity), enzyme inhibitors and their importance, phenomenon of inhibition (competitive, uncompetitive and non-competitive inhibition including allosteric inhibition).

Lipids

Fatty acids, essential fatty acids, structure and function of triacylglycerols, glycerophospholipids, sphingolipids, cholesterol, bile acids, prostaglandins, saponification value, acid value, iodine number. **7 Hrs**

UNIT-IV

Alkaloids **15 Hrs**

Natural occurrence, General structural features, Isolation and their physiological action. Hoffmann's exhaustive methylation, Emde's modification, Synthesis of Hygrine and Nicotine. Medicinal importance of Nicotine, Hygrine, Quinine, Morphine, Cocaine, and Reserpine.

Terpenes

Occurrence, classification, isoprene rule; Synthesis of Citral, Neral and α-terpineol.

Books Suggested:

1. Finar I. L., Organic Chemistry, Vol. I, 6th Ed., Vol.II, 3rd Ed., 2002.
2. Clayden, J.; Greeves, N.; Warren, S.; Wothers, P.; *Organic Chemistry,* Oxford University Press, 2001.
3. Singh, J.; Ali, S.M., Singh, J. *Natural Product Chemistry,* Pragati Prakashan, 2010.
4. G. Bertini, Gray H. B., Lippard S. J., Bioorganic Chemistry, University Science Books, Viva Low Priced Student Edition, 1994.
5. Mann J., Davidson R. S., Hobbs J.B., Banthrope E.V., Harborne J.B., Natural products: Chemistry and Biological Significance, Longman, 1994.
6. Berg, J.M., Tymoczko, J.L., Stryer, L. *Biochemistry*. W.H. Freeman and Co., 6th Ed., 2006
7. Nelson D.L., Cox M.M., Lehninger, A.L. *Principles of Biochemistry*., W.H. Freeman and Co. 4th Ed., 2009.
8. Murray R.K., Granner D.K., Mayes P.A., Rodwell, V.W. *Harper's Illustrated Biochemistry*. Lange Medical Books/ McGraw-Hill. 28th Ed, 2009.

Course outcomes:

At the end of the course, the students would be able to:

CO1 Explain the classification, conformation, structure elucidation and nterconversions of carbohydrates.
CO2 Elementary treatment of disaccharides and polysaccharides.
CO3 Explain amino acids, peptides and proteins (structure, hydrolysis of protein and forces responsible for structure of proteins), and genetic material (DNA, RNA their structure and function).
CO4 Explain the chemical and biological catalysis, classification, properties, enzyme kinetics and inhibition of enzymes, mechanisms of enzyme catalyzed reactions.
CO5 Explain fatty acids, essential fatty acids, structure, function, their properties and lipid metabolism.
CO6 Explain the classification based on nitrogen heterocyclic ring of alkaloids, structure elucidation of alkaloids and synthesis of Nicotine, Atropine and Quinine.
CO7 Elucidate the isoprene and special isoprene rule, general methods of structure determination of and synthesis of terpenoids.

Minor Course (Vocational) (MIC) (VOC)
Introduction to Biomolecules

Paper code: 24VOC0620T
30 Hrs (2Hrs /week)
Credits: 2
Time: 3 Hrs.

Marks for Major Test (External): 35
Marks for Internal Exam: 15
Total Marks: 50

Note: The examiner is required to set five questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 3 marks each. In addition to this, four more questions (each question may be of 2-3 parts) will be set consisting of two questions from each unit. The student/candidate is required to attempt three questions in all, selecting one from each unit consisting of 10 marks and the compulsory Question No. 1.

Objective: This paper deals with chemistry of carbohydrates, amino acids, peptides, proteis, nucleic acids and lipids.

UNIT-I

Chemistry of Carbohydrates **8 Hrs**

Introduction, Monosaccharides: Glucose and fructose and their ring structures, epimers and anomers, mutarotation, Interconversions of aldoses and ketoses; Killiani-Fischer synthesis and Ruff degradation, Disaccharides - Maltose, lactose and sucrose, Polysaccharides - Elementary treatment of starch, cellulose and glycogen.

Protein chemistry **7 Hrs**

α-Amino Acids - Ionic properties, Structure of peptides and proteins, forces responsible for holding of protein structures. Synthesis of peptides using *N*-protecting, *C*-protecting and *C*-activating groups.

UNIT-II

Nucleic Acids **7 Hrs**

Purine and pyrimidine bases of nucleic acids, base pairing *via H*-bonding. Structure of ribonucleic acids (RNA) and deoxyribonucleic acids (DNA).

Lipids **8 Hrs**

Fatty acids, essential fatty acids, structure and function of triacylglycerols, glycerophospholipids, sphingolipids, cholesterol, bile acids, prostaglandins, saponification value, acid value, iodine number.

Minor Course (Vocational) (MIC) (VOC)
Introduction to Biomolecules Lab

Paper code: 24VOC0620P
60Hrs (4Hrs /week)
Credits: 2
Time: 3 Hrs.

Marks for Major Test (External): 35
Marks for Internal Exam: 15
Total Marks: 50

Objective: Hands on practice on isolation natural products and their purification, estimation of carbohydrates and glycine and determination of saponification value and iodine number of oil/fats.

1. Isolation of casein and lactose from milk.
2. Analysis of carbohydrates: aldoses and ketoses, reducing and non-reducing sugars.
3. Estimation of carbohydrates using anthrone by spectrophotometric method.
4. Study of the titration curve of glycine.
5. Saponification value of oil or a fat.
6. Determination of Iodine number of an oil/ fat.

Note: **The examiner will allot one practical at the time of end term examination. Candidates are required to obtain minimum passing marks separately in practical component and theory as per the University rules.**

Books Suggested:

1. Finar I. L., Organic Chemistry, Vol. I, 6th Ed., Vol.II, 3rd Ed., 2002.
2. Clayden, J.; Greeves, N.; Warren, S.; Wothers, P.; *Organic Chemistry*, Oxford University Press, 2001.
3. Singh, J.; Ali, S.M., Singh, J. *Natural Product Chemistry*, Pragati Prakashan, 2010.
4. G. Bertini, Gray H. B., Lippard S. J., Bioorganic Chemistry, University Science Books, Viva Low Priced Student Edition, 1994.
5. Mann J., Davidson R. S., Hobbs J.B., Banthrope E.V., Harborne J.B., Natural products: Chemistry and Biological Significance, Longman, 1994.
6. Berg, J.M., Tymoczko, J.L., Stryer, L. *Biochemistry*. W.H. Freeman and Co., 6th Ed., 2006
7. Nelson D.L., Cox M.M., Lehninger, A.L. *Principles of Biochemistry*., W.H. Freeman and Co. 4th Ed., 2009.
8. Murray R.K., Granner D.K., Mayes P.A., Rodwell, V.W. *Harper's Illustrated Biochemistry*. Lange Medical Books/ McGraw-Hill. 28th Ed, 2009.
9. Vogel A.I., *Elementary Practical Organic Chemistry Part 3, 2/E Quantitative Organic Analysis,* Pearson Education, 2011.
10. Louis F. F, *Experiments in Organic Chemistry*, Heath Company 3rd Ed. 1975.
11. Pasto D., Johnson C., Miller M., *Experiments and Techniques in Organic Chemistry*, Pearson, 1991
12. Middleton H., *Systematic Qualitative Organic Analysis,* Edward Arnold & Co.,1948.
13. Clark H.T., *Handbook of Organic Analysis-Qualitative and Quantitative*, Adward Arnold, 5th Ed., 1975.
14. Vogel A.I., *Textbook of Practical Organic Chemistry*, Longman, 4th Ed. 1978
15. Mohan J., *Analytical Organic Chemistry*. Alpha Science International Ltd, 2003.
16. Manual of Biochemistry Workshop, Department of Chemistry, University of Delhi 2012.

Course outcomes:

At the end of the course, the students would be able to:

CO1 Explain the classification, conformation, structure elucidation and nterconversions of carbohydrates.
CO2 Elementary treatment of disaccharides and polysaccharides.
CO3 Explain amino acids, peptides and proteins (structure, hydrolysis of protein and forces responsible for structure of proteins), and genetic material (DNA, RNA their structure and function).
CO4 Explain the principles, instrumentation and estimation of carbohydrates and glycine.
CO5 Develop the skill of performing experiments, analysing data and compile experimental information in the form of lab record.
CO6 Defend *viva-voce.*