॥ सा विद्या या विमुक्तये ॥

स्वामी रामानंद तीर्थ मराठवाडा विद्यापीठ, नांदेड

'ज्ञानतीर्थ', विष्णुपुरी, नांदेड – ४३१ ६०६ (महाराष्ट्र राज्य) भारत

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

'Dnyanteerth', Vishnupuri, Nanded - 431 606 (Maharashtra State) INDIA

Established on 17th September, 1994, Recognized By the UGC U/s 2(f) and 12(B), NAAC Re-accredited with'B++' grade

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विज्ञान व तंत्रज्ञान विद्याशाखे अंतर्गत राष्ट्रीय शैक्षणिक धोरणानुसार पदव्युत्तर स्तरावरील प्रथम वर्षाचे अभ्यासक्रम शैक्षणिक वर्ष २०२३–२४ पासून लागू करण्याबाबत.

प रि प त्र क

संदर्भ:– १. जा.क्र.शै–१/एनईपी२०२०/S&T/अक्र/२०२३–२४/१३० दिनांक ३०/०६/२०२३

२. जा.क्र.शै–१/एनईपी२०२०/S&T/अक्र/२०२३–२४/१३३ दिनांक ०७/०७/२०२३

या परिपत्रकान्वये सर्व संबंधितांना कळविण्यात येते की, संदर्भीय परिपत्रकान्वये दिनांक १६ जून २०२३ रोजी संपन्न झालेल्या मा. विद्यापरिषदेच्या बैठकीतील ऐनवेळचा विषय क्र. ०५/५६–२०२३ अन्वये मान्यता दिल्यानुसार विज्ञान व तंत्रज्ञान विद्याशाखे अंतर्गत राष्ट्रीय शैक्षणिक धोरणानुसार अभ्यासक्रम शैक्षणिक वर्ष २०२३–२४ पासून लागू करण्यात आलेले आहेत. तथापी वरील संदर्भीय परिपत्रक १ व २ अन्वये प्रकाशित केलेल्या अभ्यासक्रमामध्ये अभ्यासमंडळानी किरकोळ दुरूस्ती करून अभ्यासक्रम सादर केले आहेत. त्यानुसार दुरूस्तीसह खालील अभ्यासक्रम लागू करण्यात येत आहेत.

1. M. Sc. Chemistry I year (Affiliated College)

सदरील परिपत्रक व अभ्यासक्रम प्रस्तुत विद्यापीठाच्या **www.srtmun.ac.in** या संकेतस्थळावर उपलब्ध आहेत. तरी सदरील बाब ही सर्व संबंधितांच्या निदर्शनास आणून द्यावी, ही विनंती.

'ज्ञानतीर्थ' परिसर,
विष्णुपुरी, नांदेड – ४३१ ६०६.
जा.क्र.:शैक्षणिक–१/परिपत्रक/एनईपीपीजी/S&T/
२०२३–२४/312

आपली विश्वासू

डॉ. सरिता यन्नावार
सहाय्यक.कुलसचिव

दिनांक : २०.०९.२०२३.
21

प्रत माहिती व पुढील कार्यवाहीस्तव :

१) मा. अधिष्ठाता, विज्ञान व तंत्रज्ञान विद्याशाखा, प्रस्तुत विद्यापीठ.
२) मा. संचालक, परीक्षा व मूल्यमापन मंडळ यांचे कार्यालय, प्रस्तुत विद्यापीठ.
३) मा. प्राचार्य, सर्व संबधित महाविद्यालये, प्रस्तुत विद्यापीठ.
४) सिस्टम एक्सपर्ट, शैक्षणिक विभाग, प्रस्तुत विद्यापीठ. यानां देवून कळविण्यात येते की, सदरील परिपत्रक विद्यापीठाच्या संकेतस्थळावर प्रसिध्द करण्यात यावे.

Swami Ramanand Teerth Marathwada University,Nanded-431606

Syllabus of M.Sc. I yr. Chemistry

As per NEP-2020

(Structure and Syllabus of Two Years Degree Program with Multiple Entry and Multiple Exit Option)

(TWO YEARS PG COURSE W.E.F. 2023-2024)

SEMESTER PATTERN

Post Graduate (PG) Programme in

Chemistry,Affiliated Colleges

Under the Faculty of

Science and Technology

FROM DESK OF CHAIRMAN, BOARD OF STUDIES IN CHEMISTRY

The new education policy 2020 state that education is a fundamental for achieving full human potential, developing and equitable and just society and promoting National development true quality higher education.

Quality higher education aim to develop good thoughtful well rounded and creative individuals. The way to achieve such capabilities is possible only through holistic and multidisciplinary education with freedom for students to study the curriculum.

The global education development agenda reflected in sustainable development goal (SDG-4) of 2030 agenda adopted by India in 2015, seeks to "ensure inclusive and equitable quality education and promote lifelong learning opportunities for all by 2030".

The higher education in India is expanding manifolds in diversified fields like basic sciences, technologies, medical, engineering, etc. The expansion and maintenance of quality in higher education needs serious attention.

Undoubtedly UG programs were conceived as preparation for post-graduation so its structure remained unchanged and was long due you for an overhaul. The present education policy has significant drawbacks of rigidity in choosing subject combination, skill acquisition outside chosen subject and small scope for research at UG level. The NEP has changed all of these in one stroke having following best features as:

a) Flexibility in choosing subject combinations.

b) Vertical and horizontal mobility across the subject.

c) Multiple entries and multiple exit option.

d) Main streaming of skill based courses.

e) Significant emphasis on research at UC level.

f) Credit based evaluation system.

I as a chairman of board of studies in chemistry of Swami Ramanand Teerth Marathwada University Nanded happy to state that program objectives were finalized in the online meeting

where more than 35 members including all board of study members and invited board of study member were present. The program objectives are listed below:

The students graduating with degree or post graduating with degree having chemistry as a major subject should be able to:

1) Acquire core competency in subject chemistry and in allied subject areas.
2) Know basic principles instrumental techniques used in laboratories.
3) Students are expected have coherent understanding of fundamental principles, current trends as well as future opportunities in subject area.
4) Capability to characterize, identify, separate components of unknown compounds using modern instrumental methods.
5) Competency in critical thinking after identifying assumptions that frame our thinking and action, checking out their degree of accuracy and validity and finally our response from different perspectives.
6) Skill to adopt role of chemistry in safe handling of chemicals, environmental issues and other social concerns.
7) Awareness of different values systems including our own, understand the moral dimensions of decisions and accept responsibility for them.
8) The ability to engage the lifelong learning in broadest context of socio technological change.
9) Ability to elicit views of others, mediate disagreements and come up with reach conclusions in group discussions.

I am delighted to share curriculum and credit framework for post graduate program along with syllabi for implementation in school of chemical sciences of our university as well as affiliated college from academic year 2023-2024.

I take this opportunity to thank honorable vice chancellor respected Dr. Udhavrao Bhosle sir, Pro- Chancellor respected Dr. Jogendra Singh Bisen sir, Registrar respected Dr. Sarjerao Shinde Sir, Former Dean respected Dr. L. M. Waghmare sir, incharge dean Dr. M. K. Patil sir, all board of study members for helping and guiding me in making curriculum compatible.

Details of the Board of Studies Members in the subject Chemistry under the faculty of Science & Technology of S.R.T.M. University, Nanded

Sr. No.	Name of the Member	Designation	Address	Contact No.
1	Dr. D. R. Munde	Chairman	Science College Nanded	9421756689
2	Dr. B. S. Dawane	Member	School of chemical Sciences SRTMU Nanded	9423584000
3	Dr. Krishna Chaitanya	Member	School of Chemical Sciences SRTMU Nanded	7385721802
4	Dr. S. B. Sirsat	Member	Yeshwant Mahavidyalaya Nanded	9890374904
5	Dr. Jaman A. Angulwar	Member	Dayanand Science College Latur	9423246209
6	Dr. S. D. Dhage	Member	S.S.J.E.S. ACS College Gangakhed	9404864600
7	Dr. N. S. Kaminwar	Member	L.B.S. College Dharmabad	7588524845
8	Dr. A. S. Bondge	Member	Shivneri Mahavidyalaya Shirur Anantpal	9423577771
9	Dr. A. B. Chidrawar	Member	Degloor College Degloor	9423140093
10	Dr. Y. S. Nalwar	Member	Toshniwal ACS College Sengaon	9421292020
11	Dr. S. P. Hangirgekar	Member	Shivaji University Kolhapur	7276689374
12	Dr. S. V. Bhosle	Member	IICT Hydrabad	9490065673
13	Dr. B. C. Khade	Member	D.S.M. College Parbhani	9423443275
14	Dr. P. Bhaskar Reddy	Member	Bio Phore India Pharmaceuticals Hydrabad	9160744744
15	Miss. Goge Reshma Vikram	Member	Dyanand Science College Latur	
16	Miss. Tompe Pragati P.	Member	Yeshwant mahavidyalaya Nanded	

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science & Technology

Credit Framework for Two Year PG Program

Subject: Chemistry

Year & Level 1	Sem. 2	Major Subject (DSC) 3	Major Subject (DSE) 4	RM 5	OJT / FP 6	Research Project 7	Practicals 8	Credits 9	Total Credits 10
1	1	Inorganic Chemistry-SCHEC 401 (4 Cr) Organic Chemistry SCHEC 402 (4 Cr) Physical Chemistry SCHEC 403 (4 Cr)	Physical Method in Chemistry (SCHEE 401) (3Cr) OR Bioorganic Chemistry (SCHEE 402) (3Cr)	SVECR 401 Research Methodology (3 Cr)	--		Lab. Course I Inorganic Chemistry SCHEP 401 (2Cr) Lab. Course II Physical Chemistry SCHEP 402 (2Cr)	22	44
	2	Inorganic Chemistry SCHEC 451 (4 Cr) Organic Chemistry SCHEC 452 (4 Cr) Physical Chemistry SCHEC 453 (4 Cr)	Analytical chemistry (SCHEE 451) (3Cr) OR Biophysical Chemistry (SCHEE 452) (3Cr)	---	On Job Training SCHEOJT 451 (3 Cr) OR Field Project SCHEFP 452 (3 Cr)	--	Lab. Course III Organic Chemistry SCHEP 451 (2Cr) Lab. Course IV Analytical Chemistry SCHEP 452 (2Cr)	22	
Exit option: Exit Option with PG Diploma *(after 2024-25)*									

M. Sc. First Year Semester I *(Level 6.0)*

Teaching Scheme

	Course Code	Course Name	Credits Assigned			Teaching Scheme (Hrs/ week)	
			Theory	Practical	Total	Theory	Practical
Major	SCHEC 401	Inorganic Chemistry 1	**04**	**--**	**04**	**04**	**--**
	SCHEC 402	Organic Chemistry 2	**04**	**--**	**04**	**04**	**--**
	SCHEC 403	Physical Chemistry 3	**04**	**--**	**04**	**04**	**--**
Elective (DSE)	(SCHEE 401) OR (SCHEE 402)	Physical Method in Chemistry OR Bioorganic Chemistry	**03**	**--**	**03**	**03**	**--**
Research Methodology	SVECR 401	Research Methodology	**03**	**--**	**03**	**03**	
DSC Practical	SCHEP 401	Lab. Course I Inorganic Chemistry	**--**	**02**	**02**	**--**	**04**
	SCHEP 402	Lab. Course II Physical Chemistry	**--**	**02**	**02**	**--**	**04**
Total Credits			**18**	**04**	**22**	**18**	**08**

M. Sc. First Year Semester I *(Level 6.0)*

Examination Scheme

[20% Continuous Assessment (***CA***) and 80% End Semester Assessment (***ESA***)]

Subject (1)	Course Code (2)	Course Name (3)	Theory				Practical		Total Col (6+7) / Col (8+9) (10)
			Continuous Assessment (CA)			ESA			
			Test I (4)	Test II (5)	Avg of (T1+T2)/2 (6)	Total (7)	CA (8)	ESA (9)	
Major	SCHEC 401	Inorganic Chemistry 1	**20**	**20**	**20**	**80**	--	--	**100**
	SCHEC 402	Organic Chemistry 2	**20**	**20**	**20**	**80**	--	--	**100**
	SCHEC 403	Physical Chemistry 3	**20**	**20**	**20**	**80**	--	--	**100**
Elective (DSE)	(SCHEE 401) OR (SCHEE 402)	Physical Method in Chemistry OR Bioorganic Chemistry	**15**	**15**	**15**	**60**	--	--	**75**
Research Methodology	**SVECR401**	RESEARCH Methodology	**15**	**15**	**15**	**60**	--	--	**75**
DSC And DSE Practical	SCHEP 401	Lab. Course I Inorganic Chemistry	--	--	--	--	**10**	**40**	**50**
	SCHEP 402	Lab. Course II Physical Chemistry	--	--	--	--	**10**	**40**	**50**

M. Sc. First Year Semester II *(Level 6.0)*

Teaching Scheme

	Course Code	Course Name	Credits Assigned			Teaching Scheme (Hrs/ week)	
			Theory	Practical	Total	Theory	Practical
Major	SCHEC 451	Inorganic Chemistry	04	--	**04**	04	--
	SCHEC 452	Organic Chemistry	04	--	**04**	04	--
	SCHEC 403	Physical Chemistry	04	--	**04**	04	--
Elective (DSE)	(SCHEE 451) OR (SCHEE 452)	Principles of Spectroscopy OR Biophysical Chemistry (3Cr)	03	--	**03**	03	--
On Job Training	**SCHEO451**	ON Job Training	03	--	**03**	03	
SCHEP and SCHEP	SCHEP 451 (2Cr)	Lab. Course III Organic Chemistry	--	02	**02**	--	04
	SCHEP 452 (2Cr)	Lab. Course IV Analytical Chemistry	--	02	**02**	--	04
Total Credits			**18**	**04**	**22**	**14**	**08**

M. Sc. First Year Semester II *(Level 6.0)*

Examination Scheme

[20% Continuous Assessment (***CA***) and 80% End Semester Assessment (***ESA***)]

Subject (1)	Course Code (2)	Course Name (3)	Theory				Practical		Total Col (6+7) / Col (8+9) (10)
			Continuous Assessment (CA)			ESA			
			Test I (4)	Test II (5)	Avg of (T1+T2)/2 (6)	Total (7)	CA (8)	ESA (9)	
Major	SCHEC 451	Inorganic Chemistry	20	20	20	80	--	--	100
	SCHEC 452	Organic Chemistry	20	20	20	80	--	--	100
	SCHEC 403	Physical Chemistry	20	20	20	80	--	--	100
Elective (DSE)	(SCHEE 451) OR (SCHEE 452)	Principles of Spectroscopy OR Biophysical Chemistry (3Cr)	15	15	15	60	--	--	75
On Job Training	**SDSCO451**	ON Job Training	15	15	15	60	--	--	75
DSC And DSE Practical	SCHEP 451 (2Cr)	Lab. Course III Organic Chemistry	--	--	--	--	10	40	50
	SCHEP 452 (2Cr)	Lab. Course IV Analytical Chemistry	--	--	--	--	10	40	50

Program Objectives

1. Students will have a firm foundation in the fundamentals and application of current chemical and scientific theories including those in Analytical, Inorganic, Organic and Physical Chemistries.
2. Understand the common themes running through ionic, covalent and metallic descriptions of chemical bonding, including principles of main group elements. Enhance the knowledge on metal clusters and nuclear chemistry.
3. The master's specialization, Organic Chemistry, will give you in-depth knowledge about organic-chemical reactions with a focus on principles for effective synthesis strategies, stereo selectivity, catalysis, as well as organometallic chemistry.
4. Explain the fundamentals of atomic structures with respect to quantum mechanical approach in detail by understanding wave mechanics in three dimensions and able to discuss about the advanced concepts of chemical kinetics.
5. Students will appreciate the central role of chemistry in our society and use this as a basis for ethical behaviour in issues facing chemists including an understanding of safe handling of chemicals, environmental issues and key issues facing our society in energy, health and medicine.

Program specific outcome

1. To impart the chemistry knowledge of global standard
2. Global level opportunity for research and Ph.D. program
3. Discipline specific competitive examinations conducted by different organizations
4. Enormous job opportunities in chemical, pharmaceutical, food and material industries including academic institutions
5. Specific placement in R and D in various industries

M. Sc. First Year, Semester-I
Inorganic Chemistry - I
Paper : (SCHEC-401)
Credit - 04

Marks : 100 60 P

Course pre-requisite:

- Student should have basic Knowledge of Inorganic chemistry such as periodic properties and trends, ligands, metal complexes, oxidation states of metal, metal chelates etc.
- Knowledge of different theories metal complexes and their applications.

Objectives:

1. To look at the evidence and experiments that are used in the analysis of the reaction pathways of metal complexes.
2. To understand the concepts of organometallic chemistry, coordination chemistry, and material chemistry to catalysis.
3. To understand the nature and bonding in metal complexes with spectroscopic methods
4. To understand how different elements are taken up selectively by different cells and intracellular compartments and structure and function of complexes and material that are formed in the biological environment. .

Module: 1. Reactions of metal complexes.(Part I) 10 P

Introduction. Labile and Inert complexes. Ligand substitution reactions. SN1: substitution, nucleophilic, unimolecular mechanism (Dissociative mechanism): Introduction, Characteristics, Example. SN2: substitution, Nulcleophilic, Bimolecular Mechanism (Associative mechanism):Introduction, Characteristics, Example. SN1 CB : Substitution Nucleophilic Unimolecular Conjugate Base Mechanism : Characteristics, Example. Anation Reaction. Electron-transfer reactions (Redox reaction): Introduction with example. Outer sphere mechanism, tunneling mechanism, essential requisite for electron transfer, factors which favor outer sphere electron transfer reactions. Inner-sphere mechanism, characteristics, example, proof for inner sphere mechanism, inner sphere mechanism and bridging ligand, inner sphere mechanism and electronic configuration.

Module: 2. Reactions mechanism (Part II). 10P

Substitution reactions of square-planar complexes. Evidence for associative type SN2 mechanism. Trans effect, applications of trans effect. Theories of trans effect, the polarization theory, evidences in favour of the polarization theory, defect of this theory, the Pi- bonding theory. Cis effect.

Module: 3. Chemistry of nanomaterials and nano science 20 P

Introduction: Terminology, optical properties of nonmaterials, characterization methods, top down and bottom-up fabrication, templeted synthesis using frameworks, supports and substrates, self-assembled nanostructures , control of nanoarchitecture, one dimensional control, two dimensional control, three dimensional control, bioinorganic

nanomaterials**,** DNA and nanomaterials, natural and artificial nanomaterials and bionanocomposites.

Module: 4. Electronic Absorption spectra of transition metal complexes. 20P

Introduction, Basis of electron absorption, **Spin orbit coupling:** i) Russell-sounder coupling ii) j-j- coupling

Microstates and its calculations from

i) the number of orbital and number ofelectron ii) Orbital degeneracy, spin degeneracy and number of unpaired electrons

Term Symbols: Rules for determining term symbols, Hund's rule for deciding the relative energies of term symbols (Hund's First,Second And third rule)

Determination of ground States, Hole formation, Symmetry species of terms

Selection rules: I) Laporte selection rule ii) Spin section rules

Spectra of transition metal complexes: splitting of terms, Orgel diagrams for tetrahedral and octahedral complexes, Orgel correlation diagrams, Tanabe –Sugano correlation diagrams (T-S diagrams) for d^2,d^3 configurations, Comparison between Orgel and T-S diagrams .

Nephelauxetic effect, Nephelauxetic ratio (β) and Nephelauxetic series.

Charge transfer spectra: LMCT, MLCT and charge transfer in complexes having metal in mixed valence state (Metal to metal charge transfer)

Comparison between d-d transition and charge transfer spectra.

Magnetic properties of complexes: i) cooperative magnetism ii) spin crossover complexes

Reference Books :

1. Advanced Inorganic Chemistry, F.A. Cotton and Wilkinson, John Wiley.
2. Inorganic Chemistry, J.E. Huhey, Harpes and Row.
3. Inorganic Electronic Spectroscopy, A.B.P. Lever, Elsevier.
4. Magneto chemistry, R.L. Carlin, Springer Verlag.
5. Comprehensive Coordination Chemistry eds, G. Wilkinson, R.D. Gillars and J.A. McCleverty, Pergamon.
6. Advanced Inorganic Chemistry : Satyaprakash, J.D. Tuli, Version I S.K. Basu and R.D. Madan.
7. Advanced Inorganic Chemistry : Vol. I and II Gurudeep Raj.
8. Concise Inorganic Chemistry : J.D. Lee.
9. Principles of Inorganic Chemistry : Puri, Sharma and Kalia.
10. Inorganic Chemistry (Principles, structures and reactivity) (4th Edition): J.E. Huheey, E.A. Keitler and R.L. Keitler.
11. Inorganic Chemistry 3rd Edition : G.Y. Miessler and D.A. Tarr.
12. Selected topics in Inorganic Chemistry : W.U. Malik, J.D. Tuli and R.D. Madan.
13. Chemistry of the elements : N.N. Greenwood and A. Earnshaw.
14. Symmetry and Spectroscopy of molecules : K. Veera Reddy.
15. Inorganic Chemistr : Attkin and Shriver.
16. Some Aspects of Crystal Filed Thoery : T.M. Dunn, D.S. Mcclure and R.G. Person.
17. Introduction to Ligand Fild: B.N. Figis

Outcome: Student will be able to

1. Learn various approaches in analyzing structures of simple molecules.
2. Understand the proposed pathways for reactions taking place in coordination complexes such as substitution reactions, redox reactions etc. and the various factors affecting to rates of these reactions.
3. Learn about mechanisms proposed for reactions taking place in coordination complexes, and will be able to understand to explain the product formation based on these mechanisms.
4. Understand how to construct molecular orbital diagrams for simple molecules as well as coordination complexes.
5. Draw molecular orbital diagrams for sigma and pi bond formation in coordination complexes and will be able to understand and explain the difference between respective molecular orbital diagrams.

M. Sc. First Year, Semester-I
Organic Chemistry - I
Paper : (SCHEC-402)
Credit - 04

Marks: 100 **60 P**

Course pre-requisite:

- Knowledge of basic concepts in organic chemistry such as General Organic Chemistry, electronic displacement effect, reaction intermediates, and their mechanism with stereo chemical aspects.
- Knowledge of symmetric and asymmetric molecule.

Objectives:

- Students should learn about Nature of Chemical bonding in Organic molecules, Structure and Reactivity.
- To understand the various concept of Stereochemistry, Asymmetric synthesis, absolute configuration and Conformation analysis.
- To explain the mechanism of aliphatic electrophilic and nucleophilic substitution reactions.
- To interpret the problems of Benzenoid and Non Benzenoid compounds.
- Students develop the knowledge of Thermodynamic of the reaction and Kinetic of the reactions
- Student should explain the Free radical mechanism.
- To develops skill of writing mechanism.

Module: 1. Nature of Bonding in Organic Molecules and Reaction Mechanism: 15 P

Delocalised chemical bonding–conjugation, cross-conjugation, inductive resonance, hyperconjugation, field effect and steric effect, tautomerism. Generation, structure and stability of carbocations, carbanions, free radicals, carbenes and nitrenes. Huckel's rule, energy level of π-molecular orbitals, annulenes, anti-aromaticity, homo-aromaticity. Aromaticity in benzenoid and non-benzenoid compounds, alternant and non-alternant hydrocarbons, Types of mechanism, types of reaction, thermodynamic and kinetic requirements, kinetic and thermodynamic control, Hammond's postulate. Potential energy diagrams, transition state and intermediates, methods of determining mechanism, isotope effects. Effect of structure on reactivity–Resonance and quantitative treatment. The Hammett equation and linear free energy relationship, substituents and reaction constants. Taft equation.

Module: 2. Stereochemistry: 15 P

Stereo chmical principles : Enantiometric relationships, Distereomeric relationships, R and S, E and Z nomenclature, Dynamic stereochemistry, Prochiral relationships. Homotopic, enantiotopic, groups and faces, Stereo-specific and stereo-selective reactions. Conformational analysis of halo, hydroxy and methyl mono and disubstituted Cyclohexane, decalins, effect of conformation on reactivity, conformation of glucose and

fructose. Elements of symmetry, chirality, molecules with more than one chiral center, threo and erythro isomers, optical purity, enantiotopic, and diasteretopic atoms, groups and faces, stereospecific and stereoselective synthesis. Asymmetric synthesis. Optical activity in absence of chiral carbon (biphenyls, allenes and spiranes), chirality due to helical shape, Methods of resolution and recemic modification.

Module: 3. Aliphatic and Aromatic Nucleophilic Substitution: 15P

The SN^2, SN^1, mixed SN^1 and SN^2 and SET mechanism. The neighbouring group mechanism, neighbouring group participation by π and σ bonds, anchimeric assistance. The SN^i mechanism. Nucleophilic substitution at an allylic, aliphatic and a vinylic carbon. Reactivity effects of substrate structure, attacking nucleophile, leaving group and reaction medium. Phase transfer catalysis, ambident nucleophile, regioselectivity, Classical and nonclassical carbocations, phenonium ions, norbornyl system, common carbocation rearrangement. Application of NMR pectroscopy in detection of carbocations. SN^{Ar}, SN^1, benzyne and SRN^1 mechanism. Reactivity – effect of substrate structure leaving group and attacking nucleophile. Sommelet-Hauser and Smiles rearrangements.Von Richter rearrangement reaction.

Module: 4. Aliphatic and Aromatic Electrophilic Substitution: 15P

Bimolecular mechanism - SE^2 & SE^i. The SE^1 mechanism, electrophilic substitution accompanied by double bond shift. Effect of substrates, leaving group and the solvent polarity on the reactivity. The arenium ion mechanism, orientation and reactivity, energy profile diagrams. The ortho/para ratio, ipso attack. Quantitative treatment of reactivity in substrates and electrophiles. Diazonium coupling, Vilsmeir reaction, Gatter-Koch reaction.

Self Study for Enrichment (Not to be included for External Examination)

Allylic halogenation (NBS), oxidation of aldehydes to carboxylic acids, auto-oxidation, coupling of alkynes and arylation of aromatic compounds by diazonium salts. Sandmeyer reaction. Free radical rearrangement. Hunsdiecker reaction.

Books:

1. Advanced Organic Chemistry-Reaction Mechanism and structure, Jerry March, John Wiley.
2. Advanced Organic Chemistry, F.A. Carey and R.J. Sundberg, Plenum.
3. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
4. Structure and Mechanism in Organic Chemistry, C.K. Ingold, Cornell University press.
5. Organic Chemistry, R.T. Morrison Boyd, Prentice-Hall.
6. Modern Organic Reactions, H.O. House, Benjamin.
7. Principles of Organic Synthesis, R.O.C. Norman and J.M. Coxon, Blackie Academic and Professional.
8. Reaction Mechanism in Organic Chemistry, S. M. Mukherji and S.P. Singh, Macmillan.
9. Stereochemistry of Organic Compounds, D. Nasipuri, New Age International.
10. Stereochemistry of Organic Compounds, P. S. Kalsi, New Age International.

Outcome: Student will be able to

- Understand the various types of Reaction Mechanism.
- Adopt the concept of Bonding in Organic Molecules.
- Learn the concept of Stereochemistry and to identify the Stereo chemical reactions.
- Explain the various problems of aromaticity, homoaromaticty and antiaromaticity.
- Familiarize the various types of Substitution reactions and their mechanism
- Gain knowledge of free radical reactions.
- Justifies the various effect of substrate.

M. Sc. First Year, Semester-I
Physical Chemistry - I
Paper : (SCHEC-403)
Credit - 04

Marks: 100 **60 P**

Course pre-requisite:

- Basic information like classical laws and quantum mechanical laws, particle and wave nature, rules governing filling of electrons in shell, coupling of magnetic field of electron orbital and spin motion.
- Basic ideas of laws of thermodynamics, key equations in thermodynamics, Activity, activity coefficient, basic concept of partition function, different fundamental electrochemistry aspects, heterogeneous equilibrium and their applications.

Objective:

- To understand the basic concepts, laws and postulates of quantum mechanics
- To understand the concept of wave functions and operators and to solve Schrodinger wave equation for rigid rotor, harmonic oscillator and for hydrogen atom
- To understand the concept of angular momentum and electronic structure of atoms
- To understand laws of thermodynamics, concept of partial molar properties and non-ideal systems
- To understand the distribution and thermodynamic probability and to discuss the partition functions and its significance
- To relate entropy production in different system and understand Onsager's relations
- Develop skill in problems solving

Module: 1. Quantum Chemistry: **18P**

A) Introduction to Exact Quantum Mechanical Results:

a) The postulates of quantum mechanics.

b) Schrödinger equation in Laplacian and Hamiltonian form. Significance of Eigen – values and Eigen functions. Significance of Ψ and Ψ^2.

c) Discussion of solutions of the Schrödinger equation to

i. Particle in one dimensional box,

ii. Particle in three dimensional box,

iii. Harmonic oscillator,

iv. The rigid rotator and

v. Hydrogen and Hydrogen like systems.

d) Orthogonality and normalisation of wave functions.

e) Numericals on (c) and (d).

B) Approximate Methods:

a) The variation theorem, linear variation principle.

b) Perturbation theory (first order and non degenerate).

C) Angular Momentum:

a) Ordinary angular momentum, generalized angular momentum, eigen functions for angular, Momentum, eigen values of angular momentum.

b) Spin, anti-symmetry and Pauli's exclusion principle, commutation elation, Zeeman splitting, Spin orbital coupling and R-S couplings.

c) Operator using ladder operators, addition of angular momentum.

Home assignment for students: Application of Schrödinger equation to hydrogen atom. Applications of variation method and perturbation theory to the Helium atom.

Module: 2. Thermodynamics : 18P

A. Classical Thermodynamics:

a) Brief resume of concepts of laws of thermodynamics. Free energy and entropies.

b) Partial molar, partial molar free energy chemical potential, partial molar volume and partial molar heat content and their significances. Determinations of these quantities.

c) Concept of fugacity and determination of fugacity by graphical method and from equation of state.

d) Non-ideal systems : Excess functions for non-ideal solutions.

e) Activity, activity coefficient. Debye-Huckel theory for activity coefficient of electrolytic solutions, determination of activity and activity coefficients by 1) solubility 2) E.M.F. method. 3) vapour pressure method, Ionic strength.

B. Statistical Thermodynamics:

a) Concept of distribution, thermodynamics probability, ensemble averaging, postulates of ensemble averaging. Canonical, grand canonical and microcanonical ensembles.

b) Partition functions: Translational, rotational, vibrational and electronic partition functions. calculation of thermodynamic properties in terms of partition functions.

c) Applications of partition functions.

d) Numericals on A(e), B(b)

Home assignment for students :

a) Corresponding distribution laws (Max well-Boltzaman distribution law **b)** Heat capacity behaviour of solids –chemical equilibria constant in terms of partition functions.

Module: 3. Electrochemistry I 10P

a) Anomaly of strong electrolytes, Deby-Huckel theory, Onsager equation, & its verification wine effect, Deby falkenhagen effect, ion solvent, intractions.

b) Thermodynamics of electrified interface equation, Derivation of electro capillary, Lippmann equation (surface excess)

c) Structure of electrified interfaces equation, Electrical double layer, Theories of structure of Electrical double layer. Helmoholtz-perrin. Gouy-Chapman theory, Stern's theory.

Module: 4. A .Crystallography 14P

a) Solid state defects.

b) Semiconductors, N and P type, effect of temperature on N and P type Semi conduction.

c) Packing of uniform spears, octahedral and tetrahedral voids(holes), close packing of spear.

d) Isomorphism, lattice energy and born haber cycle.

B. Phase Rule :

a) Recapitulation of phase rule and terms involved in it.

b) Three component system: representation of ternary systems.

c) Partially miscible three liquid systems:- 1) system composed of three liquid components, one partially miscible pairs, two partially miscible, three partially

miscible pairs. 2) System composed of two solid and a liquid components:- formation of eutectic systems, crystallization of pure components only, formation of binary compounds, one double salt formation .

Home assignment for students: formation of binary compounds hydrate formation, formation of ternary compounds, formation of solid solutions, partially miscibility of phases.

Books Suggested

1. Physical Chemistry -P.W. Atkins, ELBS.
2. Introduction to Quantum Chemistry -A.K.Chandra,Tata McGraw Hill.
3. Quantum Chemistry - Ira N.Levine, Prentice Hall.
4. Coulson's Valence -R. McWeeny ELBS.
5. Chemical Kinetics -K.J.Laidler, McGraw Hill.
6. Kinetics and Mechanism of Chemical Transformations -J.Rajaraman and J.Kuriacose, Macmillan.
7. Micelles, Theoretical and Applied Aspects - V.Moroi, Plenum
8. Modern Electrochemistry Vol.I & II, J.O.M. Bockris & A.K.N. Reddy, Plenum
9. Introduction to Polymer Science - V.R.Gowarikar, N,V.Vishwanathan & J.Sridhar, Wiley Eastern.

Outcome: The students will be able to

- Explain basic concepts, laws and postulates of quantum mechanics
- Describe different wave functions and operators
- The Schrodinger wave equation for the calculation of Energies of rigid rotor and harmonic oscillator and solve it for hydrogen atom
- Explain the concept of angular momentum
- Describe the electronic structure of atoms
- Good overview of laws of thermodynamics, partial molar properties for different systems and concept and examples of non-ideal systems
- Discuss concept distribution with examples, they will be able to explain most probable distribution and thermodynamic probability
- Concept of partition functions and its significance
- Can relate and explain the entropy production in different system and understand Onsager's relations
- Solve problems related to quantum chemistry, will have large horizon of critical thinking and analytical reasoning

M. Sc. First Year, Semester-I
Physical Method in Chemistry
Paper : (SCHEE-401)
Credit - 03

Marks : 75 **45 P**

Course pre-requisite:

1. Basic knowledge of Symmetry elements and symmetry operation.
2. Idea to apply different Statistical tests for data collected.
3. Basic knowledge of solid state of the matter and use of different law's for their structure determination.

Objectives:

- To introduce the concepts of symmetry.
- Study the concept of group theory for understanding molecular representations.
- To provide an introductory treatment of bonding theories, electronic and vibrational spectroscopy.
- Molecular Symmetry, Symmetry operations and symmetry elements: Plane of symmetry, Proper/Improper Axis of symmetry, Inversion center, Identity element.

Module: 1. Symmetry and Group Theory in Chemistry **15P**

Symmetry elements and symmetry operation, definitions of group, subgroup, relation between orders of a finite group and its subgroup.Conjugacy relation and classes.Point symmetry group.Schonfiles symbols, representations of groups by matrices (representation of the C_n, C_{nv}, C_{nh}, D_{nh} etc. groups to be worked out clearly.) Character of a representation.The great orthogonality theorem (without proof) and its importance. Character tables C_{1h}, C_{2V}, C_{3V} and their use.

Module: 2. Statistical Treatment Of Analytical Data **10P**

Introduction, types of errors, significant figures, precision and accuracy, methods of expressing accuracy and precision,mean and standard deviation, the confidence limit, test of significance the F-test, the student t- test, rejection of results the Q – test.Statistics for small data sets, linear least squares, correlation coefficient. Sampling, types of sampling, techniques of sampling of gases, fluids and solids.Numericals.

Module: 3. X-ray Diffraction **10P**

Bragg condition. Miller indices, Laue method, Bragg method, Debye-Scherrer method of X-ray structural analysis of crystals, index reflections, identification of unit cells from systematic absences in diffraction pattern. Structure of simple lattices and X-ray intensities, structure factor and its relation to intensity and electron density, phase problem. Ramachandran diagram.

Numerical on Braggs equation. $n\lambda=2dSin\theta$

Module: 4. A) Electron Diffraction: **10P**

Scattering intensity vs. Scattering angle, Wierl equation, measurement technique, elucidation of structure of simple gas phase molecules with suitable examples.

Home assignment for students: Low energy electron diffraction and structure of surfaces.

B) Neutron Diffraction

Scattering of neutrons by solids and liquids, magnetic scattering, measurement

techniques.

Home assignment for students: Elucidation of structure of magnetically ordered unit cell, applications.

Books Suggested

1. Physical Methods in Chemistry - R.S. Drago, Saunders College.
2. Fundamentals Of Analytical Chemistry – Garry Christain
3. Fundamentals Of Analytical Chemistry - Skoog and West 9th edition
1. 4.Chemical Applications of Group Theory - F.A. Cotton.
4. Basic Principles of Spectroscopy - R. Chang, McGraw Hill.
5. Analytical Chemistry –Alka Gupta
6. Quantitative Analysis –R.A.Day and underwood

Outcome: Students will be able to

- Understand how to recognize symmetry elements in a molecule.
- Assign the point group to a molecule.
- Deal with degenerate and non-degenerate representations.

M. Sc. First Year, Semester-I

Bioorganic Chemistry (Elective)
Paper : (SCHEE-402)
Credit - 03

Marks : 75 **45 P**

Course pre-requisite:

The Fundamental knowledge of composition of cell, its functioning, carbo hydrates, lipids etc.

Objectives:

- **know about the macromolecules in the biological systems and mode of their functioning.**

Module: 1. Cell Structure and Functions: **10P**

Structure of prokarytic and eukaryotic cells, intracellular Organelles and their functions, comparison of plant and animal cells Overview of metabolic processes-catabolism and anabolism. ATP-the biological energy currency. Origin of life-unique properties of carbon, chemical evolution and rise of living systems. Introduction to biomolecules, building blocks of bio-macromolecules.

Module: 2. Carbohydrates: **10P**

Conformation of monosaccharides, strucute and functions of PImportant derivatives of minosaccharides like glycosides, deoxy sugars, myoinosito, amino sugars. N-acetylmuramic acid, sialic acid, disaccharides and polysaccharides. Structural polysaccharides – cellulose and chitin. Storage polysaccharides-starch and glycogen. Structure and biological functions of glucosaminoglycans or mucopolysaccharides. Carbohydrates of glycoproteins and glycolipids. Role of sugars in biological recognition. Blood group substances. Ascorbic acid. Carbohydrate metabolism – Kreb's cycle, applications of carbohydrates.

Module: 3. Lipids: **10P**

Fatty acids, essential fatty acids, structure and function of triacylglycerols. Glycerophospholipids ,sphiningolipids, cholesterol, bile acides prostaglandins. Lipoproteins composition and function, role in atherosclerosis. Propertieof lipid aggregates-micelles, bilayers, liposomes and their possible biological functions. Biological membrages. Flid mosaic model of membrane structure. Lipid metabolism–B-oxidation of fatty acids.

Module: 4. A) Amino-acids, Peptides and Proteins : **08 P**

Chemical and enzymatic hydrolysis of proteins to peptides, amino acid sequencing. Secondary strucutre of proteins, forces responsible for holding of secondary structures. A-helix, b-sheets, super secondary structure, triple helix structure of collagen, Tertiary structure of protein-folding and domain structure. Quaternary structure. Amino acid metabolism-degradation and biosynthesis of amino acids, sequencedetermination: Chemical/enzymatic/mass spectral, racemization/ detection. Chemistry of oxyocin and tryptophan releasing hormone 9TRH).,

B) Nucleic Acids: **07 P**

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 and forces responsible for holding it. Chemical and enzymatic hydrolysis of nucleic acids. The chemical basis for heredity, and overview of replication of DNA, transcription, functions of nucleotides. Chemical synthesis DNA

Books

1. Principles of Biochemistry, A. A. Lehninger, Worth publishers.
2. Biochemistry, L. Stryer, W. H. Freeman.
3. Biochemistry, J. David Rawn. Neil Patterson.
4. Principles of Biochemistry, A. A. Lehninger, Worth publishers.
5. Biochemistry, L. Stryer, W. H. Freeman.
6. Biochemistry, J. David Rawn. Neil Patterson.
7. Biochemistry, oet and Voet, John Wiley.
8. Outlines of Biochemistry, E.E. Conn and P. K. Stumpf, John Wiley.
9 Bioorganic Chemistry A Chemical Approach to Enzyme Action, Hermann Dugas & C. Penny, Springer –Verla Understanding Enzymes, Trevor palmer, Prentice Hall.
9. Enzyme Chemistry Impact and Applications, Ed. Collin J. Suckling, Chapman and Hall
10. Enzyme Mechanisms Ed. M. I. Page and A. Williams, Royal Society of Chemistry.
11. Fundamentals of Enzymology, N. C. Price ad L. Stevens, Oxford University Press.
12. Immobilized Enzymes: An Introduction and Applications in Biotechnology, Michael D. Trevan, John Wiley.
13. Enzymatic Reaction Mechanisms, C. Walsh, W. H. Freemain.
14. Enzyme Structure and Mechanism, A. Fresht, W. H. Freeman..
15. Biochemistry: The Chemical Reactions of Living Cells, D.E. Metzler, Academic Press.

Outcome:

The basic principles govering the metabolic reactions, energy pathwasys, functioning of catalytic systems , evolution of life and fundamental process governing it

M. Sc. First Year, Laboratory Course – I

(Inorganic Chemistry)

Paper: (SDSCP-401 & 451)

Credit - 04

Marks : 50 **60P**

Objectives:

- To understand the role of various factors in structure determination of coordination complexes, the operating procedures and principles lying behind applications of various analytical techniques in determination of structure of complexes.
- To learn the basic principles involved in the analysis of inorganic mixtures such as acidic and basic radicals, sodium carbonate extract, its preparation and use while analysis, original solution, its preparation and use, group reagents, spot test reagents and their use while analyzing inorganic mixture, solubility product, common ion effect etc
- To understand the reactions taking place while analyzing various acidic and basic radicals in a given mixture and to deepen the level of understanding of inorganic chemistry.

1. Record and viva voce
2. Detection of three acidic and three basic radicals from a given salt mixture.
   Report the spot test of radicals. (At least five mixtures)
3. Preparation of metal complexes and characterized by spectral analysis.
   a. Tris-(thiourea) copper(I) sulphate
   b. Bis (acetylacetanato) copper (II)
   c. Potassium trioxalato ferrate(III)
   d. Cis -potassium dioxalato diaquo chromate(III)
   e. Bis(dimetyl glyoxime) Nickel (0) Complex
   f. Hexammine nickel(II) Chloride
   g. Tris(Acetyl acetanato) Magnease(III)
   i. Schiff's base copper (II) Complexes
4. Separation and estimation of one of the metal ion volumetrically.
   a. Fe^{+3} and Zn^{+2} b. Ni+2 and Cu+2
   c. Cu+2 and Ba+2 d. Ni+2 and Zn+2
   e. Cu+2 and Fe+2 f. Ba+2 and Mg+2

Outcome: Students will be able to

- Learn synthesis methods for the preparation of various coordination complexes and will understand the basic principles involved in operational procedures while synthesizing the complexes to a deeper level.
- To characterize a synthesized complex using various characterization techniques such as melting point determination, solubility behavior in various solvents, molar conductance, magnetic susceptibility measurements, IR and electronic spectra etc.
- While following all these methods he/she will be able to understand operation procedures, care that should be taken while using these techniques and the practical utility of these techniques.
- Understand the basic principles lying behind inorganic analysis such as precipitation, solubility product, buffer solution, applications of buffer solution in maintaining pH, common ion effect etc. and this much information will be helpful while analyzing any inorganic compound in future.

M. Sc. I Semester –I
Laboratory Course II
(Physical Chemistry)
Paper : (SCHEP – 402)

Marks : 50 **60 P**

Objective:

- To understand basic principles and theory of different instruments & experiments
- To perform different experiments on conductometer, pH meter, potentiometer, calorimeter, polarimeter, refractometer ; etc.

N.B. 1. Performance of eighteen experiments is expected
2. At least one experiment on each instrument should be done.
3. Student should prepare the required solutions.

SECTION - A
INSTRUMENTATION:
(Any eight)

1. CONDUCTOMETER:

1. To estimate the concentrations of sulphuric acid, acetic acid and copper sulphate in given solution.
2. To determine solubility product and thermodynamic properties (ΔG, ΔH, ΔS) of sparingly soluble salts.
3. To determine the relative strength of chloroacetic acid and acetic acid.
4. To determine the hydrolysis constant of Aniline hydrochloride.
5. To investigate basic hydrolysis of ethyl acetate at four different temperatures and to find out the energy of activation .

2. POTENTIOMETER:

1. To determine PK_1 PK_2 values of Phosphoric acid.
2. To determine strength of strong acid and weak acid in given mixture.
3. To determine the oxidation state of metal ion by method of concentration cell without transparence.

3. pH-METER:

1. To determine Hammet constant of given substituted benzoic acid.
2. To determine pH values of various mixtures of sodium acetate and acetic acid in aqueous solution and hence to find out dissociation constant of acid.

4. COLORIMETER

1. To determine equilibrium quotient for formation of mono thiocyanate iron(III) complex.
2. To determine Indicator constant of an indicator.
3. To determine concentration of Cu(II) iron in given solution titrating with E.D.T.A. solution.

5. REFRACTOMETER:

1. To determine the molar refractivity of methyl acetate, ethyl acetate, n-hexane and carbon tetra chloride and to calculate refractive equivalence of C, H and Cl atom.
2. To study the variation of refractive index with composition of mixture of CCl_4 and ethyl acetate.

6. POLARIMETER.

1. To determine the relative strength of two acids.

2. To determine the percentage of two optically active substance (d-glucose and dtartaric acid) in the mixture.

SECTION B
NON-INSTRUMENTATION
(Any seven)

1. To determine partial molar volume of ethanol and water mixture at given Composition .
2. To determine molecular weight of high polymer by viscosity measurement.
3. To study the effect of surfactant on surface tension of water by using stalagmometer.
4. To determine solubility of benzoic acid at different temperature and hence to determine it's heat of solution.
5. To investigate the autocatalytic reaction between KMnO4 and oxalic acid and to find energy of activation.
6. To determine the rate constant of hydrolysis of methyl acetate catalyzed by HCl.
7. To determine effect of ionic strength on rate constant of reaction between potassium per sulphate and potassium iodide.
8. To investigate the solubility of three component system and hence tie line on bimodal curve.
9. To study the variation of viscosity with composition of mixture of i) ethanol-water ii) methanol-ethylidene chloride iii) nitric acid- Chloroform and determine whether or not there is compound formation between two liquids.
10. To determine surface tension of methyl acetate, ethyl acetate and chloroform and hence to calculate atomic parachors of C, H, Cl.
11. To determine order of reaction of given reaction kinetics by fractional change method.
12. To study distribution of benzoic acid between benzene and water at room temperature and hence show that benzoic acid dimerises in benzene.

Outcome: Student will be able to

- Apply their knowledge for setting various experiments based on the instrumentations studied
- Perform different qualitative and quantitative analysis.

M. Sc. First Year, Semester-II

Inorganic Chemistry

Paper: (SCHEC-451)
Credit - 04

Marks : 100 **60 P**

Objectives :

- To inspire students for research activities in all fields.
- To inspire students to take enthusiastically part in class.
- To make enable students for publications in reputed journals.
- To work out interaction amongst students and skilled personalities from industries.
- To make enable students for SET/NET/GATE examination.
- To generate scientific attitude amongst students through various means.

Module: 1. Catalyst. **15 P**

Introduction, General principle and mechanism of catalytic reaction. Types of catalysts. Homogeneous Catalysis: Hydrogenation of alkenes, Hydroformulation, Methanol Carbonylation, Wacker oxidation of alkenes, Palladium-catalysed C-C bond forming reaction, Heterogeneous catalysis: The nature of Heterogeneous catalysts, amonia synthesis, Sulfur dioxide oxidation, Fischer-Tropsch Synthesis, Alkene Polymerization, New directions in heterogeneous catalysis such as Tethered catalysts.

Module: 2. Bioinorganic Chemistry: **15 P**

Biological importance of essential and non-essential elements. Na/K Pump.

Metalloporphyrins : Structure of porphyrin molecule.

Hameoglobin **:**Structure, function of haemoglobin. Myoglobin **:** Structure & function.Difference between haemoglobin & Myoglobin.

Chlorophyll : Structure & function, Photosynethesis PS-I & PS-II. Electron carrier proteins in biological system:

i. Iron sulfur proteins - Rubredoxin, ferrodoxin.
ii. Cytochrome : Structure & function.
iii. Iron storage protein : Ferritin.
iv. Iron transporting biomolecule : Transferrin, siderophores (Non Protein), hemerythrin and hemocyanins.

Biological enzymes : Nitrogenase and Superoxide dismuthases.Vitamin B12 (Cynocobalanine), structure and function.

Module: 3. Structural methods in inorganic chemistry **20 P**

a. **Vibrational spectroscopy**: Introduction Physical basis requirement for vibrational spectroscopy. Number of modes of vibration. Force constant concept in vibrational spectroscopy. Application of vibrational spectroscopy with respect to change in spectra ofdonor molecule upon complexation.
b. **Electron spin resonance spectroscopy**: Introduction, Basic principle Hyperfine structure of ESR in isotropic system (Exampes). EPR spectra of transition metal

complexes as single crystals. Nuclear spin of metal ion. Reference compound in ESR. Frequency in ESR and g-splitting factor.(Numericals)

c. **Mossbauer spectroscopy**: Introduction, Basic principle, Condition for the Mossbauer spectroscopy Parameter from Mossbauer spectra, isomer shift and electrical quadruple interactions. Structural deduction.(Illustration) Mossbauer spectra of inorganic compound/ complexes.

Module : 4. Concept of Isolobality and Isolobal analogies 10 P

Concept, examples of isolobal organometallic and main group fragments.

Reference Books:

1. Advanced Inorganic Chemistry, F.A. Cotton and Wilkinson, John Wiley.
2. Inorganic Chemistry, J.E. Huhey, Harpes and Row.
3. Inorganic Electronic Spectroscopy, A.B.P. Lever, Elsevier.
4. Magneto chemistry, R.L. Carlin, Springer Verlag.
5. Comprehensive Coordination Chemistry eds, G. Wilkinson, R.D. Gillars and J.A. McCleverty, Pergamon.
6. Advanced Inorganic Chemistry : Satyaprakash, J.D. Tuli, Version I S.K. Basu and R.D. Madan.
7. Advanced Inorganic Chemistry: Vol. I and II Gurudeep Raj.
8. Concise Inorganic Chemistry: J.D. Lee.
9. Principles of Inorganic Chemistry: Puri, Sharma and Kalia.
10. Inorganic Chemistry (Principles, structures and reactivity) (4th Edition): J.E. Huheey, E.A. Keitler and R.L. Keitler.
11. Inorganic Chemistry 3rd Edition: G.Y. Miessler and D.A. Tarr.
12. Selected topics in Inorganic Chemistry: W.U. Malik, J.D. Tuli and R.D. Madan.
13. Chemistry of the elements: N.N. Greenwood and A. Earnshaw.
14. Symmetry and Spectroscopy of molecules: K. Veera Reddy.
15. Physical Chemistry through Problems: Dogra and Dogra.
16. Inorganic Chemisstr : Attkin and Shriver.
17. Elements of Magnetochemistry : A. Samal and R.L. Datta.
18. Some Aspects of Crystal Filed Thoery : T.M. Dunn, D.S. Mcclure and R.G. Person.
19. Introduction to Magnetochemistry : Alan Earnshaw.
20. Introduction to Ligand Files: B.N. Figgis.
21. Physical methods in chemistry by Drago R.S.
22. Coordination chemistry by R.Gopan and V Ramlingam
23. Structural methods in inorganic chemistry by E A V Ebsworth, D W H Rankin and S Cradock
24. Infrared UV- Visible spectroscopy by Nakamoto.

Outcome: Students will be able to

- Learn basic terms regarding electronic spectra of coordination complexes, interpretation of electronic spectra and various important parameters necessary for it, drawing of Orgel andT-S diagrams used for electronic spectra, prediction of possible electronic transitions

present in electronic spectra of coordination complexes etc.

- Understand magnetic nature of complexes, measurement of magnetic moment in coordination complexes, prediction of magnetic nature of complexes using spin only formula.
- learn the terms such as diamagnetic and paramagnetic nature of coordination complexes, difference between them, anomalous magnetic moments, spin cross over etc.
- understand the chemistry of carbonyl and nitrosyl molecules, their application as ligand molecules in complex formation, structure and bonding present in various carbonyl and nitrosyls complexes, applications etc.
- learn chemistry of boranes, carboranes and metal clusters, the concept of 3C-2e bond used to explain structural aspects in boranes and carboranes, polyhedral skeletal electron pair theory and its applications in explaining structures of metal clustes etc.

M. Sc. First Year, Semester-II

Organic Chemistry Paper: (SCHEC-452)

Credit - 04

Marks: 100 **60 P**

Objective:

- Students should learn the mechanism of elimination reactions
- To develops the ability to apply the knowledge of addition and elimination reactions
- To adopt the knowledge of pyricyclic reactions and sigma tropic reaction. To expose the students to various chemical reactions
- To learn about the addition of C-C Multiple Bonds and Carbon-Hetero Multiple Bonds
- To adopt the skill of photochemical reactions.

Module: 1. Elimination Reaction: **15P**

The E^2 , E^1 and E^1CB mechanisms and their spectrum. The E2C Mechanism, Regiochemistry of the Double Bond, Stereochemistry of the Double Bond, Orientation of the double bond. Reactivity – effects of substrate structures, attacking base, the leaving group and the medium. Mechanism and orientation in pyrolytic elimination. 1,4 Conjugate Eliminations, reactions in which c=c and c≡c bonds are formed.

Module: 2. Addition to Carbon – Carbon and Carbon - Hetero Multiple Bonds: **15P**

Mechanistic and stereochemical aspects of addition reactions involving electrophiles, nucleophiles and free radicals, regioselectivity and chemoselectivity, orientation and reactivity. Addition to cyclopropane ring. Hydroboration, Michael reaction. Sharpless asymmetric Epoxidation.

Mechanism of metal hydride reduction of saturated and unsaturated carbonyl compounds, acids, esters and nitriles. Addition of Grignard reagents, Organo-zinc and organo-lithium reagents to carbonyl and unsaturated carbonyl compounds. Wittig reaction. Mechanism of condensation reaction involving enolates- Aldol, Knoevenagel, Claisen, Mannich, Benzoin, Perkins and Stobbe reaction.

Module: 3. Pericyclic Reactions: **15P**

Molecular orbital symmetry, Frontier orbitals of ethylene, 1,3- butadiene, 1,3,5-haxatriene and allyl system. Classification of pericyclic reactions. Woodward-Hoffmann correlation diagrams. FMO and PMO approach. Electrocyclic reactions- conrotatory and disrotatory motions, 4n, 4n +2 and allyl systems. Cycloadditions – antarafacial and suprafacial additions, 4n and 4n +2 systems, 2+2 addition of ketenes, 1,3 dipolar cycloadditions and cheleotropic reactions. Sigmatropic rearrangements - Suprafacial and antarafacial shifts of H, sigmatropic shifts involving carbon moieties, 3,3 and 5,5-Sigmatropic rearrangements. Claisen, Cope and aza-Cope rearrangements.

Module: 4. Photochemistry **15P**

Principles–photochemical theory, electronic excitation, singlet and triplet states, Jablonski diagram. Energy transfer, quantum efficiency.

a) Photochemistry of carbonyl compound: Photoreduction, Norrish type–I & II,Paterno-Buchi reaction.

b) Photochemistry of α, β-unsaturated ketones.

c) Photochemistry of olefins: cis-trans isomerism.

d) Miscellaneous photochemical reaction: Photo-fries reaction of anilides,

Photorearrangements, Barton reaction singlet molecular oxygen reaction Photochemical formulation of smog photo-degradation of polymers, photochemistry of vision, nπ- pπ rearrangement.

Self Study for Enrichment (Not to be included for External Examination)

Hydrogenation of double and triple bond, Hydrogenation of aromatic rings. Hydrolysis of esters and amides, ammonolysis of esters. Functional group transformations, functional tautomerism and ene reactions.

Books:

1. Advanced Organic Chemistry-Reaction Mechanism and structure, Jerry March, John Wiley.
2. Advanced Organic Chemistry, F.A. Carey and R.J. Sundberg, Plenum.
3. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
4. Structure and Mechanism in Organic Chemistry, C.K. Ingold, Cornell University Press.
5. Organic Chemistry, R.T. Morrison Boyd, Prentice-Hall.
6. Modern Organic Reactions, H.O. House, Benjamin.
7. Principles of Organic Synthesis, R.O.C. Norman and J.M. Coxon, Blackie Academic and Professional.
8. Pericyclic Reactions, S. M. Mukherji, Macmillan, India.
9. Reaction Mechanism in Organic Chemistry, S. M. Mukherji and S.P. Singh, Macmillan.

Outcome: Student will be able to

- Understand the various types of Elimination Reaction .
- Adopt the concept of E1, E2 and E1CB mechanism.
- Learn the concept of pericyclic reaction and their transformation.
- Explain the various problems of . Woodward-Hoffmann correlation diagrams. FMO and PMO approach .
- Familiarize the various types of photochemical reactions and their mechanism
- Gain knowledge of functional group transformation .
- Justifies the various type of reaction mechanism .

M. Sc. First Year, Semester-II
Physical Chemistry
Paper : (SCHEC-453)
Credit - 04

Marks: 100 **60P**

Objective:

- To understand concepts and properties of surfactants and macromolecules
- To state laws, principles, theories related to the electrochemistry of the solutions
- To discuss and understand the corrosion, its monitoring and presentation
- To discuss different theories of reaction rates
- To understand the kinetics of complex reactions, catalysis etc.
- To perform the calculations and solve the numerical of electrochemistry and chemical kinetics
- To develop skill in problems solving, critical thinking and analytical reasoning

Module: 1. Surface Chemistry: **17P**

A. Adsorption:

a) Surface tension, capillary action, pressure difference across curved surface (Laplace equation).
b) Gibbs adsorption isotherm.
c) BET equation and estimation of surface area.
d) Surface films on liquids (Electro-kinetic phenomenon) and catalytic activity at surfaces.

B. Micelles:

a) Surface active agents, classification of surface active agents.
b) Micellisation, hydrophobic interaction, critical miceller concentration (CMC), factors affecting the CMC of surfactants, counter ion binding to micelles, thermodynamics of micellisation - phase separation and mass action models.

Home assignment for students: solubilisation, micro emulsion reverse micelles. Kelvin equation for vapour pressure of droplets.

Module : 2. Macromolecules: **08 P**

a) Polymers - definition, types of polymers, electrically conducting, fire resistant, liquid crystal polymers.
b) kinetics of polymerization, mechanism of polymerization.
c) Difference between polymers and macromolecules.
d) Molecular mass, number and mass average molecular mass, molecular mass determinations by i) osmometry, ii) viscometry, iii) diffusion and iv) light scattering methods.

Home assignment for students: Sedimentation, chain configuration of macromolecules, calculation of average dimensions of various chain structures.

Module: 3. Electrochemistry-II: **17P**

a) Over potential, types of over potentials.

b) Exchange current density, Derivation of Butler-Volmer equation, Tafel plot.
c) Semi conductor interface. Theory of double layer at Semi conductor, electrolyte solution Interface, effect of light at semiconductor, Solution interface.
d) Polarography, Theory, instrumentation, working and applications of the technique.
e) Introduction to corrosion, homogenous theory, forms of corrosion, Corrosion monitoring and prevention methods

Home assignment for students:

a) Quantum aspect of charge transfer at electrodes –solution interfaces, quantization of charge transfer, tonnelling
b) Electro catalysis influence of various parameters. Hydrogen electrodes,
c) Biochemistry, Threshold membrane phenomenon, Nernst-Plank equation.

Module: 4. Chemical Dynamics: 18P

a) Methods of determining rate laws – i) Differential method and ii) Fractional change method.
b) Theories of reaction rates – i) collision theory of reaction rates, steric factor,
a. Transition state theory, thermodynamic formulation of TST.
c) Ionic reactions, kinetic salt effects.
d) Dynamic chain (Kinetics of the reactions, thermal/photochemical) –
a. pyrolysis of acetaldehyde , ii) decomposition of ethane, iii) hydrogenchlorine reaction, iv) hydrogen-bromine reaction.
e) Oscillatory reactions (Belousov-Zhabotinsky reaction).
f) Enzyme catalysis, kinetics of enzyme reactions, Michalis - Menten equation.
g) General features of fast reactions, study of fast reaction by flow method. Flash
h) photolysis and the nuclear magnetic resonance method.
i) Dynamics of unimolecular reactions - i) Lindemann hypothesis
ii) Hinshelwood theory iii) K-R-R treatment and iv) slater's theory .
i) Numricals on (a) and (b).

Home assignment for students :

a) Steady state kinetics, kinetic and thermodynamic control of reactions, treatment of unimolecular reactions.
b) Dynamics and molecular motions, probing the transition state, dynamics of barrierless chemical reactions in solution.
c) Dynamics of unimolecular reactions (Rice-Ramsperger-Kassel - Marcus [RRKM] theory of unimolecular reactions.)

Books Suggested

1. Physical Chemistry -P.W. Atkins, ELBS.
2. Introduction to Quantum Chemistry -A.K.Chandra,Tata McGraw Hill.
3. Quantum Chemistry - Ira N.Levine, Prentice Hall.
4. Coulson's Valence -R. McWeeny ELBS.
5. Chemical Kinetics -K.J.Laidler, McGraw Hill.
6. Kinetics and Mechanism of Chemical Transformations -J.Rajaraman and J.Kuriacose, Macmillan.
7. Micelles, Theoretical and Applied Aspects - V.Moroi, Plenum
8. Modern Electrochemistry Vol.I & II, J.O.M. Bockris & A.K.N. Reddy, Plenum

9. Introduction to Polymer Science-V.R.Gowarikar, N,V.Vishwanathan & J.Sridhar, Wiley Eastern.
10. Advanced physical chemistry – J.N. Gurtu & A. Gurtu, A Pragati Edition.

Outcome: Students will be able to

- Understand the basic concepts and properties of surfactants and macromolecules
- State and apply different laws, principles, theories related to the electrochemistry of the solutions.
- Discuss and apply the information about corrosion, its monitoring and presentation.
- Distinguish different theories of reaction rates.
- Understand the kinetics of complex reactions, catalysis etc.
- Perform the calculations and solve the numerical of electrochemistry and chemical kinetics.
- Develop skill in problems solving, critical thinking and analytical reasoning.

M. Sc. First Year, Semester-II
Principles of Spectroscopy
Paper: (SCHEE-451)
Credit - 03

Marks: 75 **45P**

Objective:

- This course aims to introduce the basic principles of spectroscopy
- To understand how of electromagnetic radiations in certain region energy interact with the matter.
- To understand principles behind these techniques and interaction of radiation with the matter.
- To interpret the rotational, vibration and electronic spectra of simple molecules.

Course contents

Module: 1. Unifying Principles: **10**P

Electromagnetic radiation, interaction of electromagnetic radiation with matter absorption, emission, transmission, reflection, refraction dispersion, polarisation and scattering. Uncertainty relation and natural line width and natural line broadening, transitionprobability, results of the time dependent perturbation theory, transition moment, selectionrules, intensity of spectral lines.

Home assignment for students: Born-Oppenheimer approximation rotational,vibrational and electronic energy levels.

Mircowave Spectroscopy: Classification of molecules, rigid rotor model, effect of isotopic substitution on the transition frequencies, intensities, non-rigid rotor. Stark effect, nuclear and electron spin interaction and effect of external field.

Module: 2. Vibrational and Raman Spectroscopy **15P**

a) Vibrational Spectroscopy: Review of linear harmonic oscillator, vibrational energies of diatomic molecules, zero point energy, force constant and bond strengths; an harmonicity, Morse potential energy diagram, vibration-rotation spectroscopy, P, Q, R, branches. Breakdown of Oppenheimer approximation; vibrations of polyatomic molecules. Selection rules, normal modes of vibration group frequencies, overtones, hot bands, factors affecting the band positions and intensities.

b) Raman Spectroscopy: Classical and quantum theories of Raman Effect. Pure rotational, vibrational and vibrational-rotational Raman spectra, selection rules, mutual exclusion principle. Resonance Raman Spectroscopy,

Module: 3. Electronic Spectroscopy **05P**

Atomic Spectroscopy: Energies of atomic orbitals, vector representation of momenta and vector coupling, spectra of hydrogen atom and alkali metal atoms.

Module: 4. Molecular Spectroscopy: **10P**

Energy levels, molecular orbitals, vibronic transitions, vibrational progressions and geometry of the excited states, Franck-Condon principle, electronic spectra of polyatomic molecules. Emission spectra; radioactive and non-radioactive decay, internal conversion, spectra of transition metal complexes, charge-transfer spectra.

Photoelectron Spectroscopy: Basic principles; photo-electric effect, ionization process, Koopman's theorem.

Books Suggested

1. Modern Spectroscopy - J.M. Hollas, John Wiley
2. Applied Electron Spectroscopy for Chemical Analysis d.H.Windawi&F.L.Wo.Wiley Interscience.
3. NMR, NQR, EPR and Mossbauer Spectroscopy in Inorganic Chemistry, R.V. Parish,Ellis Harwood.
4. Physical Methods in Chemistry - R.S. Drago, Saunders College.
5. Introduction to molecular Spectroscopy - G.M.Barrow, McGraw Hill.
6. Basic Principles of Spectroscopy - R.Chang, McGraw Hill.
7. Theory and Applications of UV Spectroscopy - H.H.Jaffe&M.Orchin,IBH-Oxford.
8. Introduction to Phoroelectron Spectroscopy - P.K.Ghosh, John Wiley.
9. Introduction to Magentic Resonance - A.Carringt on & A.D.Maclachalan, Harper & Row.

Outcomes: Students will be able to:

- Explain the basic principles of rotational, vibrational, electronic and Ramanspectroscopy.
- Identify and explain factors that influence the strength and frequency of peaks in theMicrowave, IR spectra.
- Describe the selection rule for rotational, Vibrational and electronic spectroscopy.
- Determine the vibrations for a molecule and identify whether they are active ininfrared and/or Raman spectroscopy.
- Explain the difference between Stokes and anti-Stokes lines in a Raman spectrum andjustify the difference in intensity between Stokes and anti-Stokes lines.
- Draw the Stokes and anti-Stokes lines in a Raman spectrum of a compound whengiven the energies of the different transitions.
- Understand the electronic spectra of atomic and diatomic molecular systems.
- Justify the absorption lines in atomic electronic spectra and the broad bands inmolecular electronic spectra.
- Able to interpret the molecular electronic spectra and deduce the electronic structureinformation in ground and excited states of diatomic molecules.

M. Sc. First Year, Semester-II

Laboratory Safety_

Paper: (SCHEE-452)

Credit - 03

Marks: 75 **45P**

Course objectives

Course designed to aware of best practices available to prevent injury and illness as well as protect workers from the diverse hazards encountered in laboratories, including exposure to chemical, biological, physical, pharmaceutical and radio logical hazards. Students/teachers/researchers/workers will understand the importance of laboratory safety to learn to tackle the laboratory emergencies, chemical/biological/physical/radiological hazards, lab inspections and compliance, managing and working with chemicals, Ability and knowledge of safe laboratory techniques and waste disposal.

Course outcomes:

- By the end of the module the Students will be able to understand lab safety for their health.
- They will be able to apply their knowledge while working in laboratory.
- It will help them to avoid the accidents, health injuries and illness.

Module: 1. Introduction : **10P**

Introduction to Laboratory Safety, The Bhopal gas incidence (Lessons to be learned: Shared Responsibilities), Vizag gas leak incidence, Bangalore Forensic lab incidence, pharma lab Hyderabad incident, Delhi college incidence, Indian institute of Biology IICB Jadhavour incidence, Sasmira Institute Worli Mumbai incience. Risks in a electric/chemical/biological/radiation Laboratory, Health Effects Due to "Hazardous" Exposure Exposure Routes, Toxicity Risk Assessment) Personal Protective Equipment (PPE) Proper Attire (Eye/Face Protection, Lab Coats, Gloves, Respirators, Disposal/Removal of PPE), Safety rules. Emergency Equipment Safety Showers/Eye Washes, Key Campus and Department Chemical Safety Contacts, Case studies of chemical incidences.

Module: 2. Laboratory Emergency Spills, Fires/electric/ chemical/radiation Hazardous : **10P**

General Preparation for Emergencies, Handling the Accidental Release of Hazardous Materials, notifications Spill Containment and Clean-up, Leaking Gas Cylinders, Fire Extinguishers types. Chemical Hygiene Plan, the Material Safety Data Sheets (MSDS), Assessment of Chemical Toxicity, Toxic Hazards (Dose, Risk Assessment, Types of Toxins, Flammable Hazards, Flammability Characteristics, Flammability Classes, Causes of Ignition, Reactive Hazards, Explosives, Electric fire hazards etc., Radiation hazards. Case studies of incidences.

Module: 3. Managing and working with chemicals and Waste Handling: **10P**

Working with Highly Reactive or Explosive Substance, Working with Compressed Gases (Parts of the Cylinder, Cylinder Pressure Regulator, Storage Guidelines, Transporting Cylinders, Handling Compressed Gas Cylinders,

Characterization of Waste, Collection and Storage (Lids, Leaks, Labels, Location, Containers) Consequences of Mixing Incompatibles, Solid Wastes (Chemicals, Broken Glass, Sharps, Cylinders, Pick-up), Special Cases, Hazardous Waste Minimization. Principal of Biosafety, guidelines, regulations, decontamination and disinfections. Disposal of biological materials.

Module: 4. Health risks and First Aid : 15P

Health risks in different sectors like Fertilizer, Pesticides, Petrochemical, Food, Electrical, chemical, nanomaterials, cracker industries, physical, radioactive, pharmacy, Radioactive, biological laboratory/sector etc. Importance of First aid and First Aid for accidents, Case studies of incidences.

Recommended Study Materials (Books)

1. Manual of Laboratory Safety
(Chemical, Radioactive and Biosafety with Biocides)
Authors: Najat Rashid, Ramnik Sood
Publisher: Jaypee Brothers Medical Publishers Pvt. Limited
Year of Publication: 2013.
ISBN: 9789350906224, 9350906228

2. Laboratory Safety Theory and Practice
Author: Anthony Fuscaldo
Publisher: Elsevier Science
Year of publiction 2012.
ISBN: 9780323153652, 0323153658

3. CRC Handbook of Laboratory Safety, 5th Edition
Author: A. Keith Furr
Publisher: CRC Press
Year of Plication: 2020
ISBN: 9781420038460, 142003846X

4. Handbook of Laboratory Health and Safety Measures
Editor: S.B. Pal
Publisher: Springer Netherlands
Year of Publication: 2013.
ISBN: 9789401578974, 9401578974

5. Laboratory Safety for Chemistry Students
Author Robert H. Hill, Jr., David C. Finster
Publisher: Wiley
Year of Pblication: 2011.
ISBN: 9781118212646, 1118212649

6. Research Laboratory Safety
Author: Daniel Reid Kuespert
Publisher: De Gruyter
Year of Publication: 2016.
ISBN: 9783110444438, 3110444437

7. Complete Guide to Laboratory Safety
Author: Dan Scungio, Terry Jo Gile
Publisher: HCPro
Year of Publication: 2014.
ISBN: 9781556451287, 1556451288

M. Sc. II Semester
Laboratory Course III
(Organic Chemistry)
Paper : (SCHEP - 451)

Marks : 50 **60 P**

Objectives:

- To learn the techniques of separation of organic mixtures
- To apply the skill in two stage preparation
- To adopt skill of purification and crystallization
- To able to understand the estimation of given organic compound
- To understand micro scale technique.

1. Techniques:

a) Simple distillation.
b) Steam distillation.
c) Thin layer chromatography.
d) Column chromatography.

2. Qualitative analysis:

a) Separation, Purification, sample submission and identification of compounds of binary mixture (one solid and one liquid) by chemical method (Any six).
b) Separation, Purification, sample submission and identification of compounds of binary mixture (solids) physical method (Any three).

3. Preparations (Double stage), (Any Four):

a) Phthallic anhydride-phthalimide-Anthranilic acid.
b) Acetophenone-oxime-Acetanilide.
c) Phthallic anhydride-o-benzoyl benzoic acid-Anthraquinone.
d) Chlorobenzene-2,4-dinitrochlorobenzene-2,4-dinitrophenol.
e) Benzoin-benzil-benzilic acid.
f) Acetanilide-p-bromoacetanilide-p-bromo aniline.

4. Use of Computer (ChemDraw, ChemSketch, ISI Draw):

Draw the structure of aliphatic, aromatic and heterocyclic compounds and get the correct IUPAC name.

Reference Book:

1. Vogel practical organic chemistry.

Outcomes : Students will be able to

- Learn the pilot separation of the binary mixture
- Familiarize the systematic procedure of organic mixture analysis
- The preparation involving nitration, bromination, Sandmayer reaction, and Aldol condensation
- Learn the test involving identification of special elements
- Learn the confirmatory test for various functional groups
- Understand the technique involving drying and crystallization by various methods
- Expertise the various techniques of preparation and analysis of organic substances
- Learn the estimation of various organic compounds.
- Understand micro scale technique.

M. Sc. I Semester-II
Laboratory Course – IV
(Analytical Chemistry)
Paper SCHEP 452

Marks: 50 **60P**

Objective:

- To understand basic principles and theory of different instruments
- To perform different experiments on conductometer, pH meter, potentiometer, calorimeter, polarimeter, refractometer.
- To set various experiments based on the different instrumentations
- To understand basic principles and theory of measurements of density, viscosity, refractive index, surface tension, adsorption.
- To perform different qualitative and quantitative analysis.

Section-A
(Intrumental)
(Any eight)

A. Conductometry

1. Determination of the strength of strong acid and weak acid from mixture solution conductometrically
2. Analysis of aspirin by conductometric method.

B. Potentiometry

1. Determination of the strength of halides in the given mixture using Potentiometry.
2. Determine the acid and basic dissociation constant of an amino acid (Glycine) and hence isoelectric point of an acid

C. pH-metry

1. Acid-base titration in non-aqueous media by pH-metry (benzoic acid in ethanol / NaOH).
2. Determination of pKa of weak acid by pH-metry.
3. Determination of degree of dissociation of weak electrolyte and to study the deviation from ideal behaviour that occurs with a strong electrolyte.

D. **Colorimetry**

1. Varification of Beer's law for a) KMn04 and Cu^{+2} ammonia complex solution.
2. Determination of empirical formula for the formation of ferric salicylate complex by Job's method.
3. Determination of stability constant for the formation of complex between Fe^{3+} ions and 5-sulphosalicylic acid.

E. Polarimetry

1. Determination of rate constant for inversion of cane sugar by polarimetry.
2. Study of inversion of cane sugar by enzyme kinetics.

3. Determine the percentage of two optically active substances in a mixture polarimetrically.

F. Flame photometry

1. Estimation of Na+ / K+ by Flame photometry.

Section-B

(Non-Instrumental)

(Any seven)

A. Statistical analysis

1. Application of '**t**' test for experimental data.
2. Application of rejection criteria (Q test) for experimental data.
3. Treatment of analytical data with least square method applied to Beer's law for $KMnO_4$ solutions.

B. Chromatography

1. Separation of cations and anions by paper chromatography and determination of Rf values.
2. Determination of Ion-exchange capacity of an cation exchanger.
3. Determination of Ion-exchange capacity of an anion exchanger.

C. Chemical Kinetics

1. Investigate the reaction between bromic acid and hydroiodic acid.
2. To study the kinetics of iodination of acetone.

D. Heterogeneous equilibria:

1. Determine the formula of complex form between Cupric ion and ammonia by distribution method.
2. Investigate the solubility of three component system and hence draw a tie lone on bimodal curve.
3. Determination of hardness of water by complexometric titration.

Outcome: Student will be able to

- Understand the basic principles and theory of different instruments used during the conduction of the experiments
- Perform the different experiments on conductometer, pH meter, potentiometer, colorimeter, polarimeter, flame photometry
- Apply their knowledge for setting various experiments based on the instrumentations Studied
- Perform different qualitative and quantitative analysis.