GURU NANAK COLLEGE (AUTONOMOUS)

(Affiliated to university of Madras and Accredited at A++ Grade By NAAC)
Guru Nanak Salai, Velachery, Chennai - 600042

SCHOOL OF SCIENCES

M.Sc., CHEMISTRY

(SEMESTER PATTERN WITH CHOICE BASED CREDIT SYSTEM)

Syllabus

(For the PG Batch of 2024-26 and thereafter)

LOCF - LEARNING OUTCOME BASED CURRICULUM FRAMEWORK

1. About the Programme - Preamble

The purpose of post-graduate education in Chemistry is to create highly skilled man power in specific areas, which leads to greater knowledge and creation of wealth of the nation. Chemistry is a fundamental science and has contributed immensely to the improvement of the life of people by providing many requirements and essentialities. The developments in chemistry during last few decades are phenomenal and it is also seen that more inclination is towards biological sciences. New branches of chemistry are emerging and gaining importance, such as bioorganic chemistry, bioinorganic chemistry, nano chemistry, materials chemistry, computational chemistry, etc. Chemistry at industrial scale is also undergoing radical changes and is based on deep understanding the chemical phenomena. The aid of computers has also accelerated the growth in the practice of Chemistry. Chemists cannot isolate themselves from other disciplines. So, inter disciplinary courses /extra disciplinary courses have also been included which will help the students to have wider knowledge of other disciplines. Green chemistry has emerged as a new approach to the practice of Chemistry. Chemical industry is now under pressure from both the Government and the Society to develop eco-friendly processes and products which will reduce waste and prevent toxic substances from entering the environment. Efforts are taken to minimize polluting the environment and at the same time not compromising with the gain of knowledge which will enable the students to accept any challenge in chemistry and to move towards research

2. Vision

To enhance the quality of education beyond the text book / syllabi based – exam oriented system to research and analytical based learning, to produce quality graduates and post graduates to excel in the field of education / research / industry, to encourage the learners of exceptional quality to take up research and motivate them to contribute to the needs of the society and to encourage the faculty to constantly involve themselves in research in addition to the regular work, which would enable them to develop research-oriented learning skills.

3. Mission

- To inculcate the scientific methodology of learning chemistry by focusing more on practical.
- To enhance the creativity in learning chemistry among the learners using visual aids.

- ❖ To produce and to modernize the infra-structure to impart and understand the importance of practical skill accuracy and data interpretation.
- ❖ To encourage the learners to participate in the teaching – learning process to enhance their analytical and problem-solving skill and to develop leadership qualities.
- ❖ To motivate the students by conducting seminars/workshops with the inputs of eminent scientists, distinguished alumni and industrialist.
- ❖ Visit to Industries and scientific centers to have exposure on sophisticated instruments and recent developments in chemistry.

4. Program Educational Outcomes (PEOs)

PEO 1: Values of Life, Ethics & Social Concern

The graduates exhibit truth, loyalty, and love as integral moral principles, thereby contributing to a society characterized by enhanced well-being and fundamental goodness in behavior.

PEO 2: Employability & Entrepreneurship

The graduates apply analytical, logical, and critical problem-solving skills in professional contexts, elevating employability and cultivating entrepreneurial capabilities through upskilling.

PEO 3: Regional/National/Global Relevance & Competency

The graduates foster advanced analytical skills and a heightened appreciation for current Regional/National/Global perspectives, enabling informed and sustainable decision-making in a dynamic environment.

PEO 4: Skill Enhancement, Self-Directed & Lifelong Learning

The graduates independently engage in skill-based learning, utilizing infrastructure and opportunities for continuous upskilling, enabling self-evaluation and lifelong excellence attainment.

PEO 5: Research Skills & Innovation

The graduates proficiently apply scientific reasoning, fostering creativity, strategic thinking, and effective problem-solving skills. They demonstrate a core competency in generating innovative ideas for advancements and inventions.

5. Programme Outcomes (POs)

At the completion of M. Sc. in Chemistry the students are able to have:

PO 1 : Enriched knowledge to solve complex problems and develop scientific temper.

PO 2 : Advanced knowledge in inter/multi-disciplinary aspects

PO 3 : Integrated self-learning through project works, co-curricular activities, industrial exposure and field trainings

PO 4 : Resilient moral and ethical values for becoming a responsible citizen.

PO 5 : Comprehend concepts of sustainability for scientific and technological progress.

6. Programme Specific Outcomes (PSOs)

The students at the time of graduation will be able to

PSO 1 : To understand, demonstrate and solving major concepts in all disciplines of chemistry.

PSO 2 : Hands-on training in organic/inorganic/advanced functional materials synthesis and their characterization.

PSO 3 : To inculcate the scientific temperament of chemical sciences.

PSO 4 : To create foundation for research and development in Chemistry and to familiarize with current and recent developments in Chemistry

PSO 5 : To train students in skills related to Chemistry for academic and industrial requirement.

7. PEO – PO mapping

	PEO 1	PEO 2	PEO 3	PEO 4	PEO 5
PO 1	3	3	2	3	3
PO 2	2	3	3	3	3
PO 3	3	3	3	3	2
PO 4	3	3	3	3	2
PO 5	2	2	3	3	3

8. PO – PSO mapping

	PO 1	PO2	PO3	PO4	PO5
PSO 1	3	3	2	2	3
PSO 2	3	3	3	2	3
PSO 3	3	3	3	3	3
PSO 4	3	3	3	2	3
PSO 5	3	3	3	3	3

9. Choice Based Credit System (CBCS)

The College follows the CBCS with Grades under the Semester pattern. Each course is provided with a credit point based on the quantum of subject matter, complexity of the content and the hours of teaching allotted. This is done after a thorough analysis of the content of each subject paper by the members of the Board of Studies and with the approval of the Academic Council. Students are also offered a variety of Job oriented Elective, Multidisciplinary skill-based courses as part of the curriculum. Students can earn extra credits by opting for Massive Open Online Courses (MOOCs) and Certificate Courses.

The evaluation method under CBCS involves a more acceptable grading system that reflects the personality of the student. This is represented as Cumulative Grade Point Average (CGPA) and Grade Point Average (GPA) which are indicators of the Academic Performance of the student. It provides students with a scope for horizontal mobility and empowers them with the flexibility of learning at

their convenience.

Eligibility for Admission

Candidates applying for the **PG-Chemistry** programme should have taken the **UG degree in Chemistry with Mathematics and Physics as Allied subjects** from a recognized university as per the norms of the University of Madras.

Duration of the Course

The PG programme is of two years duration with four semesters. The period from June to November is termed as the odd semester and the period from December to April is referred to as the even semester. Each semester must compulsorily have 90 working days before the students appear for the final End Semester Examination.

Course Structure

The PG Chemistry programme consists of 14 Core courses with 4 credits, 5 elective courses with 3 credits, 2 extra disciplinary elective courses with 3 credits and 4 Soft Skill courses with 2 credits each. Internship training is a compulsory component for all the PG programmes with 2 credits and a project work of 6 credits.

10. Consolidated Credit Structure

Component	**No. of Courses**	**Credits**
Core (Including Practical)	14	56
Elective	5	15
EDE	2	6
Soft Skills	4	8
Internship	1	2
Project	1	6
Total		**93**

11.Credit Distribution for Each Semester

Semester	Course Component	Subject Name	Credits	Hours	Internal	External	Total
I	Core-I (Theory)	Organic Chemistry – I	4	4	50	50	100
	Core-II (Theory)	Inorganic Chemistry – I	4	4	50	50	100
	Core-III (Theory)	Physical Chemistry I	4	4	50	50	100
	Core Elective - I #	#	3	4	50	50	100
	Core-IV* (Practical)	Organic Chemistry Practical	-	4	50	50	100
	Core-V* (Practical)	Inorganic Chemistry Practical	-	4	50	50	100
	Core -VI*(Practical)	Physical Chemistry Practical	-	4	50	50	100
	Soft Skill –1	Communication and Presentation Skills	2	2	50	50	100
	Total		**17**	**30**			
II	Core-VII (Theory)	Organic Chemistry – II	4	4	50	50	100
	Core-VIII (Theory)	Inorganic Chemistry – II	4	4	50	50	100
	Core-IX (Theory)	Physical Chemistry – II	4	4	50	50	100
	Core-IV* (Practical)	Organic Chemistry Practical	4	4	50	50	100
	Core-V* (Practical)	Inorganic Chemistry Practical	4	4	50	50	100
	Core -VI*(Practical)	Physical Chemistry Practical	4	4	50	50	100
	EDE 1##	##	3	4	50	50	100
	Soft Skill – 2	Personality Enrichment	2	2	50	50	100
	Total		**29**	**30**			
Semester	**Course Component**	**Subject Name**	**Credits**	**Hours**	**Internal**	**External**	**Total**
III	Core-X (Theory)	Organic Chemistry – III	4	4	50	50	100

	Core-XI (Theory)	Inorganic Chemistry – III	4	4	50	50	100
	Core-XII (Theory)	Physical Chemistry – III	4	4	50	50	100
	Core Elective- II #	Research Methodology and Research Ethics	3	4	50	50	100
	Core Elective -III * (Practical)	Electroanalytical Chemistry Practical	-	4	50	50	100
	Core Elective -IV* (Practical)	Analytical Chemistry Practical	-	4	50	50	100
	EDE II##	##	3	4	50	50	100
	Soft Skill-3	Employability Skills	2	2	50	50	100
	Summer Internship**	Summer Internship **	2				
	Total		**22**	**30**			
IV	Core– XIII (Theory)	Organic Chemistry – IV	4	4	50	50	100
	Core– XIV (Theory)	Physical Chemistry – IV	4	4	50	50	100
	Core Elective – V#	#	3	4	50	50	100
	Core Elective-III * (Practical)	Electroanalytical Chemistry Practical	3	4	50	50	100
	Core Elective -IV* (Practical)	Analytical Chemistry Practical	3	4	50	50	100
	Core – Project	Project	6	8	50	50	100
	Soft Skill-4	Advanced computing skills	2	2	50	50	100
	Total		**25**	**30**			
		Total Credits	**93**				

*** Practical Examinations are conducted once in an academic year – at the end of semester II and semester IV.**

****The students must undergo summer internship for three weeks (minimum of 21 days) after the second semester and the reports to be submitted.**

 # The following elective courses are offered to the students of Chemistry department.

Elective –1: Analytical Chemistry

Elective –2: Research Methodology and Research Ethics

Elective –3: Chemistry of Natural Products

Elective – 4: Nanochemistry and its applications

Elective - 5 : Electroanalytical Chemistry Practical

Elective – 6: Analytical Chemistry Practical

Any one EDE (Extra Disciplinary Elective) offered by other department to be opted by the chemistry students in semester II and semester III.

The following EDE courses are offered to other departments.

EDE – 1: Nutrition and Dietetics

EDE – 2: Applied Chemistry

EDE – 3: Environmental Chemistry

EDE – 4: Forensic Science

Examination

Continuous Internal Assessment (CIA) will be for 50 percent and

End Semester Examination (ESE) will be for 50 percent.

Continuous Internal Assessment (CIA)

Every semester will have a mid-semester examination which will be conducted on completion of 45 working days in each semester. A Model exam for three hours duration will be conducted on completion of 80 working days in each semester. Internship credits will be given in **Semester III** after verification of documents by the respective Heads.

The schedule for the tests is as follows:

CIA	Schedule	Syllabus Coverage
Mid Semester Examination	After **45** working days of the Semester	60%
Model Examination	After **80** working days of the Semester	95%

The components for the CIA (Theory & Practical's) are as follows:

Internal Components			
Assessment Type	**Nature**	**Maximum Marks**	**% of Weightage**
CIA	Mid Semester Examination	50	10
Model	Model Examination	100	10
	Assignment		10
	Class activities		15
	Attendance		05
Total			**50**

The class activity relates to a programme of accepted innovative techniques such as Seminar, Quiz, Portfolio creation, Power Point presentation, Objective tests, Role play, Group discussion, Case Study etc. The mode of evaluation of the class activity will be fixed before the commencement of the semester and an approval will be obtained from the Head of the programme/wing. The students will be informed of the various methods of evaluation once the semester begins.

A record of all such assessment procedures will be maintained by the department and is open for clarification. Students will have the right to appeal to the Principal in case of glaring disparities in marking. CIA marks for practical subjects will be awarded by the respective faculty based on the performance of the student in the model practical examination, observation notebook, submission of record books, regularity and attendance for the practical classes. The attendance particulars for practical classes will be maintained by the concerned faculty. The marks for attendance will be awarded as per the following:

% of General Attendance	**Marks Awarded**
90-100	5
75-89	4
60-74	3
<60	0

End Semester Examinations (ESE)

After the completion of a minimum of 90 working days each semester, the End Semester Examinations will be conducted. Examinations for all UG and PG programmes will be held for all courses in November/December and April/May. Practical examinations will be conducted only during the end of the odd / even semester before, during or after the commencement of the theory exam. The schedule for ESE Practical's will be notified by the Controller of Examinations in consultation with the Dean (Academics)

12. Mode of Evaluation

METHODS OF EVALUATION		
Internal Evaluation	Mid Sem Exam (10)	50 Marks
	Model Exam (10)	
	Assignment (10)	
	Class activity (15)	
	Attendance (5)	
External Evaluation	End Semester Examination	50 Marks
Total		100 Marks

13. Method of Assessment

Remembering (K1)	• The lowest level of questions requires students to recall information from the course content • Knowledge questions usually require students to identify information in the textbook. • Suggested Keywords: **Choose, Define, Find, How, Label, List, Match, Name, Omit, Recall, Relate, Select, Show, Spell, Tell, What, When, Where, Which, Who, Why**

Understanding (K2)	• Understanding off acts and ideas by comprehending organizing, comparing, translating, interpolating and interpreting in their own words. • The questions go beyond simple recall and require students to combined at altogether • Suggested Keywords: **Classify, Compare, Contrast, Demonstrate, Explain, Extend, Illustrate, Infer, Interpret, Outline, Relate, Rephrase, Show, Summarize, Translate**
Application (K3)	• Students have to solve problems by using / applying a concept learned in the classroom. • Students must use their knowledge to determine a exact response. • Suggested Keywords: **Apply, Build, Choose, Construct, Develop, Experiment with, Identify, Interview, Make use of, Model, Organize, Plan, Select, Solve, Utilize**
Analyze (K4)	• Analyzing the question is one that asks the students to breakdown something into its component parts. • Analyzing requires students to identify reasons causes or motives and reach conclusions or generalizations. • Suggested Keywords: **Analyze, Assume, Categorize, Classify, Compare, Conclusion, Contrast, Discover, Dissect, Distinguish, Divide, Examine, Function, Inference, Inspect, List, Motive, Relationships, Simplify, Survey, Take part in, Test for, Theme**
Evaluate (K5)	• Evaluation requires an individual to make judgment on something. • Questions to be asked to judge the value of an idea, a character, a work of art, or a solution to a problem. • Students are engaged in decision-making and problem–solving. • Evaluation questions do not have single right answers. • Suggested Keywords:

	Agree, Appraise, Assess, Award, Choose, compare, Conclude, Criteria, Criticize, Decide, Deduct, Defend, Determine, Disprove, Estimate, Evaluate, Explain, Importance, Influence, Interpret, Judge, Justify, Mark, Measure, Opinion, Perceive, Prioritize, Prove, Rate, Recommend, Rule on, Select, Support, Value
Create **(K6)**	• The questions of this category challenge students to get engaged in creative and original thinking. • Developing original ideas and problem solving skills • Suggested Keywords: **Adapt, Build, Change, Choose, Combine, Compile, Compose, Construct, Create, Delete, Design, Develop, Discuss, Elaborate, Estimate, Formulate, Happen, Imagine, Improve, Invent, Make up, Maximize, Minimize, Modify, Original, Originate, Plan, Predict, Propose, Solution, Solve, Suppose, Test, Theory**

SEMESTER - I

PROGRAMME: M.Sc. CHEMISTRY	**BATCH:** 2024 - 26
PART:	**COURSE COMPONENT:** CORE - I
COURSE NAME: Organic Chemistry–I	**COURSE CODE:**
SEMESTER: I	**MARKS:**100
CREDITS: 4	**TOTAL HOURS:** 60
THEORY AND PROBLEMS	

COURSE OBJECTIVE:

To encompass the concepts of stereochemistry as well as the reaction mechanisms of addition, substitution and elimination in organic synthesis.

COURSE OUTCOMES:

On completion of the course the students will be able to

1. Identify the absolute configuration of molecules–D/L, R/S, erythro /threo, meso/dl, E-Z, Pro R, Pro S, Re and Si face.
2. Apply the concept to conformational analysis for cyclic and acyclic systems
3. Determine the reaction mechanism by kinetic and non-kinetic methods, mechanism and applications of aliphatic nucleophilic substitution reactions
4. Get a detailed picture of electrophilic, nucleophilic and free radical addition reaction mechanisms with stereo chemical aspects. Mechanism of carbene, nitrene intermediates and application in name reactions.
5. Explain the reaction mechanism and stereo chemistry of E1, E2 and E1CB and to predict its regioselectivity

UNIT-I: Stereochemistry–I **(15 hours)**

Optical activity - chirality- conditions for optical activity-asymmetry and dissymmetry - dissymmetry of allenes, biphenyls, para cyclophanes, ansa compounds and molecules with helical structures – absolute configuration – D /L and R/ S notation of acyclic chiral molecules, allenes, biphenyls and spiro compounds – molecules with more than one asymmetric centre – erythro / threo and meso / dl configuration – Fisher-Projection – Newmann and Sawhorse projection- interconversion of projection formulae – prochiral centre - Crams rule and Prelogs rule-optical purity– enantiomeric excess–stereo specific and stereoselective reactions.

Geometrical isomerism: E-Z nomenclature of olefins and oximes- geometrical and optical isomerism of mono and disubstituted cyclopropane, cyclobutane, cyclopentane and cyclohexane derivatives - homotopic, enantiotopic and diastereotopic hydrogen - prochiral carbon (up to 10 carbons only)-pro R and pro S & Re and Si face-determination of configuration.

UNIT-II: Stereochemistry–II (10 hours)

Conformation and conformational analysis - conformation of simple 1,2- disubstituted ethane derivatives- cyclopropane, cyclobutane, cyclopentane and cyclohexane derivatives- conformational free energy– conformational analysis of mono and disubstituted cyclohexanes and their stereochemical feature (geometrical and optical isomerism) – conformation and stereochemistry of decalin and 9-methyldecalin-conformation of glucose.

Conformation and reactivity: steric and product development control – reduction of tertiary butyl cyclohexanone by hydride – stereo chemistry of oxidation of cis and trans tertiary butyl cyclohexanols by Cr (VI) – stereochemistry of the reaction between nitrous acid and α-amino cyclohexanols. Asymmetric synthesis: Evans and Enders methods.

UNIT-III: Methods of determining reaction mechanisms (15 hours)

Kinetic and non-kinetic methods of determining reaction mechanisms-Thermodynamic and kinetic aspects - spectroscopic studies – Hammond's postulate - isotope effects – energy profile diagrams – intermediate *vs* transition state – product analysis and its importance – cross over experiments. Quantitative treatment of structure and reactivity – Hammett and Taft equations. Classification of solvents, solvent effects in organic chemistry–solute–solvent interactions– specific and non-specifics elective solvation.

S_N1, S_N2 and S_Ni mechanism–neighbouring group participation– reactivity, structural and solvent effects–substitution in norbornyl and bridge head systems–substitution by ambident nucleophiles such as cyano, nitro, phenoxide and ambident dianions–substitution at carbon doubly bonded to oxygen and nitrogen – alkylation and acylation of amines, halogen exchange, von-Braun reaction, alkylation and acylation of active methylenecarboncompounds, hydrolysis of esters, Claisen and Dieckmann condensations.

UNIT-IV: Organic reaction mechanisms – Addition to carbon-carbon and carbon-hetero multiple bonds (10 hours)

Mechanism - Electrophilic, nucleophilic and free radical addition. Addition of halogen, nitrosyl chloride to olefins, Hydration of olefins and acetylenes. Hydroboration, Hydroxylation and Michael addition. Diels-Alder reaction, 1,3 -dipolar additions. Carbene and their addition to double bond- Simmon –Smith reaction, Mannich, Stobbe, Darzen, Wittig, Wittig-Horner and Benzoin reactions. Nitrene: Methods for generating nitrenes and their reactions.(Stereochemical aspects to be studied wherever applicable).

UNIT–V: Elimination Reactions (10 hours)

E1, E2 and E_1CB mechanism – spectrum, orientation of the double bond – Hoffman and Saytzeff rule – competition, elimination and substitution. Typical eliminations to be studied – dehydration, dehydro-halogenation and similar reactions. Stereochemistry of E2 eliminations in cyclohexanes and bicyclic systems. Mechanism of pyrolytic elimination. Examples: Chugaev and Cope elimination.

PRESCRIBED BOOKS:

1. D.Nasipuri, Stereochemistry of Organic Compounds, 2nd Edition, New Age Publishers, 2005.
2. March's Advanced Organic Chemistry: Reactions, Mechanisms, and Structure, 8th Edition, Michael B. Smith, 2019.
3. E.L.Eliel., S.H.Wilen, Stereochemistry of Organic Compounds, John Wiley & Sons, 2008.
4. Sachin Kumar Ghosh, Advanced General Organic Chemistry-A Modern Approach, Part I, 3rd Edition, 2010.
5. V.K.Ahluwalia, Rakesh Kumar Parashar, Organic Reaction Mechanisms, 4th Edition, 2010.
6. R.T.Morrison, R.N.Boyd and S.K.Bhattacharjee, Organic Chemistry, Pearson Prentice hall, 7th Edition, 2012.
7. Dr.Anup Pathak, Dr. Anupa Saha, Organic Chemistry, Volume I , 2nd Edition, 2012.
8. P.S.Kalsi, Stereochemistry and Mechanism Through Solved Problems, New Age International Ltd, 5th Edition, 2019.
9. P.S.Kalsi, Stereochemistry, Conformation and Mechanism, New Age New Academic Sciences, 10th Edition, 2020.
10. P.S.Kalsi, Organic reactions and their Mechanism, New Age International Ltd, 5th Edition,2021.

REFERENCE BOOKS:

1. K.Mackie, M.Smith, P.Aitken, Guide Book to Organic Synthesis, ELBS, England, 3rd Edition, 2000.
2. R.Bruckner, Advanced Organic Chemistry Reaction Mechanism, Elsevier, New Delhi, 2002.
3. J.Clayden, N.Greeves, S.Warren and P.Wothers, Organic Chemistry, Oxford University Press, 2nd Edition, 2014.
4. F.A.Carey and R.J.Sundberg, Advanced Organic Chemistry, Parts A and B. Springer,

5th Edition, 2015.

E-LEARNING RESOURCES:

1. www.epgpathshala.nic.in
2. https://nptel.ac.in/
3. https://swayam.gov.in/
4. https://www2.chemistry.msu.edu/faculty/reusch/VirtTxtJml/intro1.htm

GUIDELINES TO THE QUESTION PAPER SETTERS
QUESTION PAPER PATTERN

Section	Question Component	Numbers	Marks	Total
Section- A	MCQ:1-10 , Fill in : 11-15 , T/F:16-20 Answer all questions	1 – 20	1	20
Section-B	Short Answer/Problems Answer any 5 out of 8 questions	21–28	7	35
Section-C	Essay Answer any 3 out of 5 questions	29-33	15	45
TOTAL MARKS				**100**

BREAK UP OF QUESTIONS

Unit	Section A	Section B		Section C
		Theory	Problem	
I	4	1	1	1
II	4	2		1
III	4	1	1	1
IV	4	1		1
V	4	1		1
TOTAL	**20**	**8**		**5**

PSO-CO mapping

	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	3	2	3	3	3
CO 2	3	3	3	2	3
CO 3	3	2	3	3	3
CO 4	3	3	3	3	3
CO 5	3	2	3	3	3
Ave.	3	2.4	3	2.8	3

PSO-CO-question paper mapping

CO No.	**COURSE OUTCOME**	**PSOs ADDRESSED**	**COGNITIVE LEVEL (K1 to K6)**
CO1	Identify the absolute configuration of molecules– D/L, R/S, erythro /threo, meso/dl, E-Z, Pro R, Pro S, Re and Si face.	PSO 1, PSO 3, PSO4, PSO5	K1, K2, K3, K4, K5, K6
CO2	Apply the concept to conformational analysis for cyclic and acyclic systems	PSO1, PSO2, PSO 5.	K1, K2, K3, K4, K5, K6
CO3	Determine the reaction mechanism by kinetic and non-kinetic methods, mechanism and applications of aliphatic nucleophilic substitution reactions	PSO 1, PSO 3, PSO4, PSO5	K1, K2, K3, K4, K5,
CO4	Get a detailed picture of electrophilic, nucleophilic and free radical addition reaction mechanisms with stereo chemical aspects. Mechanism of carbene, nitrene intermediates and application in name reactions.	PSO 1,PSO2, PSO 3, PSO4, PSO5	K1, K2, K3, K4, K5,
CO5	Explain the reaction mechanism and stereo chemistry of E1, E2 and E1CB and to predict its regioselectivity.	PSO 1, PSO2, PSO 3, PSO4, PSO5	K1, K2, K3, K4, K5,

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

PROGRAMME: M.Sc. CHEMISTRY	**BATCH:** 2024 - 26
PART:	**COURSE COMPONENT:** CORE -II
COURSE NAME: Inorganic Chemistry–I	**COURSE CODE:**
SEMESTER: I	**MARKS:**100
CREDITS: 4	**TOTAL HOURS:** 60
THEORY AND PROBLEMS	

COURSE OBJECTIVE:

To impart the knowledge on coordination complexes, rings, cages, cluster type inorganic compounds and nuclear chemistry.

COURSE OUTCOMES:

On completion of the course the students will be able to

1. Discuss and compare the various theories of bonding in coordination complexes.
2. Evaluate and apply the reaction mechanisms, stability constant, and the various methods of determination of stability constant and the stereochemistry of the inorganic complexes.
3. Outline the mechanism of electron transfer reactions and Marcus -Hush theory and predict the substitution reaction of complexes.
4. Explain and interpret the various models of nucleus and various nuclear reactions.
5. Explain about the inorganic cages, clusters and rings which are very much useful for leading current research area of materials science.

UNIT-I: Bonding and properties of coordination complexes (15 hours)

Stereo isomerism of coordination complexes. Stability of metal complexes and determination of stability constants by Job's and Bjerrum's method. Introduction to CFT, CFSE, spectrochemical series and applications. High spin and low spin complexes-Magnetic properties of coordination compounds. para, dia, ferro and ferrimagnetism, origin of magnetism, temperature dependance of magnetism – Curie-Weiss law and Neel effect Calculation of Δ_o and Δ_t and their relationship. Jahn-Teller tetrahedral distortion. theorem and its consequences, static and dynamic J-T. Nephelauxetic effect, Molecular orbital theory-based on group theoretical approach, Symmetry of molecular orbitals formed from atomic orbital overlap, LCAO-MO model, TASO, LUMO and HOMO concepts in bonding. M.O. diagrams of octahedral, tetrahedral and square planar complexes.

UNIT- II: Reactions in coordination compounds (15 hours)

Labile and Inert complexes. Substitution reaction in octahedral complexes – general mechanism, general rate law for A, D and I - distinction between D, Id, IA pathways, replacement of coordinated water, mechanism of acid hydrolysis, base hydrolysis – DCB mechanism –direct and indirect evidences in favor of the mechanism. Stereochemical changes in dissociation (S_N2) and displacement (S_N2) mechanism through various geometries of coordination compounds. Ligand substitution reactions without cleavage of M-L bond. Anation reactions. Substitution in square planar complexes – general mechanism, Trans effect, influences of entering and leaving groups. Application of trans effect – synthesis of isomers of Pt(II) and Co(III) complexes – theories of trans effect. Stereoisomerism in inorganic complexes, Optical rotatory dispersion (ORD) and circular dichroism (CD). Isomerization and racemization reactions in octahedral complexes.

UNIT –III: Coordination chemistry - Reaction mechanisms (10 hours)

Electron transfer reactions – Inner sphere (ISET) and outer sphere (OSET) electron transfer processes. Key ideas concerning electron transfer between transition metals. Chemical activation and electron transfer, role of bridging ligand with ISET reaction – tunneling transfer – multiple bridging in the activated complex in the ISET process. Complimentary and non- complimentary ET reactions. Cross reactions and Marcus-Hush theory.

UNIT-IV: Nuclear Chemistry (10 hours)

Nuclear structure: Composition of the nucleus, nuclear size, shape and density, nuclear models: shell model-salient features, filling of orbitals, nuclear configuration, Liquid drop model, theories of nuclear forces – pi-meson theory. Nuclear reactions: types of nuclear reactions, nuclear fission, fission products, theory of nuclear fission. Orbital electron capture, kinetics of nuclear reactions ($t_{1/2}$ and decay constant) - applications of carbon dating and rock dating. Discovery of artificial radioactivity, synthesis of trans-uranium elements, importance and applications of artificial radioactivity, production and separation of radioactive isotopes.

UNIT-V: Inorganic Rings, Cages and Clusters (10 hours)

Clusters: Boranes, carboranes, metallo boranes and metallo carboranes- synthesis and structure of neutral boron hydrides, polyhedral borane anions and dianions, capping rules,

PSEPT (Wade's rules). Low nuclearity metal-carbonyl clusters and 14 n+2 rule, high nuclearity metal-carbonyl and other clusters (Rhenium cluster complexes) with internal atoms.

Boron-nitrogen compounds: Borazines and B-N clusters. P-N and P-S compounds: polyphosphazene and cyclic aminophosphanes, phosphorus-oxide and phosphorus-sulfide cages. Sulfur-nitrogen compounds.

Isopoly and heteropoly acids and salts (Mo, W, V, Nb and Ta), Heteropoly anions-structure and reactivity; heteropoly blues. Macrocyclic ligands; types- Schiff bases; crown ethers and cryptands and porphyrins.

PRESCRIBED BOOKS:

1. P.W. Atkins, T. Overton, J. Rourke, M. Weller and F. Armstrong; Shriver and Atkins: Inorganic Chemistry, 5th Edition, Oxford University Press, 2013.
2. J. E. Huheey, E. A. Keiter, R.L. Keiter and O. K. Medhi, Inorganic Chemistry Principles of structure and reactivity, 4th Edition, Pearson, 2013.
3. C. E. Housecroft and A. G. Sharpe, Inorganic Chemistry, 4th Edition, Prentice-Hall, 2012.
4. K.F. Purcell and J.C. Kotz, Inorganic Chemistry, Sengage Learning India Pvt. Ltd, 1st Edition, 2010.
5. Karl H. Lieser, Nuclear and Radiochemistry: Fundamentals and Applications, 2nd Edition, 2001, Wiley, NY.
6. H. J. Arnikar, Essentials of Nuclear Chemistry, 4th Edition, New Age Publishers, 1995.
7. D. M. P. Mingos, David J. Wales, Cluster Chemistry, Prentice Hall, 1990.

REFERENCE BOOKS:

1. M.C. Day and J. Selbin, Theoretical Inorganic Chemistry, Literary Licensing, LLC, 2012.
2. I. Kaplan, Nuclear Physics, 2nd Edition, Narosa Book Distributors Pvt. Ltd.
3. G. Friedlander, J. W. Kennedy, E. S. Macias and J. M.Miller, Nuclear and Radiochemistry, John Wiley & Sons, 1985.
4. D. Banerjea, Coordination Chemistry, Asian Books Pvt. Ltd., 2nd Edition, 2007.

E-LEARNING RESOURCES:

1. https://www.chemicalforums.com/
2. https://nptel.ac.in/
3. https://chem.libretexts.org/
4. http://www.ilpi.com/genchem/web.html#12

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

Section	Question Component	Numbers	Marks	Total
Section- A	MCQ:1-10 , Fill in : 11-15 , T/F:16-20 Answer all questions	1 – 20	1	20
Section-B	Short Answer/Problems Answer any 5 out of 8 questions	21–28	7	35
Section-C	Essay Answer any 3 out of 5 questions	29-33	15	45
TOTAL MARKS				**100**

BREAK UP OF QUESTIONS

Unit	Section A	Section B	Section C
I	4	2	1
II	4	1	1
III	4	1	1
IV	4	2	1
V	4	2	1
TOTAL	**20**	**8**	**5**

PSO – CO mapping

	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	2	3	2	3	3
CO 2	3	2	3	3	3
CO 3	3	3	3	2	3
CO 4	2	3	3	3	2
CO 5	3	3	3	3	2
Ave.	2.6	2.8	2.8	2.8	2.6

PSO-CO-question paper mapping

CO No.	COURSE OUTCOME	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Discuss and compare the various theories of bonding in coordination complexes.	PSO1, PSO3, PSO5	K1, K2, K3
CO2	Evaluate and apply the reaction mechanisms, stability constant, and the various methods of determination of stability constant and the stereochemistry of the inorganic complexes.	PSO1, PSO4, PSO5	K1, K2, K3
CO3	Outline the mechanism of electron transfer reactions and Marcus -Hush theory and predict the substitution reaction of complexes.	PSO1, PSO3,	K1, K3, K5
CO4	Apply and interpret the various models of nucleus and various nuclear reactions.	PSO1, PSO3, PSO4	K1, K3, K4
CO5	Explain about the inorganic cages, clusters and rings which are very much useful for leading current research area of materials science.	PSO1, PSO4, PSO5	K1, K4, K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

PROGRAMME: M.Sc. CHEMISTRY	**BATCH:** 2024 - 26
PART:	**COURSE COMPONENT:** CORE- III
COURSE NAME: Physical Chemistry–I	**COURSE CODE:**
SEMESTER: I	**MARKS:** 100
CREDITS: 4	**TOTAL HOURS:** 60
THEORY AND PROBLEMS	

COURSE OBJECTIVE:

To learn the basic concepts in group theory, chemical kinetics and the need for quantum mechanics and appreciate their significance.

COURSE OUTCOMES:

On completion of the course the students will be able to

1. Analyze the need for quantum mechanics, relate quantum mechanical operators to observables and the use of operator algebra to solve simple eigen value equations, relate molecular phenomena viz. translational, rotational and vibrational motion to model systems and solve Schrodinger equation to arrive at the eigen values.
2. Distinguish molecular and crystallographic symmetry, to assign point group for molecules, apply multi symmetry operations to derive character tables.
3. Gain knowledge of symmetry-based selection rules for vibration land electronic spectroscopy and predict the IR and Raman activity of a molecule.
4. Acquire in depth knowledge about theories of chemical kinetics and to calculate specific rate, activation energy and frequency factor.
5. Gain knowledge of isotopic effect in kinetics, Bronsted- Bjerrum and Hammet and Taft equation.

UNIT–I: Quantum Chemistry–I **(12 hours)**

Inadequacy of classical theory-blackbody radiation-photo electric effect-Compton effect- Bohr's Quantum theory and subsequent developments-wave particle duality-deBroglie equation- Heisenberg's uncertainty principle. Quantum mechanical postulates - Schrodinger wave equation- elementary applications of Schrodinger equation- the particle in a box(one, two and three dimensional cases) –particle in a ring.

UNIT–II: Group Theory-I **(12 hours)**

Symmetry elements and symmetry operations-products of symmetry operations. Point groups-identification and determination. Representation of Groups - Reducible and irreducible representations- direct product representation- Great Orthogonality theorem-its consequences- Character tables - C_{2v} and C_{3v}

UNIT–III: Group Theory–II (12 hours)

Applications of Group Theory -Hybrid orbitals in non-linear molecules-(BF_3, NH_3, CH_4, XeF_4, PCl_5 and SF_6). Vibrational modes in non-linear molecules (H_2O, NH_3, BCl_3, CH_4 and XeF_4), Selection Rules for Infrared and Raman Spectra, Electronic spectra of ethylene, formaldehyde and acetaldehyde*. *** not for ESE.**

UNIT–IV: Chemical Kinetics-I (12 hours)

Effect of temperature on reaction rates-collision theory of reaction rates-molecular beams- collision cross sections-effectiveness of collisions-probability factors-potential energy surfaces-partition functions-and activated complex. Eyring equation-estimation of free energy and entropy of activation and their significance.

UNIT–V: Chemical Kinetics-II (12 hours)

Reactions in solutions-effect of pressure, dielectric constant and ionic strength on reactions in solutions-Bjerrum equation- Kinetic isotope effects- Primary, Secondary and solvent isotope effects. Linear free energy relationships-Hammett and Taft equations.

PRESCRIBED BOOKS:

1. D.A. McQuarrie, Quantum Chemistry, University Science books, viva books Pvt.Ltd., 2nd Edition, Reprint, 2016.
2. I.N.Levine, Quantum Chemistry, Pearson Education Pvt.Ltd.,7th Edition, 2016.
3. R.Anantharaman, Fundamentals of Quantum Chemistry, Macmillan India Limited, 2nd Edition, 2004.
4. R.K.Prasad,Quantum Chemistry, New Age India, 4th Edition, 2020.
5. V.Ramakrishnan and M.S.Gopinathan, Group theory in Chemistry, Vishal Publication, 2nd Edition, Reprint 2013.
6. K.V.Raman, Group theory and applications in Chemistry, Tata McGraw Hill, 3rd Edition, 1994.
7. S.Swarnakakshmi, T.Saroja, R.M.Ezhilarasi, A Simple approach to group theory in Chemistry, Universities Press, Kindle Edition, 2019.
8. R.K.Prasad, Quantum Chemistry-theory solved problems and solutions, New Age International publishers, Reprint 2017.
9. J.Rajaram and J.C.Kuriacose, Kinetics and Mechanism of Chemical Transformations, McMillan India Ltd., 3rd Edition, Reprint,2009.
10. K.J.Laidler, Chemical Kinetics, Harper and Row, Pearson Pvt. Ltd., New York, 3rd Edition, 2011.
11. K.L. Kapoor, A text book of Physical Chemistry, Macmillan India Ltd, reprint, 2010.

REFERENCE BOOKS:

1. F. A. Cotton, Chemical application of group theory, John Wiley & Sons Inc., New Delhi, 3rd Edition, 2009.

2. Alan Vincent, Molecular Symmetry and Group theory-Programmed Introduction to chemical applications, Wiley, NewDelhi, 2nd Edition, 2013.
3. H. Eyring, J. Walter and G. Gimball, Quantum Chemistry, John Wiley & Sons Inc., NewYork,1944.
4. L. S. Pauling and F. B. Wilson, Introduction to quantum mechanics, McGraw Hill Book Company, New York, 2015.
5. Peter Atkins and Ronald Friedman Molecular quantum mechanics, Oxford University Press, Oxford, 5th Edition, 2011.
6. David J.Griffiths, Introduction to Quantum mechanics, Cambridge University Press, 3rd Edition, Fifth reprint, 2018.
7. G.M.Barrow, Physical Chemistry, Tata McGraw Hill, 5th Edition, 2008.
8. R.G.Frost and Pearson, Kinetics and Mechanism, Wiley, New York, 3rd Edition, 1981.
9. W.J.Moore and R.G. Pearson, Kinetics and Mechanism, Wiley, New York, 3rd Edition,1981.

E-LEARNING RESOURCES:

1. www.chemguide.co.uk>physical>basicrates>energyprofiles
2. iopscience.iop.org
3. http://nptel.ac.in
4. mooc.org
5. http://www.ch.ic.ac.uk/achemlab/symmetry/
6. http://www.reciprocalnet.org/edumodules/symmetry/intro.html

GUIDELINES TO THE QUESTION PAPER SETTERS
QUESTION PAPER PATTERN

Section	Question Component	Numbers	Marks	Total
Section- A	MCQ:1-10 , Fill in : 11 -15 T/F:16-20 Answer all questions	1 – 20	1	20
Section-B	Short Answer /Problems Answer any 5 out of 8 questions	21–28	7	35
Section- C	Essay Answer any 3 out 5 questions	29– 33	15	45
TOTAL MARKS				**100**

BREAK UP OF QUESTIONS

Unit	Section A	Section B		Section C
		Theory	Problem	
I	4	1	1	1
II	4	1		1
III	4	2		1
IV	4	1		1
V	4	2		1
TOTAL	**20**	**8**		**5**

PSO – CO mapping

	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	3	2	3	2	2
CO 2	3	1	3	3	2
CO 3	3	2	3	3	2
CO 4	3	3	3	3	3
CO 5	3	3	3	3	3
Ave.	3	2.2	3	2.8	2.4

PSO-CO-question paper mapping

CO No.	COURSE OUTCOME	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Analyze the need for quantum mechanics, relate quantum mechanical operators to observables and the use of operator algebra to solve simple eigen value equations, relate molecular phenomena viz. translational, rotational and vibrational motion to model systems and solve Schrodinger equation to arrive at the eigen values.	PSO 1 PSO 3	K1 to K3
CO2	Distinguish molecular and crystallographic symmetry, to assign point group for molecules, apply multi symmetry operations to derive character tables.	PSO 1, PSO 3, PSO 4,	K1 to K3
CO3	Gain knowledge of symmetry-based selection rules for vibration land electronic spectroscopy and predict the IR and Raman activity of a molecule.	PSO 1, PSO 3, PSO 4,	K1 to K4
CO4	Acquire in depth knowledge about theories of chemical kinetics and to calculate specific rate, activation energy and frequency factor.	PSO 1, PSO 2, PSO 3, PSO 4, PSO 5	K1 to K3
CO5	Gain knowledge of Isotopic effect in kinetics, Bronsted- Bjerrum and Hammet and Taft equation	PSO 1, PSO 2, PSO 3, PSO 4, PSO 5	K1 to K4

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5=Evaluate, K6=Create

PROGRAMME: M.Sc. CHEMISTRY	**BATCH:** 2024 - 26
PART:	**COURSE COMPONENT:** CORE ELECTIVE - I
COURSE NAME: Analytical Chemistry	**COURSE CODE:**
SEMESTER: I	**MARKS:**100
CREDITS: 3	**TOTAL HOURS:** 60
THEORY	

COURSE OBJECTIVE:

To create the industry ready students with fundamental understandings and diverse applied knowledge in analytical chemistry.

COURSE OUTCOMES:

On completion of the course the students will be able to

1. Create a skill to evolve proper analytical data and practice to report the result with uncertainty.
2. Enhance the competency in the analysis for complex materials and also the finished products of chemical manufacturing sectors.
3. Enable the industrial practice on instrumental methods analysis in all the arena of chemical processes.
4. Establish the competency of chemical analysis in the applied research, chemical processes and testing / quality control laboratories with regulatory compliances.
5. Develop new analytical methods and have a competence to validate the developed method for industrial applications

UNIT-I: Fundamentals in chemical analysis and analytical laboratory functioning

(**10 hours)**

Statistical treatment of analytical data: regression analysis, standard deviation-comparison of results- F, T and Q tests. Calibrations – general idea of calibration, calibration of glassware, balance, instruments and other equipment. Uncertainty in chemical analysis: theory, significance, sources of uncertainty for simple volumetric analysis. Sampling of solid, liquid and gases – primary sample, laboratory sample, analytical sample, handling, collection, transport, storage.

Details on method development and method validation in chemical analysis, essentials of quality control and quality assurance systems in chemical processes; Basic idea and necessity of accreditations/certification such as GLP, ISO(NABL),FDA and FSSAI. Role of ISI and Agmark certification on the consumer products.

UNIT- II: Analysis of complex materials and atomic spectroscopy (15 hours)

Physico-chemical analysis of medicines (formulated), ores, fertilizers, alloys, packed foods, water and air. [Note: Any one representative example in each category and testing of important parameters only.]

Theory, instrumentation and applications of atomic absorption, spectroscopy ICP-MS; Flame emission spectrometry and ICP-OES. Application of these techniques in water and food analysis. Moisture analyser (KFRmethod) and C, H, N analysis (instrumental methods).

UNIT-III: Separation techniques (15 hours)

Chromatographic techniques: classification, principle, instrumentation (if applicable) and applications of column, ion-exchange, electrophoresis, TLC, paper chromatography, GLC and HPLC (with different detectors) and GPC. Special emphasis on GC- MS, GC-MS/MS, LC-MS, LC-MS/MS. Role of chromatographic techniques in R&D and quality control laboratories.

UNIT-IV: Electroanalytical methods (12 hours)

Polarography –Theory and instrumentation. Types of current- includes kinetic & catalytic current, advantages and disadvantages of DME. Significance of Ilkovic equation and its significance. Qualitative and quantitative applications to the analysis of inorganic compounds and determination of dissolved oxygen. Cyclic voltammetry – theory, instrumentation and applications to inorganic and organic compounds. Application of CV in applied research viz.,prediction of reaction mechanism, redox behavior of chemical compounds and identification of number of electrons in the electrochemical processes. Amperometry and biamperometry-theory, instrumentation and applications. EIS Technique in Chemical Analysis

UNIT-V: Thermal and radioanalytical techniques (8 hours)

Principle, instrumentation and applications of TGA, DTA and DSC. Radio isotopes, Radio analytical methods-principle, instrumentation and applications of neutron activation and isotopic dilution analysis. Radiometric titrations, radiometric methods in diagnosis of diseases.

PRESCRIBED BOOKS:

1. David Harvey; Modern Analytical Chemistry; McGraw-Hill, 1st Edition, 2000.
2. J.Mendham, R.C.Denney, J.D.Barnes and M.Thomas, Vogel's Text book of quantitative

Chemical Analysis; Pearson Education Pvt.Ltd., 6th Edition, 2004.

3. D.A. Skoog, Principles of Instrumental Analysis, 5th Edition, Saunders College Publishing, Philadelphia, London, 1998.
4. Connor's Text book of Pharmaceuticals Analysis, John Wiley, 3rd Edition, 2001.
5. Kolthaf I M., Polarography, John Wiley & Sons Inc., 1952.
6. DouglasA., Skoog, Donald M. West and F.James Holler, Analytical Chemistry: An Introduction; 7th Eedition, Saunders College Publishers, 2000.

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REFERENCE BOOKS:

1. E.Prichard, Quality in the analytical chemistry Laboratory, John Wiley and sons, 1997.
2. W.Funk,.V.Dammann,.G.Donnevert,.Quality assurance in analytical, VCH Weinheim,1995.
3. Douglas A. Skoog, Donald M. West and F. James Holler, Fundamentals of Analytical Chemistry; 9th Edition, Harcourt Asia Pvt., Ltd., 2014.
4. Dean, John A. Merritt, Lynne L., Jr. Settle, Frank A., Jr. Willard, Hobart H;Instrumental Methods of Analysis, Wadsworth Publishing, 7th Edition,1988.
5. A.J.Bard and L.R.Faulkner, Electro chemical methods, JohnWiley,1980.
6. S.M.Khopkar, Environmental Pollution Analysis, New Age International publication, 2011.
7. Seonard'l Ciacere, Water and water pollution (hand book), Vol I to IV, Marcel Dekkerinc.N.Y,1972.
8. Guidelines for drinking-water quality, 3rd Edition, (incorporating first and second addenda), WHO report.
9. Martin Hocking, Handbook of chemical technology and pollution control, AP Publication, 3rd Edition, 2005.
10. Chemical analysis of metals; Sampling and analysis of metal bearing ores: American Society for Testing and Materials Technology & Engineering, 1980.
11. Manual of Procedures for Chemical and Instrumental Analysis of Ores, Minerals, and Ore Dressing Products. Government of India, Ministry of Steel & Mines, Indian Bureau of Mines, 1979.
12. Yeshajahu Pomeranz, Clifton E. Meloan, Food Analysis: Theory and practice, Springer, 3rd Edition, 2002.
13. George Charalanbous, Analysis of food and beverages, Academic press,1978.

14. Encyclopaedia of industrial chemical analysis, Snell etal; Interscience,1966.

E-LEARNING RESOURCES:

1. https://chem.libretexts.org/
2. https://nptel.ac.in/course.html
3. https://www.lcresources.com/resources/reslinks.html
4. https://www.chemicalforums.com/index.php?PHPSESSID=kjkh7lljum5hebhscma2hhlsp7&board=8.0
5. Refer websites of ISO, NABL, FDA, USEPA, ASTM, ICH, FSSAI and BIS

Visits to:

1. GLP, ISO and FDA certified R&D and QC laboratories.
2. BIS & FSSAI approved establishments.
3. Various chemical industries with established analytical laboratories**.**

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

Section	Question Component	Numbers	Marks	Total
Section- A	MCQ:1-10 , Fill in : 11 -15 T/F:16-20 Answer all questions	1 – 20	1	20
Section-B	Short Answer /Problems Answer any 5 out of 8 questions	21–28	7	35
Section- C	Essay Answer any 3 out 5 questions	29– 33	15	45
TOTAL MARKS				**100**

BREAK UP OF QUESTIONS

Unit	Section A	Section B	Section C
I	4	2	1
II	4	1	1
III	4	2	1
IV	4	2	1
V	4	1	1
Total	**20**	**8**	**5**

PSO-CO mapping

	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	2	3	3	3	3
CO 2	3	3	3	2	3
CO 3	3	3	3	3	3
CO 4	3	3	3	3	3
CO 5	3	3	3	3	3
Ave.	2.8	3	3	2.8	3

PSO-CO-question paper mapping

CO No.	**COURSE OUTCOME**	**PSOs ADDRESSED**	**COGNITIVE LEVEL (K1 to K6)**
CO1	Create a skill to evolve proper analytical data and practice to report the result with uncertainty.	PSO1, PSO2, PSO3, PSO4	K1 – K6
CO2	Enhance the competency in the analysis for complex materials and also the finished products of chemical manufacturing sectors.	PSO2, PSO3, PSO4, PSO5	K1 – K6
CO3	Enable the industrial practice on instrumental methods analysis in all the arena of chemical processes.	PSO2, PSO3, PSO4, PSO5	K1 – K6
CO4	Establish the competency of chemical analysis in the applied research, chemical processes and testing / quality control laboratories with regulatory compliances.	PSO3, PSO4, PSO5	K1 – K6
CO5	Develop new analytical methods and have a competence to validate the developed method for industrial applications.	PSO3, PSO4, PSO5	K1 – K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

SEMESTER - II

PROGRAMME: M.Sc. CHEMISTRY	**BATCH:** 2024 - 26
PART:	**COURSE COMPONENT:** CORE- VII
COURSE NAME: Organic Chemistry–II	**COURSE CODE:**
SEMESTER: II	**MARKS:** 100
CREDITS: 4	**TOTAL HOURS:** 60
THEORY	

COURSE OBJECTIVE:

To study the mechanisms of oxidation, reduction, aromatic electrophilic, nucleophilic substitutions, pericyclic reactions, rearrangements and the concepts of aromaticity.

COURSE OUTCOMES:

On completion of the course the students will be able to

1. Use oxidation and reduction reagents for preparing a new synthetic compound.
2. Apply the concept of aromaticity to identify aromatic, anti-aromatic and non-aromatic compounds.
3. Apply logically the concept of direction for both electrophilic and nucleophilic reactions in aromatic compounds.
4. Identify the different types of rearrangement reactions and predict the mechanisms involved.
5. Use the Woodward-Hoffmann rule to predict the stereochemistry of product under thermal and photochemical conditions for different types of pericyclic reaction.

UNIT-I: Oxidation and Reduction (15 hours)

Mechanism –oxidation reactions – use of chromium(VI), MnO_4^-, MnO_2, TPAP, Moffatt, Oppenauer and Swern oxidation of alcohol–oxidative cleavage of glycols and their related compounds, Oxidative cleavage of ketones, aldehydes and alcohols, ozonolysis- oxidation of methylene to carbonyl, oxidation of aryl methane – allylic oxidation of olefins. Reductions: catalytic hydrogenation – hydrides – nucleophilic and electrophilic -MPV reduction- selectivity in reduction of 4-t-butyl cyclohexanones using selectrides-synthetic importance of Clemmensen and Wolf-Kishner reductions-Modifications of Wolf-Kishner reduction-Birch reduction.

UNIT–II: Aromatic electrophilic and nucleophilic substitutions (15 hours)

Aromatic electrophilic substitution: The arenium ion mechanism. Orientation and reactivity of mononuclear, polynuclear aromatic hydrocarbons (Naphthalene, Anthracene) and Heterocyclic compounds (Quinoline and Isoquinoline) nitration, halogenations, sulphonation, alkylation, acylation and diazonium coupling. Formylation reactions (Gattermann, Gattermann-Koch, Vilsmeyer-Haack and Riemer-Tiemann reaction)-synthesis of di and tri substituted benzenes

(symmetrical tribromobenzene, 2-Amino-5-methylphenol, 3-nitro-4-bromobenzoicacid, 3,4-dibromonitrobenzene,1,2,3-trimethylbenzene) starting from benzene or any monosubstituted benzene.

Aromatic nucleophilic substitution: Methods for the generation of benzyne intermediate and reactions of aryne intermediate- nucleophilic substitution involving diazonium ions. Aromatic nucleophilic substitution of activated halides. Ziegler alkylation. Chichibabin reaction and von-Richter rearrangement.

UNIT–III: Aromaticity (10 hours)

Concept of aromaticity, Huckel's rule, Craig's rule – Huckel MO theory of aromaticity frost cycle Alternant and Non-alternant hydrocarbons –Aromaticity of benzenoid, heterocyclic and non-benzenoid compounds systems with 2, 4, 8 and 10 electrons – Annulenes (up to C18) compounds, azulene, ferrocene, tropolone and sydnones. Concept of homo aromatic and hetero aromatic molecules.

UNIT–IV: Pericyclic Reactions (10 hours)

Introduction-construction of π molecular orbitals of ethylene and 1,3-butadiene, symmetry in π molecular orbitals. Classification- electrocyclic reactions – Woodward Hoffmann rule- (4n) π and (4n+2) π systems- Ring opening and ring closing reactions -interconversion of cyclobutene-butadiene system and interconversion of cyclohexadiene-hexatriene, FMO analysis, Orbital Correlation diagram method.

Cycloaddition-Woodward Hoffmann rule in (π2s+π2s) and (π4s+π2s) cycloaddition reactions-FMO analysis and Correlation diagram method. -Retro Diels-Alder reactions. Sigmatropic rearrangements – Classification- Woodward- Hoffmann rule– FMO analysis of [1,3], [1,5] and [1,7] hydrogen shift reactions – carbon shift reactions. [3,3] sigmatropic shifts–Cope and Claisen Rearrangement, Degenerate Cope reaction, Fluxional isomerism semibullvalene and bullvalene. Cheleotropic Reactions-[2+2]Cheleotropic cycloaddition, Cheleotropic Elimination (Basic idea only).

UNIT–V: Molecular rearrangements and naming reactions (10 hours)

A study of mechanism of the following rearrangements: Beckmann, Curtius, Hofmann, Schmidt, Lossen, Wolff, Pinacol, Wagner Meerwin, Demjanov, Dienone-Phenol, Favorski, Benzidine, Claisen, Cope, Sommlet-Hauser, Pummerer and Von-Richter rearrangements. A study of the following name reactions: Dieckmann cyclization, Hofmann-Loffler Freytag reaction, Shapiro reaction, Eschenmoser-Tanabe and Ramburg-Backlund reactions.

PRESCRIBED BOOKS:

1. R.Bruckner, Advanced Organic Chemistry, Reaction Mechanism, Elsevier, NewDelhi, 2002.
2. J. March, Advanced Organic Chemistry; Reactions, Mechanisms and Structure, Wiley interscience, 6th Edition,2007.
3. Sachin Kumar Ghosh, Advanced General Organic Chemistry-A Modern Approach, Part I, 3rd Edition, 2009.
4. V.K.Ahluwalia, Rakesh Kumar Parashar, Organic Reaction Mechanisms, 4th Edition, 2009
5. T.L.Gilchrist and C.W.Rees, Carbenes, Nitrenes and Arynes, Thomas Nelson and Sons Ltd.,London,1969.
6. Jagdamba Singh and Jaya Singh, Photochemistry and Pericyclic reaction, New Academic Sciences Limited ,3rd Edition, 2012.
7. Ratan Kuma rKaur, Frontier Orbital and Symmetry Controlled Pericyclic reaction ,Books & allied Pvt.Ltd.,1st Edition, 2010.
8. P.S.Kalsi,Organic reactions and their Mechanism, New Age International Ltd, 5th Edition, 2021.

REFERENCE BOOKS:

1. F.A.Carey and R.J.Sundberg, Advanced Organic Chemistry, Part A and Part-B, Springer (INc), 5th Edition, 2015.
2. J.Clayden,N.Greeves,S.Warren and P.Wothers, Organic Chemistry, Oxford University Press, 2nd Edition, 2014.
3. R.O.C.Norman and J.M.Coxon, Principles of organic synthesis, CRC Press, 3rd Edition, 2012.
4. W.Carruthers and Goldham, Some Modern Methods of Organic Synthesis, Cambridge University Press, 4th Edition, 2012.
5. H.O.House, Modern Synthetic Reactions, The Benjamin Cummings Publishing Company, London,1972.

E-LEARNING RESOURCES:

1. www.epgpathshala.nic.in
2. https://nptel.ac.in/
3. https://swayam.gov.in/
4. https://www2.chemistry.msu.edu/faculty/reusch/VirtTxtJml/intro1.htm

GUIDELINES TO THE QUESTION PAPER SETTERS
QUESTION PAPER PATTERN

Section	Question Component	Numbers	Marks	Total
Section- A	MCQ:1-10 , Fill in : 11 -15 T/F:16-20 Answer all questions	1 – 20	1	20
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TOTAL MARKS				**100**

BREAK UP OF QUESTIONS

Unit	Section A	Section B		Section C
		Theory	Problem	
I	4	2		1
II	4	1		1
III	4	1	1	1
IV	4	1		1
V	4	1	1	1
Total	**20**	**8**		**5**

PSO-CO mapping.

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	2	3	3	3
CO 2	3	2	3	3	3
CO 3	3	2	3	3	3
CO 4	3	2	3	3	3
CO 5	3	2	3	3	3
Ave.	3	2	3	3	3

PSO-CO-question paper mapping

CO No.	COURSE OUTCOME	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Use oxidation and reduction reagents for preparing a new synthetic compound.	PSO 1, PSO2, PSO 3, PSO4, PSO5	K1, K2, K3, K4, K5, K6.
CO2	Apply the concept of aromaticity to identify aromatic, anti-aromatic and non- aromatic compounds.	PSO1, PSO3, PSO 5.	K1, K2, K3, K4, K5.
CO3	Apply logically the concept of direction for both electrophilic and nucleophilic reactions in aromatic compounds	PSO 1, PSO 3, PSO4, PSO5	K1, K2, K3, K4, K5.
CO4	Identify the different types of rearrangement reactions and predict the mechanisms involved.	PSO 1,PSO2, PSO 3, PSO4, PSO5	K1, K2, K3, K4, K5.
CO5	Use the Woodward-Hoffmann rule to predict the stereochemistry of product under thermal and photochemical conditions for different types of pericyclic reaction.	PSO 1, PSO2, PSO 3, PSO4, PSO5	K1, K2, K3, K4, K5,

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

PROGRAMME: M.Sc. CHEMISTRY	**BATCH:** 2024 - 26
PART:	**COURSE COMPONENT:** CORE-VIII
COURSE NAME: Inorganic Chemistry–II	**COURSE CODE:**
SEMESTER: II	**MARKS:** 100
CREDITS: 4	**TOTAL HOURS:** 60
THEORY	

COURSE OBJECTIVE:

To provide an in-depth knowledge on organometallic chemistry, solid state chemistry with the recent advancements of materials science.

COURSE OUTCOMES:

On completion of the course the students will be able to

1. Analyze the structure, bonding and reactivity of organometallic compounds, assess about synthetically useful transformations and gain information on the mechanism of the catalytic processes of organo metallic complexes that is useful for the current synthetic organic chemistry field.
2. Identify elaborately on the content of biological inorganic processes that helps the students in the future research of biomimetics and computational chemistry.
3. Utilize the complete knowledge on the oxygen carriers and iron sulphur proteins and able to analyze how metal ions take part in biological system and their physiological effect on biological system and to compile photosynthesis and photosystem1 and photosystem 2, vitamin B12 model system and their reaction.
4. Explain the complete description of chemistry behind the solids and to analyze the preparation, characterization of solids and describe the principles concerning solid state structures and to describe specific crystal structures by applying basic crystallographic concepts.
5. Explore the magnetic properties of solids and its recent applications in various field

UNIT – I: Organometallic compounds (15 hours)

Synthesis, structure, bonding and reactivity of metal alkyls, carbenes, alkenes, alkynes, DCD model, arene complexes - metallocenes and bent metallocenes (Ferrocenes, Zirconium and Titanium complexes). Organometallic reactions: association, substitution, addition, oxidative addition, reductive elimination, insertion and deinsertion, electrophilic and nucleophilic attack on ligands and fluxional isomerism. Catalytic applications of organometallics: Hydrogenation of olefins, Wacker-Smidt synthesis, oxo process, Repp's

catalyst,Monsanto acetic acid process, Zeigler-Natta polymerization of alkenes and oligomerisation, Enantioselective functional group interconversions. Transmetallation and cyclization reaction of organometallics.

UNIT–II: Bio-inorganic chemistry -I (10 hours)

Introduction to Bio-inorganic chemistry. Metal Storage, Transport and Bio mineralization; ferritin, transferrin and siderophores, sodium and potassium ion balance. Essential and trace metal ions. Metalloenzymes - Zinc enzymes – carboxypeptidase and carbonic anhydrase, Vitamin B12, catalase, peroxidase, superoxide dismutase and copper proteins. Medicinal applications of coordination compounds– anti rheumatoid - gold compound –anti diabetic - anti cancer agents– role of metal ions in diagnosis and treatment-Cisplatin.

UNIT–III: Bio-inorganic chemistry -II (10 hours)

Oxygen Carriers – Haemoglobin, myoglobin – structure – function -Oxygenation and stereochemistry – Bohr effect, Non – heme oxygen carriers –Hemerythrin and Haemocyanin. Biological redox systems: cytochromes – classification, cytochrome a, b and c. Cytochrome P-450, Iron – sulphur proteins – rubredoxin and ferridoxin. Chlorophylls and photosynthesis – structure, function and mechanism. Nitrogen fixation – introduction – types of nitrogen fixing microorganisms,Nitrogenase enzyme – Metal clusters in nitrogenase – redox property – Dinitrogen complexes – nitrogen fixation via nitride formation and reduction of dinitrogen to ammonia.

UNIT-IV: Solid State Chemistry - I (15 hours)

Glide plane and screw axis, point group and space group. Structural aspects of rock salt, rutile, fluorite, antifluorite, zinc blende, wurtzite, crystobalite, spinels, inverse spinels. Single crystal analysis and its applications. Powder diffraction - refinement and structure solution of some compounds, indexing with JCPDS and its application. Band theory of solids – band gap, conduction mechanism, temperature dependence of conductivity, intrinsic and extrinsic semiconductors.

UNIT – V: Solid State Chemistry - II (10 hours)

Crystal defect, lattice defects - stoichiometric and non-stoichiometric defects, defect formation. Determination of defects, thermodynamics of Schottky and Frenkel defect, color center and incorporation of stoichiometric excess defects (structural and thermodynamic aspects). Phase transitions, diffusion, diffusion coefficient, diffusion mechanisms, vacancy and interstitial diffusion. Inorganic phosphors- synthesis and applications. LED, FED – an introduction, Lasers- introduction and types, Inorganic laser - instrument and principle, Ruby, Nd: YAG laser – working and mechanism. Magnetic properties of solids Domain theory – Hysteresis Loop – applications. Properties of pervoskites and magneto- plumbites- Hard and Soft magnetic materials- superconductivity in metals, alloys and ceramics materials (mixed oxides)- BCS theory, Meissner effect.

PRESCRIBED BOOKS:

1. J. E. Huheey, E. A. Keiter, R.L. Keiter and O. K. Medhi, Inorganic Chemistry- Principles of structure and reactivity, 4th Edition, Pearson, 2013.
2. C. E. Housecraft and A. G. Sharpe, Inorganic Chemistry, 4th Edition, Prentice-Hall, 2012.
3. K.F. Purcell and J.C. Kotz, Inorganic Chemistry, Sengage Learning India Pvt. Ltd,1st Edition, 2010.
4. Dr. B.D. Gupta, Dr. Anil J. Elias, Basic Organometallic Chemistry: Concepts, Syntheses and applications, 2nd Edition, University Press, 2013.
5. Rossette M. Roat –Malone, Bio-inorganic Chemistry: A short course, 2nd Edition, Wiley, NY, 2007.
6. A. R. West, Solid State Chemistry and its applications, Wiley,1st Edition, 2001.

REFERENCE BOOKS:

1. R. C. Mehrotra and A. Singh, Organometallic Chemistry, A Unified Approach, New Age International, 2009.
2. R. B. Jordan, Reaction Mechanism of Inorganic and Organometallic Systems, 2nd Edition, Oxford University Press, 1998.
3. Ivano Bertini, Harry B. Gray, Stephen J. Lippard, Joan Selverstone Valentine, Bioinorganic Chemistry, University Science Books, 1994.
4. Stephen J. Lippard, Jeremy M. Berg, Principles of Bioinorganic Chemistry, University Science Books, 1994.
5. D. K. Chakraborty, Solid State Chemistry, New Age Science, 2nd Edition, 2010.
6. H. V. Keer, Principles of the Solid State, 1st Edition, New Age International Publishers, 2005.

E-LEARNING RESOURCES:

1. https://www.chemicalforums.com/
2. https://nptel.ac.in/
3. https://chem.libretexts.org/

4. http://www.ilpi.com/genchem/web.html#12

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

Section	Question Component	Numbers	Marks	Total
Section-A	MCQ:1-10 , Fill in : 11-15 , T/F:16-20 Answer all questions	1 – 20	1	**20**
Section- B	Short Answer /Problems Answer any 5 out of 8questions	21–28	7	**35**
Section- C	Essay Answer any 3 out of 5 questions	29– 33	15	**45**
TOTAL MARKS				**100**

BREAK UP OF QUESTIONS

Unit	Section A	Section B	Section C
I	4	2	1
Ii	4	1	1
Iii	4	1	1
Iv	4	2	1
V	4	2	1
Total	**20**	**8**	**5**

PSO – CO mapping

	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	3	2	2	3	3
CO 2	2	2	3	3	3
CO 3	3	3	3	2	3
CO 4	3	3	2	3	2
CO 5	3	3	3	3	3
Ave.	2.8	2.6	2.6	2.8	2.8

PSO-CO-question paper mapping

CO No.	COURSE OUTCOME	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Discuss and compare the various theories of bonding in coordination complexes.	PSO1, PSO2, PSO4, PSO5	K1, K2, K4
CO2	Evaluate and apply the reaction mechanisms, stability constant, and the various methods of determination of stability constant and the stereochemistry of the inorganic complexes.	PSO1, PSO4, PSO5	K1, K2, K5
CO3	Outline the mechanism of electron transfer reactions and Marcus -Hush theory and predict the substitution reaction of complexes.	PSO1, PSO3, PSO5	K1, K2, K3
CO4	Apply and interpret the various models of nucleus and various nuclear reactions.	PSO1, PSO2, PSO3, PSO4	K1, K2, K3, K5
CO5	Explain about the inorganic cages, clusters and rings which are very much useful for leading current research area of materials science.	PSO1, PSO4, PSO5	K1, K4, K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

COURSE NAME: Physical Chemistry - II	**COURSE CODE:**
SEMESTER: II	**MARKS:**100
CREDITS: 4	**TOTAL HOURS:**60
THEORY	

COURSE OBJECTIVE:

To learn enzyme kinetics, surface reactions, fast reactions and application of quantum mechanics.

COURSE OUTCOME:

On completion of the course the students will be able to

1. Analyse the mechanism of acid –base reaction and calculate Michaelis Menten constant for enzyme – substrate binding by Linewearver- Burk plot.
2. Distinguish various adsorption isotherms and heterogeneous catalyst reactions.
3. Gain knowledge about kinetics of complex reactions and fast reactions.
4. Derive eigen values and wave functions of H and He atoms using approximation methods, concept of antisymmetric wave function and to solve Hartree and Hartree – Fock equation for helium atom.
5. Apply molecular orbital and valence bond treatment to simple homonuclear diatomic molecules- $H_2^+$and H_2, MOT of higher diatomic molecules, HMO treatment of simple conjugated systems.

UNIT–I: Catalysis (10 hours)

Acid base catalysis-mechanism of acid base catalyzed reactions-Bronsted catalysis law. Catalysis by enzymes-rate of enzyme catalyzed reactions-effect of substrate concentration, pH and temperature on enzyme catalyzed reactions-Inhibition of enzyme catalyzed reactions.

UNIT–II: Adsorption (10 hours)

Langmuir and BET adsorption isotherms-adsorption coefficient and its significance. Kinetics and mechanism of surface reactions-surface reactions catalyzed by metals, semi-conductor oxides.

UNIT–III: Kinetics of complex reactions (15 hours)

Reversible reactions-consecutive reactions-parallel reactions-Chain reactions -general treatment of chain reactions-Rice-Herzfeld mechanism and explosions limits. Study of fast reactions–relaxation methods–temperature and pressure jump methods-stopped flow and flash photolysis method.

UNIT–IV: Quantum Chemistry–II (10 hours)

The harmonic oscillator- the rigid rotor-the hydrogen atom-the Schrodinger equation for hydrogen atom– the solution – the origin of quantum numbers (angular momentum and spin)-their physical significance.

UNIT–V: Quantum Chemistry–III (15 hours)

Approximation methods – perturbation and variation method- Application to hydrogen, helium atoms- R-S coupling, j-j coupling and term symbols for atoms in ground state- Slater rules, Slater orbital and HF-SCF methods- Born – Oppenheimer approximation-Valence Bond theory for hydrogen molecule–LCAO–MO theory for di and poly atomic orbitals - concepts of hybridization-Huckel theory for conjugated molecules (ethylene, butadiene, benzene and pyridine*)-semi empirical methods.

*** not for ESE.**

PRESCRIBED BOOKS:

1. D.A. McQuarrie, Quantum Chemistry, University Science books, viva books Pvt. Ltd, 2nd Edition, reprint, 2016.
2. I.N. Levine, Quantum Chemistry, Pearson Education Pvt. Ltd, 7th Edition, 2016.
3. R. Anantharaman, Fundamentals of Quantum Chemistry, Macmillan India Limited, 2nd Edition, 2004.
4. R.K. Prasad, Quantum Chemistry, New Age India, 4th Edition, 2020.
5. R.K. Prasad Quantum Chemistry-theory solved problems and solutions, New Age International publishers, Reprint 2017.
6. J.Rajaram and J.C.Kuriacose, Kinetics and Mechanism of Chemical Transformations, McMillan India Ltd., 3rd Edition, Reprint, 2009.
7. K.J.Laidler, Chemical Kinetics. Harper and Row, Pearson Pvt. Ltd., New York, 3rd Edition, 2011.
8. K. L. Kapoor, A text book of Physical Chemistry, Macmillan India Ltd, Reprint, 2010.

REFERENCE BOOKS:

1. H.Eyring, J.Walter and G.Gimball, Quantum Chemistry, John Wiley & Sons Inc., NewYork, 1944.
2. L.S. Pauling and F.B. Wilson, Introduction to quantum mechanics With Application to chemistry McGraw Hill Book Company, New York, 2015.
3. Peter Atkins and Ronald Friedman, Molecular quantum mechanics,Oxford University Press, Oxford, 5th Edition, 2011
4. David J. Griffiths, Introduction to Quantum mechanics, Cambridge University Press ,3rd Edition, Fifth

Reprint, 2018.

5. G.M. Barrow, Physical Chemistry, Tata McGraw Hill, 5th Edition, 2008.
6. R.G. Frost and Pearson, Kinetics and Mechanism, Wiley, New York, 3rd Edition, 1981.
7. W.J. Moore and R.G. Pearson, Kinetics and Mechanism, Wiley New York, 3rd Edition, 1981

E-LEARNING RESOURCES:

1. http:/swayam.gov.in
2. http://search.ebscohost.com
3. MATLAB
4. www.virtlab.com
5. nptel.ac.in
6. http://antoine.frostburg.edu/chem/senese/101/quantum/index.shtm

GUIDELINES TO THE QUESTION PAPER SETTERS
QUESTION PAPER PATTERN

Section	Question Component	Numbers	Marks	Total
A	MCQ:1-10 , Fill up : 11-15 , T/F:16-20 Answer all questions	1 – 20	1	**20**
B	Short Answer/Problems Answer any 5 out of 8 questions.	21–28	7	**35**
C	Essay Answer any 3 out of 5 questions	29– 33	15	**45**
TOTAL MARKS				**100**

BREAK UP OF QUESTIONS

Unit	Section A	Section B		Section C
		Theory	Problem	
I	4	1		1
II	4	1		1
III	4	2		1
IV	4	1	1	1
V	4	2		1
Total	**20**	**8**		**5**

PSO – CO mapping

	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	3	3	3	3	3
CO 2	3	3	3	3	3
CO 3	3	3	3	3	3
CO 4	3	2	3	2	2
CO 5	3	2	3	2	2
Ave.	3	2.6	3	2.6	2.6

PSO-CO-question paper mapping

CO No.	**COURSE OUTCOME**	**PSOs ADDRESSED**	**COGNITIVE LEVEL (K1 to K6)**
CO1	Analyse the mechanism of acid –base reaction and calculate Michaelis Menten constant for enzyme – substrate binding by Linewearver- Burk plot.	PSO 1 PSO 3	K1 to K3
CO2	Distinguish various adsorption isotherms and heterogeneous catalyst reactions.	PSO 1, PSO 3, PSO 4,	K1 to K3
CO3	Gain knowledge about kinetics of complex reactions and fast reactions.	PSO 1, PSO 3, PSO 4,	K1 to K4
CO4	Derive eigen values and wave functions of H and He atoms using approximation methods, concept of antisymmetric wave function and to solve Hartree and Hartree – Fock equation for helium atom.	PSO 1, PSO 2, PSO 3, PSO 4, PSO 5	K1 to K3
CO5	Apply molecular orbital and valence bond treatment to simple homonuclear diatomic molecules- $H_2^+$and H_2, MOT of higher diatomic molecules, HMO treatment of simple conjugated systems.	PSO 1, PSO 2, PSO 3, PSO 4, PSO 5	K1 to K4

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

PROGRAMME: M.Sc. CHEMISTRY	**BATCH:** 2024 - 26
PART:	**COURSE COMPONENT:** CORE -IV
COURSE NAME: Organic Chemistry Practical	**COURSE CODE:**
SEMESTER: I & II	**MARKS:**100
CREDITS: 4	**TOTAL HOURS:** 60
PRACTICAL	

COURSE OBJECTIVE:

To give an exposure to lab technique for extraction of compounds from natural products and chromatographic separation.

COURSE OUTCOMES:

On completion of the course the students will be able to

1. Gain hands-on experience in the separation of two component mixture, purification and identification of the functional groups present in the organic compounds.
2. Acquire skills in the preparatory methods of organic compounds by single and double stage methods which is needed for the pharma and related industries.
3. Use various extraction methods involving natural products.
4. Learn the different separation techniques in chromatography.
5. Estimate the components of drug Quantitative technique.

Unit – I Analysis of mixture of organic compounds.

Identification of components in a two-component mixture and preparation of their derivatives. Determination of b.p./m.p. for components and m.p. for the derivatives.

Unit- II Preparation of organic compounds

(a) Single stage any five)

1. Preparation of o-benzyl benzoicacid
2. p-nitrobenzoic acid from p-nitrotoluene
3. Anthroquinone from anthracene
4. Benzhydrol from benzophenone
5. m-nitroaniline from m-dinitrobenzene
6. 1,2,3,4-tetrahydrocarbozole from cyclohexanone
7. Methylorange from sulphanilicacid

Two stage* (any three)

1. Sym-tribromobenzene from aniline.
2. p-nitroaniline from acetanilide
3. m-nitrobenzoicacid from methyl benzoate.
4. 2,4-dinitrobenzoicacid from p-nitrotoluene.
5. m-nitrobenzoicacid from benzaldehyde

6. p-bromoaniline from acetanilide

Unit- III

(a)Extraction of natural products* (any two)

1. Caffeine from tea leaves
2. Lactose from milk
3. Citric acid from lemon
4. Pipierine from black pepper

(B) Chromatographic Separations:*

1. Column chromatography-separation of anthracene and acid from anthracene picrate.
2. Thin layer chromatography separation of green leaf pigments.
3. Paper chromatography
4. Identification of amino acids

(C)Quantitative estimation of common drugs*

1. Estimation of vitamin C in tablets by Iodimetry.
2. Estimation of Aspirin by spectrophotometry

*Only for Internal Assessment

PSO – CO mapping

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CO 3	2	3	3	3	3
CO 4	2	3	3	3	3
CO 5	2	3	3	3	3
Ave.	2	3	3	3	3

PROGRAMME: M.Sc. CHEMISTRY	**BATCH:** 2024 - 26
PART:	**COURSE COMPONENT:** CORE -V
COURSE NAME: Inorganic Chemistry Practical	**COURSE CODE:**
SEMESTER: I & II	**MARKS:** 100
CREDITS: 4	**TOTAL HOURS:** 60
PRACTICAL	

COURSE OBJECTIVE:

To train the candidate in inorganic compound preparation, separation of the two metal ions by chromatographic method and deduction identification of cations by semi micro method.

COURSE OUTCOMES:

On completion of the course the students will be able to

1. Gain knowledge on the systematic analysis of an inorganic mixture.
2. Analyse the given inorganic mixture containing both common and rare cations.
3. Explore their knowledge in the volumetric analysis of metal ions.
4. Prepare the metal complexes in good yield.
5. Separate the metal ions through chromatography techniques.

EXPERIMENTS

Unit- I.

Semi micro qualitative analysis: A mixtures containing two common and two rare cations. The following are the rare cations to be included: W, Mo, Ti, Te, Se, Ce, Th, Zr,V,U and Li.

Unit -II. Complexometric titrations (EDTA) - Estimation of Ca, Mg and Zn.

Unit-III. Preparation of the following complexes (any seven):

1. Potassiumtris(oxalato)aluminate(III)trihydrate.
2. Tris(thiourea)copper(I)chloride
3. Potassiumtris(oxalato)chromate(III)trihydrate
4. Sodiumbis(thiosulphato)cuprate(I)
5. Tris(thiourea)copper(I)sulphate
6. Sodiumhexanitrocobaltate(III)

7. Chloropentamminecobalt(III)chloride
8. Bis(acetylacetanato)copper(II)
9. Hexaminenickel(II)chloride
10. Bis(thiocynato)pyridinemanganese,(ll)

Unit -IV. (Only for internal assessment)

Separation of a mixture of two metal ions by paper chromatography.

Separation of zinc and magnesium on a cation exchanger.

PRESCRIBED BOOKS:

1. V. V. Ramanujam, Inorganic Semimicro Qualitative Analysis; 3rd ed., The National Publishing Company, Chennai, 1974.
2. A. Jeya Rajendran, Microanalytical Techniques in Chemistry: Inorganic Qualitative Analysis, United global publishers, 2021.

REFERENCE BOOKS:

1. Vogel's Text book of Inorganic Qualitative Analysis, 4thed., ELBS, London.
2. G. Pass, and H. Sutcliffe, Practical Inorganic Chemistry; Chapman Hall, 1965.
3. W. G. Palmer, Experimental Inorganic Chemistry; Cambridge University Press, 1954.

PSO-CO mapping

	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
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CO 3	3	3	3	3	3
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CO 5	3	3	3	3	3
Ave.	2.8	3	3	3	3

PROGRAMME: M.Sc. CHEMISTRY	**BATCH:** 2024 - 26
PART:	**COURSE COMPONENT:** CORE - VI
COURSE NAME : Physical Chemistry Practical	**COURSE CODE:**
SEMESTER: I & II	**MARKS:** 100
CREDITS: 4	**TOTAL HOURS:** 60
PRACTICAL	

COURSE OBJECTIVE:

To understand and verify the concepts and equations in physical chemistry by carrying out suitable experiments.

COURSE OUTCOME:

On completion of the course the students will be able to

1. Study the kinetics and to determine the energy of activation of acid catalysed hydrolysis of an ester.
2. Study the effect of added salt on the kinetics of oxidation of iodide by persulphate
3. Draw and interpret the phase diagram of two component systems
4. Apply distribution law to find the partition coefficient and equilibrium constant.
5. Verify Freundlich adsorption isotherm.

UNIT-I

1. Study of the adsorption of acetic acid or oxalic acid on charcoal, verification of Freundlich isotherm and determination of concentration of given acetic acid or oxalic acid.
2. Construction of phase diagram for a simple binary system; naphthalene–biphenyl, naphthalene–p-dichlorobenzene, naphthalene-diphenylamine.
3. Construction of phase diagram for the three-component system (partially miscible liquid system) acetone –chloroform –water; chloroform–acetic acid–water.
4. Determination of the equilibrium constant of the reaction between iodine and potassium iodide by partition method.
5. Determination of the concentration of given potassium iodide solutions by partition method.
6. Determination of molecular weight of benzoic acid and the degree of association of benzoic acid in benzene using partition method.

UNIT-II

1. Kinetic study and comparison of rate constant for the inversion of cane sugar in presence of acid using polarimeter.
2. Kinetic study of the reaction between acetone and iodine in acidic medium and determination of the order with respect to iodine and acetone.
3. Kinetic study of saponification of ethylacetate by sodium hydroxide conducto metrically and determination of order of the reaction.
4. Kinetic study and comparison of acid strengths using acid catalyzed hydrolysis of methyl acetate.
5. Determination of temperature coefficient and energy of activation for the acid catalyzed hydrolysis of methyl acetate.
6. Determination of the rate constant and order for the reaction between potassium persulphate and potassium iodide.
7. Study of the primary salt effect on the kinetics of oxidation of iodide by persulphate
8. Kinetic study of the decomposition of sodium thiosulphate by mineral acid.

Typical list of possible experiments are given above. A minimum of 10 – 12 experiments have to be performed

PRESCRIBED BOOKS:

1. B.Viswanathan and P.S.Raghavan, Practical Physical Chemistry, Published by viva books, 2012.
2. B.D.Khosla,V.C.Garg and A.Khosla, Senior Practical Physical chemistry, R.Chand & Co New Delhi, 2011.
3. P.S.Sindu, Practical Physical chemistry- A modern Approach, MacMillan India Ltd, 1st Edition, 2006

REFERENCE BOOKS:

1. C.W. Garland, J.W.Nibler and D.P. Shoemaker Experiments in Physical Chemistry, Tata McGraw-Hill, NewYork, 8th Edition,2003.
2. A.M.Halpern,G.C.McBane,ExperimentsinPhysicalChemistry,W.H.Freeman&Co, NewYork. 3rd Edition, 2003.

E-LEARNING RESOURCES:

1. MATLAB
2. **www.virtlab.com**

PSO – CO mapping

	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	3	3	3	3	3
CO 2	3	3	3	2	3
CO 3	3	3	3	3	3
CO 4	3	2	2	2	3
CO 5	3	2	3	3	3
Ave.	3	2.6	2.8	2.6	3

SEMESTER - III

PROGRAMME: M.Sc. CHEMISTRY	**BATCH:** 2024 - 26
PART:	**COURSE COMPONENT:** CORE - X
COURSE NAME: Organic Chemistry–III	**COURSE CODE:**
SEMESTER: III	**MARKS:** 100
CREDITS: 4	**TOTAL HOURS:** 60
THEORY	

COURSE OBJECTIVE:

To emphasize on the theoretical concepts and applications of UV, IR, NMR, Mass spectroscopy and photochemistry of organic reactions.

COURSE OUTCOME:

On completion of the course the students will be able to

1. Predict the structure based on electronic and vibrational transitions.
2. Identify different techniques and judicially use them as per requirements.
3. Interpret spectra based on UV, IR, Mass and NMR to predict the structure of the target molecule.
4. Select the proper ionization method and interpretation of mass spectra to arrive at the structure of the target molecule.
5. Synthesize new molecules based on different types of photo chemical reactions.

UNIT-I: UV-Vis and IR spectroscopy (10 hours)

Principles and applications of ultraviolet and infrared spectroscopy in organic molecular structure determination. Optical rotator dispersion and its applications. Cotton effect, Octant rule and axial haloketone rule. Woodward-Fisher rule for conjugate systems and unsaturated ketones – Scott rules for aromatic ketones with problem solving approach. (for molecules with a maximum 10 carbon atoms)

UNIT–II: Nuclear Magnetic Resonance Spectroscopy (10 hours)

Nuclear magnetic resonance spectra: Theory- the nuclear spin, Larmor frequency, NMR isotopes, population of nuclear spin levels - relaxation processes. Chemical shift- shielding constant, diamagnetic anisotropic influence - ring currents – diatropy and paratropy. Spin-spin interaction-low and high resolution spectra. Nuclear magnetic decoupling-double resonance–nuclear overhauser effect - Fourier transform technique-^{13}C NMR spectroscopy.

UNIT–III: Applications of NMR Spectroscopy to Organic Compounds (15 hours)

Proton NMR applications to structure elucidation of simple organic molecules – chemical shift values of various chemically non-equivalent protons and correlation to protons bonded to carbon and protons bonded to other nuclei-chemical exchange, effect of deuteration. First order PMR spectra-complex spin-spin interaction between two, three, four and interacting nuclei, virtual coupling, simplification of complex spectra using shift reagents-coupling constant-variation of coupling constant with dihedral angle, Karplus curve.^{13}C-NMR applications to structure elucidation of simple organic molecules–complete decoupled CMR – off resonance spectra-chemical shift values. Elementary treatment of two-dimensional NMR spectroscopy, NOESY, COSY and DEPT.

UNIT–IV: Mass Spectrometry (15 hours)

Fragmentation process, even and odd electron ions, scission with rearrangement. Retro Diels Alder reaction, McLafferty rearrangement, double bond and / or ring equivalent simplied from a formula. Fragmentation associated with functional groups aliphatic compounds, aldehydes, ketones, carboxylic acids, esters, amides, alcohols, thiols, amines, ethers, sulphides and halides, aromatic compounds, elimination due to ortho groups. Identification of organic compounds using mass spectrometry problems. Conjunct problems based on UV-Vis, IR, NMR and Mass data. Determination of molecular formula using analytical data.

UNIT–V: Organic Photochemistry (10 hours)

Photochemistry of ketones –Norrish Type-I, Norrish type–II Photoreduction, photochemistry of olefins-cis–trans isomerization. Photocycloaddition, Paterno–Buchi reaction photo chemistry of aromatic compounds photorearrangements. Di-π methane rearrangement, Barton reaction and Photo Fries reaction. Photochemistry of cyclohexadienones-photochemistry of santonin- synthesis of Vitamin D from cholesterol.

PRESCRIBED BOOKS:

1. Y R Sharma, Elementary Organic Spectroscopy-Principles and Chemical Applications, revised edition, S.Chand & Company Pvt. Ltd., 2010.
2. P.S. Kalsi,Spectroscopy of Organic Compounds, 6th Edition, New Age International, 2007.
3. Jagdamba Singh and Jaya Singh, Photochemistry and Pericyclic reaction, New Academic

Sciences Limited, 3rd Edition, 2012.

4. V.K.Ahluwalia, Rakesh Kumar Parashar, Organic Reaction Mechanisms, 4th Edition, 2009.

REFERENCE BOOKS:

1. Donald L. Pavia, Gary M. Lampman , George S. Kriz,James A. Vyvyan, Introduction to Spectroscopy, 5th Edition, 2015.
2. Jag Mohan, Organic Spectroscopy: Principles &Applications, Paper back edition, 2nd Edition, 2004.

E-LEARNING RESOURCES

1. www.epgpathshala.nic.in
2. https://nptel.ac.in/
3. https://swayam.gov.in/
4. https://www2.chemistry.msu.edu/faculty/reusch/VirtTxtJml/intro1.htm

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

Section	Question Component	Numbers	Marks	Total
Section- A	MCQ:1-10 , Fill in : 11 -15 T/F:16-20 Answer all questions	1 – 20	1	20
Section-B	Short Answer /Problems Answer any 5 out of 8 questions	21–28	7	35
Section- C	Essay Answer any 3 out 5 questions	29– 33	15	45
TOTAL MARKS				**100**

BREAK UP OF QUESTIONS

Unit	Section A	Section B		Section C
		Theory	Problem	
I	4	1		1
II	4	1		1
III	4	1	1	1
IV	4	1	1	1
V	4	1	1	1
Total	**20**	**8**		**5**

PSO-CO mapping

	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	2	3	3	3	3
CO 2	2	3	3	3	3
CO 3	3	3	3	3	3
CO 4	3	3	3	3	3
CO 5	3	3	3	3	3
Ave.	2.6	3	3	3	3

PSO-CO-question paper mapping

CO No.	**COURSE OUTCOME**	**PSOs ADDRESSED**	**COGNITIVE LEVEL (K1 to K6)**
CO1	Predict the structure based on electronic and vibrational transitions.	PSO2, PSO4, PSO5	K1, K2, K3, K4, K5.
CO2	Identify different techniques and judicially use them as per requirements.	PSO1, PSO2, PSO3, PSO 5.	K1, K2, K3, K4, K5.
CO3	Interpret spectra based on UV, IR, Mass and NMR to predict the structure of the target molecule.	PSO 1,PSO2, PSO 3, PSO4, PSO5	K1, K2, K3, K4, K5.
CO4	Select the proper ionization method and interpretation of mass spectra to arrive at the structure of the target molecule.	PSO 1,PSO2, PSO 3, PSO4, PSO5	K1, K2, K3, K4, K5.
CO5	Synthesize new molecules based on different types of photo chemical reactions	PSO 1, PSO2, PSO 3, PSO4, PSO5	K1, K2, K3, K4, K5,K6.

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

PROGRAMME: M.Sc. CHEMISTRY	**BATCH:** 2024 - 26
PART:	**COURSE COMPONENT:** CORE XI
COURSE NAME: Inorganic Chemistry–III	**COURSE CODE:**
SEMESTER: III	**MARKS:** 100
CREDITS: 4	**TOTAL HOURS:** 60
THEORY	

COURSE OBJECTIVE:

To give insight about the inorganic spectroscopy and photochemistry of complexes.

COURSE OUTCOMES:

On completion of the course the students will be able to

1. Demonstrate the bonding properties related structural identification of coordination complexes and to compute magnetic properties.
2. Learn about UV -Visible spectroscopy and to predict the term symbols, interpret the Orgel diagram, Tanabe- Sugano diagram, electronic spectra of inorganic and organometallic compounds.
3. Compare the principles, chemical shifts, coupling constants, application of Mossbauer and NQR spectroscopy and applications of 1H,19 F,31P NMR to simple inorganic molecules.
4. Discuss the principle and instrumentation of Electron Spin Resonance spectroscopy and its applications, to apply to the free electron character available in a molecular entity to predict structure of complexes and to discuss the principle and instrumentation of photoelectron spectroscopy, Interpretation of Vibrational spectral data for ionized (M+) species.
5. Explain the various types of inorganic photochemical reactions, mechanism of solar energy conversion using ruthenium bipyridyl complexes, predict the photo processes in inorganic and apply in the development of sensitized solar cells - photo catalysis

UNIT – I: Electronic spectroscopy and its applications (15 hours)

Electronic spectra of diatomic and polyatomic molecules- Term states of d^n ions - Term Symbols- characteristics of d-d transitions - electronic spectra of coordination compounds - selection rules - band intensities and band widths – energy level diagrams of Orgel and Tanabe – Sugano diagrams - spectra of $Ti^{3+,}$ $V^{3+,}$ Ni^{2+},Cr^{3+}, Co^{2+}, Cr^{2+} and Fe^{2+} calculation of 10Dq and B for V^{3+}(oct) and Ni^{2+}(oct) complexes. Charge transfer spectra - classification, mechanisms and

interpretation with suitable examples. Magnetism in coordination complexes using A, E and T terms.

UNIT – II: Applications of IR and Raman Spectroscopy (8 hours)

Introduction to IR and Raman spectroscopy. Stretching frequency of some inorganic ions and compounds – sulphato, sulphito, carbonato, aquo, nitro, thiocyanato, cyano and thiourea. Applications of Infrared and Raman, electronic spectroscopy to inorganic systems-metal complexes, organometallic and simple inorganic compounds with special references to coordination sites, isomerism etc., inorganic structure determination. Vibrational spectra of metal carbonyls.

UNIT – III: Mossbauer and NQR Spectroscopy and applications of NMR Spectroscopy to Inorganic molecules (12 hours)

Mossbauer spectroscopy-principle, instrumentation – recoil energy, Doppler effect- number of MB signals isomer shift quadrupole splitting – magnetic splitting. Applications of ^{57}Fe, ^{119}Sn and ^{129}I Mossbauer spectroscopy. NQR spectroscopy theory and instrumentation nuclear quadrupole coupling constants-applications. Applications of ^{11}B, ^{31}P, ^{19}F, ^{119}Sn and ^{195}Pt NMR spectroscopy in the structural assessment of simple inorganic compounds. Applications of NMR in the study of co-ordination complexes, organometallic derivatives and trans effect. Inter and intramolecular exchange studies using NMR- Fluxional behavior of inorganic molecules.

UNIT – IV: ESR Spectroscopy and Photoelectron Spectroscopy (15 hours)

ESR spectra of transition metal complex - copper, manganese and vanadyl complexes. Applications of ESR spectroscopy based on multiplicity, anisotropy, magnitude of g values and A values covalency of complexes. Photoelectron spectroscopy–basic principles of UPS and XPS – photoelectron spectra- Koopmann's theorem- fine structure in PES, applications of UPS. ESCA- Introduction- chemical shift and correlation with electronic charges - satellite peaks, spectral splitting, instrumentation, applications - Auger electron spectroscopy - determination of dipole moment.

UNIT V: Photochemistry of Co-ordination Compounds (10 hours)

Types of photochemical reaction – photo isomerization, photo substitution and photo redox reactions of cobalt, chromium, platinum and ruthenium complexes. Excitons, polarons, solitons, semiconductor junctions, photocurrent and photo voltage, photoconductors, photovoltaic cells and photo galvanic cells, solar batteries. Solar energy conversion- photo electro chemistry-photo catalysis- role of ruthenium bipyridyl $[Ru(bpy)_3]^{2+}$complexes in solar energy conversion.

PRESCRIBED BOOKS:

1. Drago R.S, Physical Methods for Chemists, Saunders, (W.B), Co.Ltd, 2nd Edition, 1992.
2. Ebsworth E.A.V, DWA Rankin and C. Craddock, Structural methods in inorganic chemistry, Blackwell Science Inc., 2nd Edition, 1987.
3. Jagdamba Singh, Spectroscopy of Inorganic Compounds: Principles, Problems, and their solutions, 1st Edition, 2020.
4. V. Balzani and, V. Carassiti, Photochemistry of coordination compounds,. Academic Press, 1970.

REFERENCE BOOKS:

1. Bodie E. Douglas, Darl H. McDaniel and John J. Alexander, Concepts and Models of Inorganic Chemistry, 3rd Edition, John Wiley and Sons, 1994.
2. J. E. Huheey, E. A. Keiter, R.L. Keiter and O. K. Medhi, Inorganic Chemistry –Principles of structure and reactivity, 4th Edition, Pearson, 2013.
3. Gary L. Miessler, Donald A. Tarr, Inorganic Chemistry, 3rd Edition, Pearson, 2004.

E-LEARNING RESOURCES:

1. https://www.chemicalforums.com/
2. https://nptel.ac.in/
3. https://chem.libretexts.org/
4. http://www.ilpi.com/genchem/web.html#12

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

Section	Question Component	Numbers	Marks	Total
Section- A	MCQ:1-10 , Fill in : 11 -15 T/F:16-20 Answer all questions	1 – 20	1	20
Section-B	Short Answer /Problems Answer any 5 out of 8 questions	21–28	7	35
Section- C	Essay Answer any 3 out 5 questions	29– 33	15	45
TOTAL MARKS				**100**

BREAK UP OF QUESTIONS

Unit	Section A	Section B	Section C
I	4	2	1
II	4	1	1
III	4	1	1
IV	4	2	1
V	4	2	1
Total	**20**	**8**	**5**

PSO – CO mapping

	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	2	3	2	3	3
CO 2	3	2	3	3	3
CO 3	3	3	3	2	3
CO 4	2	3	3	3	2
CO 5	3	3	3	3	2
Ave.	2.6	2.8	2.8	2.8	2.6

PSO-CO-question paper mapping

CO No.	COURSE OUTCOME	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Demonstrate the bonding properties related structural identification of coordination complexes and to compute magnetic properties	PSO1, PSO3	K1, K2, K4, K5
CO2	Learn about UV -Visible spectroscopy and to predict the term symbols, interpret the Orgel diagram, Tanabe- Sugano diagram, electronic spectra of inorganic and organometallic compounds.	PSO1, PSO2, PSO3, PSO5	K1, K2, K3
CO3	Compare the principles, chemical shifts, coupling constants, application of Mossbauer and NQR spectroscopy and applications of ^{1}H,^{19}F,^{31}P NMR to simple inorganic molecules.	PSO1, PSO2, PSO4	K1, K3, K4, K6
CO4	Discuss the principle and instrumentation of Electron Spin Resonance spectroscopy and its applications, to apply to the free electron character available in a molecular entity to predict structure of complexes and to discuss the principle and instrumentation of photoelectron spectroscopy, Interpretation of Vibrational spectral data for ionized (M^{+}) species.	PSO1, PSO2, PSO5	K1, K2, K4, K5
CO5	Explain the various types of inorganic photochemical reactions, mechanism of solar energy conversion using ruthenium bipyridyl complexes, predict the photo processes in inorganic and apply in the development of sensitized solar cells - photo catalysis	PSO1, PSO3, PSO4, PSO5	K1, K3, K5

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

PROGRAMME: M.Sc. CHEMISTRY	**BATCH:** 2024 - 26
PART:	**COURSE COMPONENT:** CORE - XII
COURSE NAME: Physical Chemistry- III	**COURSE CODE:**
SEMESTER: III	**MARKS:** 100
CREDITS: 4	**TOTAL HOURS:** 60
THEORY AND PROBLEMS	

COURSE OBJECTIVE:

To learn the basic principles, application of spectroscopy and applications of classical thermodynamics, solution electrochemistry.

COURSE OUTCOMES:

On completion of the course the students will be able to

1. Discuss knowledge about the principle of microwave, Infrared spectroscopy.
2. Apply the knowledge gained to using UV -Visible spectroscopy and apply mass spectroscopy tofind the fragmentation pattern of molecules.
3. Understand partial molar properties and its significance, fugacity, thermodynamics of ideal and non-ideal binary solution.
4. Analyze about Debye Huckle theory of strong electrolytes, ion-ion interaction, limiting law, Onsager equation, Bjerrum ion association concept.
5. Explain the models of electrical double, mechanism of one electron transfer electrode reaction, theories of corrosion.

UNIT–I: Spectroscopy-I (15 hours)

Interaction of radiation with matter- rotational spectroscopy of rigid rotor-derivation of J_{max}-non-rigid rotor- diatomic and polyatomic molecules – Stark effect. Vibrational spectroscopy-harmonic oscillator-anharmonicity-vibrational spectra of polyatomic molecules-overtones, combination of bonds-vibrational coupling-Fermi resonance. Vibrational rotational lines-PQR branches-Determination of bond length, force constant, vibrational frequency. Applications involving isotopic substitution. Raman spectra-Stokes and anti-stokes lines. Classical and quantum theory-Rotational and vibrational Raman spectra.

UNIT– II: Spectroscopy-II (10 hours)

Electronic spectra of diatomic and polyatomic molecules- Franck-Condon principle – determination of dissociation energy – pre dissociation spectra – selection rules-types of electronic transitions–effect of conjugation and solvent-chromophores, auxochromes,

Bathochromic and Hypsochromic shifts. Term symbols for electronic states of H_2 molecule. NMR spectroscopy-principle – instrumentation - equation of motion of spin in magnetic fields, chemical shift, spin-spin coupling-relaxation effects.

Mass spectrometry-principle–instrumentation–isolation techniques-EI,CI,FD - LD, LIMA, PD, FAB, SIMS - presentation of spectral data – molecular ions-determination of molecular mass-Isotopic peaks-determination of molecular formula- Metastable peaks. Fragmentation – nitrogen rule.

UNIT-III: Thermodynamics–I (10 hours)

Partial molar properties–Partial molar free energy (chemical potential)-Partial molar volume-partial molar heat content-their significance and determination of these quantities-variation of chemical potential with temperature and pressure. Thermodynamics of real gases- gas mixture-fugacity definition-determination of fugacity– variation of fugacity with temperature and pressure- thermodynamics of ideal and non-ideal binary solutions-dilute solutions-excess functions for non-ideal solutions and their determination-the concepts of activity and activity co-efficient-determination of standard free energies-choice of standard states-determination of activity and activity coefficient for non-electrolytes.

UNIT-IV: Electrochemistry of Solutions (10 hours)

Ion-solvent interaction-Born's treatment (structureless continuum model only, no derivation); ion- ion interaction-Mean ionic activity and activity coefficient-concept of ionic strength-Debye - Huckel theory of strong electrolytes- derivation of Debye-Huckel limiting law-validity of the equation-Debye-Huckel limiting law at low and appreciable concentration of the electrolytes-qualitative and quantitative verification-Debye-Huckel- Bronsted equation.

Ion transport-theory of strong electrolytes for electrolytic conductance-derivation of Onsager equation-validity of the equation-modification of Onsager equation. Ion association-Bjerrum treatment of association-Bjerrum ion association constant-factors influencing ion association-effect of ion association on conductivity and activity coefficient of electrolytes in solution.

UNIT–V: Electrodics (15 hours)

The electrode-electrolyte interface-electrical double layer-IHP-OHP-contact adsorption-

surface excess and its importance-Thermodynamics of electrified interface-electro capillary phenomenon - Lippmann equation, Lippmann potential-polarizable and non-polarizable interface. Structure of double layer-Helmholtz-Perrin,Guoy-Chapmann and Stern models of electrical double layer. Electrokinetic phenomena (Electrophoresis, electro osmosis, sedimentation potential and streaming potential – concepts only) derivation of Butler-Volmer equation for one step electron transfer reactions, Tafel equation- significance of exchange current density and symmetry factor Polarization and over potential- A brief account of Hydrogen overpotential-factors affecting Hydrogen overpotential-mechanism of hydrogen evolution and oxygen evolution-concentration polarization.

Corrosion: Theories, types, prevention of corrosions. Fuel Cells-hydrogen-oxygen fuel cell, construction and applications

PRESCRIBED BOOKS:

1. C.N. Banwell, Fundamentals of Molecular spectroscopy, McGraw-Hill book company, 4th Edition, 2017.
2. H. Kaur, Spectroscopy, A Pragati prakashan educational publishers, 15th Edition, 2019
3. Sharma B. K., Instrumental methods of chemical analysis, Goel Publication, 24th Edition, 2014.
4. Pavia D. L. and Lampman, G.M., Introduction to Spectroscopy, Cengage Learning India Private Limited, 5th Edition, 2015.
5. K.L.Kapoor, Physical Chemistry, MacMillan India Ltd, 3rd Edition, 2009.
6. S.Glasstone ,Introduction to Electrochemistry, Liton educational Publishing INC, Reprint 2010.
7. Allen J. Bard, Larry R. Faulkner, Electrochemical Methods: Fundamentals and Applications, 2nd Edition, 2000
8. M.C.Gupta, Statistical thermodynamics, Wiley, Eastern, New Delhi, Reprint, 2009.
9. J.O.M.Bokris and A.K.N.Reddy, Electrochemistry, Vol. 1&2, Kluwer academic /Plenum publishers, New York, 2nd Edition,2002.

REFERENCE BOOKS:

1. R.S.Drago, Physical Methods in Chemistry, Thomson learning,1977.
2. Drago R.S, Physical Methods for Chemists, Saunders,(W.B),Co.Ltd, 2nd Edition,1992.

3. Christian. G.D., Analytical Chemistry,Wiley,7th Edition,2014.
4. Skoog, D.A., Instrumental methods of analysis- Saunders College Publication, 3rd Edition,2007.
5. D.R.Crow, Principles and Applications of Electrochemistry, Chapman and Hall,4th Edition, 1994.
6. Nester Perez, Electrochemistry and corrosion science, Springer London, Reprint,2010.

E-LEARNING RESOURCES:

1. http://ccl.osc.edu/ccl.cca.html
2. http://www.chem.swin.esu.au/chem_ref.html
3. http://www.colby.edu/chemistry/PChem/Lecture1.html
4. http://hyperphysics.phy-astr.gsu.edu/hbase/chemical/electrode.html#c3
5. www.spectro.com

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

Section	Question Component	Numbers	Marks	Total
Section- A	MCQ:1-10 , Fill in : 11 -15 T/F:16-20 Answer all questions	1 – 20	1	20
Section-B	Short Answer /Problems Answer any 5 out of 8 questions	21–28	7	35
Section- C	Essay Answer any 3 out 5 questions	29– 33	15	45
TOTAL MARKS				**100**

BREAK UP OF QUESTIONS

Unit	Section A	Section B		Section C
		Theory	Problem	
I	4	1	1	1
II	4	1		1
III	4	1		1
IV	4	1		1
V	4	2	1	1
Total	**20**	**8**		**5**

PSO – CO mapping

	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	3	3	3	3	3
CO 2	3	3	3	3	3
CO 3	3	3	3	3	3
CO 4	3	3	3	3	3
CO 5	3	3	3	3	3
Ave.	3	3	3	3	3

PSO-CO-question paper mapping

CO No.	**COURSE OUTCOME**	**PSOs ADDRESSED**	**COGNITIVE LEVEL (K1 to K6)**
CO1	Discuss knowledge about the principle of microwave, Infrared spectroscopy.	PSO 1 PSO 3	K1 to K3
CO2	Apply the knowledge gained to using UV - Visible spectroscopy and apply mass spectroscopy tofind the fragmentation pattern of molecules.	PSO 1, PSO 3, PSO 4,	K1 to K3
CO3	Understand partial molar properties and its significance, fugacity, thermodynamics of ideal and non-ideal binary solution.	PSO 1, PSO 3, PSO 4,	K1 to K4
CO4	Analyze about Debye Huckle theory of strong electrolytes, ion-ion interaction, limiting law, Onsager equation, Bjerrum ion association concept.	PSO 1, PSO 2, PSO 3, PSO 4, PSO 5	K1 to K3
CO5	Explain the models of electrical double, mechanism of one electron transfer electrode reaction, theories of corrosion.	PSO 1, PSO 2, PSO 3, PSO 4, PSO 5	K1 to K4

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

PROGRAMME: M.Sc. CHEMISTRY	**BATCH:** 2024 - 26
PART:	**COURSE COMPONENT:** CORE ELECTIVE - II
COURSE NAME: Research Methodology and Research Ethics	**COURSE CODE:**
SEMESTER: III	**MARKS:**100
CREDITS: 3	**TOTAL HOURS:** 60
THEORY	

COURSE OBJECTIVE:

To create the industry ready students with fundamental understandings and diverse applied knowledge in analytical chemistry.

COURSE OUTCOMES:

1. Gain knowledge about problem selection, literature search and metrics involved in research.
2. Acquire theoretical knowledge about planning, method development and data analysis involved in research.
3. Demonstrate skill in report writing in the expected format and to select the appropriate journal for publication.
4. Show integrity in research and aware of scientific ethics to be followed.
5. Follow publication ethics and identify predatory journal with the help of plagiarism software

UNIT I: Research Problem (15 hours)

Objectives of research, types of research – basic, applied, and other types-Problem selection. Innovative and Sustainable research, literature survey –primary, secondary and tertiary sources. Chemical abstract and its importance, Journals – International and National, reviews, monographs, data books. Research metrics- Impact factor, citation index, h-indexand i-10 index. Indexing – Web of Science and Scopus.

UNIT II: Research planning, methods and data analysis (10 hours)

Planning and conducting experiments-Methods development- Product, process and analytical method and validation. Case study: Organic, Inorganic and Analytical methods Presentation of data-Types of errors-Gross, systematic and random errors- types of data and data analysis - measures of mean, standard deviation and measures of variability- correlation, and method of least squares, regression analysis.

UNIT III: Scientific Report writing and publication (10 hours)

Scientific Report writing-manuscript. Thesis, books and patent–Procedure for presenting tables, graphs and figures, foot-notes, bibliography and appendices-Abbreviations, symbols and SI units-Journal finder / journal suggestion tools viz. JANE, Elsevier journal finder, Springer Journal Suggester. Publishers: ACS, RSC, Elsevier, Taylor & Francis, Wiley and Springer-Patent, IPR, copy right. Proposal writing and funding agencies in India.

UNIT IV: Scientific Conduct (10 hours)

Ethics with respect to science and research-Intellectual honesty and research integrity-Scientific misconducts: Falsification, Fabrication and Plagiarism (FFP)-Redundant publications: duplicate and overlapping publications-Selective reporting and misrepresentation of data.

UNIT V: Publication Ethics (15 hours)

Publication ethics: definition, introduction and importance-Best Practices / standard setting initiatives and guidelines: COPE, WAME, etc.-Conflicts of interest-Publication misconduct: definition, concept, problems that lead to unethical behavior -Violation of publication ethics, authorship and contributorship- Identification of publication misconduct, complaints and appeals Predatory publishers and journals-Use of plagiarism software like Turnitin, Urkund and other open source software tools.

PRESCRIBED BOOKS:

1. Scientific Integrity and Research Ethics: An Approach from the Ethos of Science (Springer Briefs in Ethics) by David Koepsell, Springer publications.
2. Textbook of Research Ethics: Theory and Practice by Sana Loue, Springer publications.

REFERENCE BOOKS:

1. Thesis and Assignment Writing – J Anderson, B.H. Dursten and M. Poole, Wiley Eastern (1977).
2. Statistical Method, Gupta S. P, Sultan Chand and Sons, New Delhi, 2004
3. Hand Book for Authors –Journal of the American Chemical Society Publications

4. Chemical publications – Their nature and uses

E-LEARNING RESOURCES:

1. https://www.publichealthnotes.com/research-ethics-definition-principles-and- advantages/
2. https://www.niehs.nih.gov/research/resources/bioethics/whatis/index.cfm
3. https://www.ccmb.res.in/newsfiles/year-2020/csir_ethics_2020.pdf
4. https://www.insaindia.res.in/pdf/Ethics_Book.pdf

GUIDELINES TO THE QUESTION PAPER SETTERS
QUESTION PAPER PATTERN

Section	**Question Component**	**Numbers**	**Marks**	**Total**
Section- A	Answer any 10 out of 12 questions (each in 50 words)	1-12	3	30
Section-B	Answer any 5 out of 7 questions (each in 300 words)	13-19	6	30
Section- C	Answer any 4 out of 6 questions (each in 1200 words)	20-25	10	40
TOTAL MARKS				**100**

BREAK UP OF QUESTIONS

Unit	**Section A**	**Section B**	**Section C**
I	3	2	1
II	2	1	1
III	2	1	1
IV	2	1	1
V	3	2	2
Total	**12**	**7**	**6**

PSO-CO mapping.

	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	2	3	3	3	3
CO 2	3	3	3	2	3
CO 3	3	3	3	3	3
CO 4	3	3	3	3	3
CO 5	3	3	3	3	3
Ave.	2.8	3	3	2.8	3

PSO-CO-question paper mapping

CO No.	COURSE OUTCOME	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Gain knowledge about problem selection, literature search and metrics involved in research.	PSO1, PSO2, PSO3, PSO4	K1 – K6
CO2	Acquire theoretical knowledge about planning, method development and data analysis involved in research.	PSO2, PSO3, PSO4, PSO5	K1 – K6
CO3	Demonstrate skill in report writing in the expected format and to select the appropriate journal for publication	PSO2, PSO3, PSO4, PSO5	K1 – K6
CO4	Show integrity in research and aware of scientific ethics to be followed.	PSO3, PSO4, PSO5	K1 – K6
CO5	Follow publication ethics and identify predatory journal with the help of plagiarism software	PSO3, PSO4, PSO5	K1 – K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

SEMESTER - IV

PROGRAMME: M.Sc. CHEMISTRY	**BATCH:** 2024 - 26
PART:	**COURSE COMPONENT:** CORE - XIII
COURSE NAME: Organic Chemistry–IV	**COURSE CODE:**
SEMESTER: IV	**MARKS:**100
CREDITS: 4	**TOTAL HOURS**: 60
THEORY AND PROBLEMS	

COURSE OBJECTIVE:

To introduce the basic methodology for the synthesis of organic compounds using retrosynthetic analysis, usage of synthetic reagents, name reactions and green synthetic methods.

COURSE OUTCOME:

On completion of the course the students will be able to

1. Apply the retro synthetic approach to develop methodology for synthesising new compounds involving C-C and C=C.
2. Logically approach the usage of various reagents for organic synthesis.
3. Apply the methodology involved in advanced name reactions for synthesizing new compounds.
4. Approach synthesis of complex organic compounds in a logical manner.
5. Apply green chemistry principles and utilize them to meet the sustainable development in recent research.

UNIT–I: Synthetic Reagents (15 hours)

Reagents used for oxidation- TPAP, Dess-martin, silver carbonate / molecular seives and CAN. Reagents used for reductions-$(PPh_3)_3RhCl$, Lindlar catalyst, 9-BBN, chiral boranes, $NaBH_3CN$, DIBAL and selectrides - Birch reduction (Hetero cyclic compound). Role of Bu_3SnH, trimethylsilylchloride, LDA and dithiane inorganic synthesis. Ring closing metathesis.

UNIT–II: Synthetic Applications of Name Reaction (10 hours)

Sandmeyer reaction, Ullmann reaction, Gomberg reaction, Pschorr reaction, Huns dicker reaction. Heck reaction, Suzuki coupling, McMurry olefination, Prins reaction, Ritter reaction, Mitsunobu reaction, Sharpless asymmetric epoxidation, Kumada coupling, Negishi coupling, Stille

coupling Buchwald-Hartwig Cross Coupling and Sonogashira coupling.

UNIT- III: Modern Synthetic Methodology (15 hours)

Retro synthetic analysis- disconnections - Synthons: Donors and acceptor and their synthetic equivalent- FGI-FGA-UMPOLUNG. Formation of C-C bond using alkylation and acylation of enamines, enolates, active methylene compounds and organometallic compounds-RMgX, R_2LiCu, RLi with special references to synthesis of 1,2-1,3-1,4-1,5-and1,6-dicarbonyl compounds. Synthesis of unsaturated carbonyl compounds using aldol condensation, Claisen reaction and Michael reaction - Cyclisation methods- Robinson annulations. Formation of C=C bond using Wittig, modified Wittig reactions, Peterson olefination and Julia olefination. Role of sulphur ylides and rearrangements (Pinacol-Pinacolone and Favorski rearrangement) in organic synthesis. Protection and deprotection of functional groups (-OH, $-NH_2$,C=O,-COOH).

UNIT-IV: Retero Synthesis of Target Molecules (10 hours)

Retero synthetic analysis, donor and acceptor synthons- examples and synthesis of target molecules - 5-hexenoic acid, bicyclo (4, 1, 0) heptane-2-one, trans-9-methyl-1-decalone, Cubane, longifolene,cis –jasmone and onocerin

UNIT–V: Green Chemistry (10 hours)

Introduction to green chemistry; efficiency/atom economy - definition, needs and goals. Twelve principles of green chemistry with detailed descriptions. Comparison of conventional chemical methods with green chemical methods. Organic synthesis in aqueous medium (highlight of requirements) - Diels-Alder reaction, Knoevenagel reaction and Heck reactions. Ionic liquids as solvent-preparation, merits of ionic liquid as solvent and application to Suzuki coupling, Henry reaction and hydrogenations. Polymer supported phase transfer catalysts – principle of catalysis and applications to C, N, O and S alkylations. Microwave and Ultrasound assisted synthesis –principle behind these techniques and application to esterification, reduction and coupling reactions.

PRESCRIBED BOOKS:

1. R.O.C Norman and J. M. Coxon, Principles of organic synthesis, CRC press, 3rd Edition, 2017.

2. Ratan Kumar Kar, Fundamentals of organic synthesis–the retro synthetic analysis vol-2, New central book agencies, first reprint,2014.
3. Timothy K. Dickens, Stuart Warren, Chemistry of the Carbonyl Group: A Step-by-Step Approach to Understanding Organic Reaction Mechanisms, Revised Edition, 2018.
4. Michael B. Smith, March's Advanced Organic Chemistry: Reactions, Mechanisms, and Structure, 8th Edition, 2019.
5. V.K.Ahluwalia, Green Chemistry-Greener alternative to synthetic organic transformation, Narosa Publishing House Pvt. Ltd, 1st Edition, 2012.
6. William Caruthers and Coldham, Modern methods of organic synthesis, Cambridge Univ. Press, 4th Edition, 2016.
7. I.L.Finar,Organic chemistry Vol-II, Pearson Education Pvt. Ltd, 5th Edition, 2006.

REFERENCE BOOKS:

1. Ratan Kumar Kar, Frontier Orbital and Symmetry Controlled Pericyclic reaction, Books & allied Pvt. Ltd, 1st Edition,2012.
2. Stuart Warren, Organic synthesis-The Dissconnection approach, John Wiley(P) Ltd, Reprint, 2011.
3. F.A.Carey and R.J.Sundberg, Advanced Organic Chemistry, Part-A and Part-B. Plenum Press, New York, 5th Edition, 2015.
4. J. Clayden, N. Greeves and S. Warren, Organic Chemistry, Oxford University Press, 2nd Edition, 2014.
5. Rashmi Sanghi and M.M.Srivastava, Green Chemistry, Narosa Publishing House Pvt. Ltd, 5th Edition, 2012.
6. J.P.Tierney and P. Lidstrom, Microwave Assisted Organic Synthesis, Wiley India Pvt. Ltd, 1st Edition, Reprint, 2016.

E-LEARNING RESOURCES

1. www.epgpathshala.nic.in
2. https://nptel.ac.in/
3. https://swayam.gov.in/
4. https://www2.chemistry.msu.edu/faculty/reusch/VirtTxtJml/intro1.htm

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

Section	Question Component	Numbers	Marks	Total
Section- A	MCQ:1-10 , Fillup : 11-15 , T/F:16-20 Answer all questions	1 – 20	1	**20**
Section-B	Short Answer /Problems Answer any 5 out of 8 questions.	21–28	7	**35**
Section- C	Essay Answer any 3 out of 5 questions	29– 33	15	**45**
TOTAL MARKS				**100**

BREAK UP OF QUESTIONS

Unit	Section A	Section B		Section C
		Theory	**Problem**	
I	4	1	1	1
II	4	1		1
III	4	1	1	1
IV	4	1	1	1
V	4	1		1
Total	**20**	**8**		**5**

PSO-CO mapping.

	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	3	2	3	3	3
CO 2	3	2	3	3	3
CO 3	3	2	3	3	3
CO 4	3	2	3	3	3
CO 5	3	2	3	3	3
Ave.	3	2	3	3	3

PSO-CO-question paper mapping

CO No.	COURSE OUTCOME	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Apply the retro synthetic approach to develop methodology for synthesising new compounds involving C-C and C=C.	PSO2, PSO3, PSO4, PSO5	K1, K2, K3, K4, K5.
CO2	Logically approach the usage of various reagents for organic synthesis.	PSO1, PSO2, PSO3, PSO 5.	K1, K2, K3, K4, K5.
CO3	Apply the methodology involved in advanced name reactions for synthesizing new compounds.	PSO 1,PSO2, PSO 3, PSO4, PSO5	K1, K2, K3, K4, K5, K6.
CO4	Approach synthesis of complex organic compounds in a logical manner.	PSO 1,PSO2, PSO 3, PSO4, PSO5	K1, K2, K3, K4, K5.
CO5	Apply green chemistry principles and utilize them to meet the sustainable development in recent research.	PSO 1, PSO2, PSO 3, PSO4, PSO5	K1, K2, K3, K4, K5.

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

PROGRAMME: M.Sc. CHEMISTRY	**BATCH:** 2024 - 26
PART:	**COURSE COMPONENT:** CORE - XIV
COURSE NAME : Physical Chemistry - IV	**COURSE CODE:**
SEMESTER: IV	**MARKS:**100
CREDITS:4	**TOTAL HOURS:** 60
THEORY	

COURSE OBJECTIVE:

To understand the significance of statistical thermodynamics, applications of photochemistry and basics of computational chemistry.

COURSE OUTCOMES:

On completion of the course the students will be able to

1. Gain knowledge on basic concepts of ensembles, statistical probabilities in the filling of atomic and molecular energy levels, partition functions and their derivation
2. Analyze and apply concepts of partition function to heat capacities of solids and gases, black body radiation, electron gas in metals
3. Explain the fundamentals of photochemistry, Absorption and Emission of radiation, Stern Volmer analysis, Quantum efficiency and Molecular structure and photophysical and photo chemical reactivity.
4. Demonstrate the fast reaction techniques such as flash photolysis and fluorescence and lifetime measurements.
5. Design molecular structure, bond angle, bond length and electron density, calculate bond energy enthalpy, entropy and free energy of constructed molecules, draw and visualize both small and big molecules using online tools and to perform online molecular docking analysis

UNIT-I: Thermodynamics-II (12 hours)

Concept of thermodynamic probability-distribution of distinguishable and indistinguishable particles. Maxwell - Boltzmann, Fermi-Dirac and Bose-Einstein statistics - Modes of contribution to energy. Partition function–Translational, vibrational and rotational

partition functions for mono, diatomic and polyatomic ideal gases.

UNIT-II: Thermodynamics–III (12 hours)

Thermodynamic functions in terms of partition functions –equilibrium constant for isotope exchange and dissociation of diatomic molecules- heat capacity of solids (Einstein and Debye models) -ortho and para hydrogen- Planck's radiation law –electron in metals.

UNIT–III: Fundamentals of photochemistry (12 hours)

Absorption and emission of radiation-Frank-Condon principle-Physical properties of electronic excited molecules - Spin multiplicity - Singlet and triplet excited states - decay of electronically excited states – radiative and non radiative processes-fluorescence and phosphorescence-Spin forbidden non-radiative transitions-internal conversion and intersystem crossing-energy transfer process-excimers and exciplexes-delayed fluorescence and phosphorescence - Triplet-Triplet annihilation-static and dynamic quenching-Stern-Volmer analysis. Quantum efficiency-quantum yield - sensitization and sensitizer - allowed- forbidden process –(Molecular structure and photophysical and photochemical reactivity)

UNIT–IV: Techniques and Photochemical Reactions (12 hours)

Quantum yield measurements-Flash photolysis techniques-Actinometry-quantum yield of photophysical process and photochemical reactions. Life time measurements- Steady state and non steady state methods. Fluorescence spectroscopy–principle-instrumentation and applications– fluorescence-based sensors

UNIT-V: Computational Chemistry (12 hours)*

Introduction to Cheminformatics - History of Cheminformatics - data storage, retrieval and presentation -Types of Databases - Cambridge structural database –different file formats (SMILES, .cif,. mol,. xyz,. Pdb etc.,) -Online property calculators with examples. Introduction to Online resources- online 2D and 3D chemical structure drawing-designing of molecules and demonstrating experiments–Protein data bank - Protein structure visualization tools –PyMol, and Swiss PDB Viewer. Introduction to drug design - Structured-based drug design - Ligand based drug design – difference between drugs and inhibitors - Molecular Docking – Types

(Rigid and flexible docking)-Online docking servers. (Definitions only - Pharmacophore, pharmacokinetics, lead molecule, search algorithm and scoring function)

***Not for End Semester Examination, only for Continuous Internal Assessment**

PRESCRIBED BOOKS:

1. B.C McClelland, Statistical thermodynamics, Chapman and Hall, London, 1973.
2. N.J.Turro, Modern Molecular Photochemistry (MMP), University Press, MenloPark, CA, 1978.
3. A.Gilbertand J. Baggott, Essentials of Molecular Photochemistry, CRC Press, London, UK, 1991.
4. Andrew R.Leach, Molecular Modelling: Principles and Applications, 2nd edition, Pearson Education; 2009

REFERENCE BOOKS:

1. B.C McClelland, Statistical thermodynamics, Chapman and Hall, London, 1973.
2. N.J.Turro, Modern Molecular Photochemistry (MMP), University Press, Menlo Park, CA,1978.
3. A. Gilbertand J. Baggott, Essentials of Molecular Photochemistry, CRC Press, London, UK,1991.
4. Andrew R.Leach, Molecular Modelling: Principles and Applications, 2nd Edition, Pearson Education; 2009.

E-LEARNING RESOURCES:

1. www.docsity.com
2. www.acdlabs.com
3. www.studocu.com
4. mooc.org
5. nptel.ac.in
6. www.gaussian.com
7. MOLPRO

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

Section	Question Component	Numbers	Marks	Total
Section- A	MCQ:1-10 , Fillup : 11-15 , T/F:16-20 Answer all questions	1 – 20	1	**20**
Section-B	Short Answer /Problems Answer any 5 out of 8 questions.	21–28	7	**35**
Section- C	Essay Answer any 3 out of 5 questions	29– 33	15	**45**
TOTAL MARKS				**100**

BREAK UP OF QUESTIONS

Unit	Section A	Section B		Section C
		Theory	Problem	
I	5	1	1	2
II	5	2		1
III	5	2		1
IV	5	2		1
V				
Total	**20**	**8**		**5**

PSO – CO mapping

	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	3	2	3	2	2
CO 2	3	2	3	2	2
CO 3	3	2	3	2	3
CO 4	3	2	3	3	3
CO 5	3	3	3	3	3
Ave.	3	2.2	3	2.4	2.6

PSO-CO-question paper mapping

CO No.	COURSE OUTCOME	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Gain knowledge on basic concepts of ensembles, statistical probabilities in the filling of atomic and molecular energy levels, partition functions and their derivation	PSO 1 PSO 3	K1 to K3
CO2	Analyze and apply concepts of partition function to heat capacities of solids and gases, black body radiation, electron gas in metals	PSO 1, PSO 3, PSO 4,	K1 to K3
CO3	Explain the fundamentals of photochemistry, Absorption and Emission of radiation, Stern Volmer analysis, Quantum efficiency and Molecular structure and photophysical and photo chemical reactivity.	PSO 1, PSO 3, PSO 4,	K1 to K4
CO4	Demonstrate the fast reaction technique such as flash photolysis and fluorescence and lifetime measurements.	PSO 1, PSO 2, PSO 3, PSO 4, PSO 5	K1 to K3
CO5	Design molecular structure, bond angle, bond length and electron density, calculate bond energy enthalpy, entropy and free energy of constructed molecules, draw and visualize both small and big molecules using online tools and to perform online molecular docking analysis.	PSO 1, PSO 2, PSO 3, PSO 4, PSO 5	K1 to K4

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

PROGRAMME: M.Sc. CHEMISTRY	**BATCH:** 2024 - 26
PART:	**COURSE COMPONENT:** CORE ELECTIVE -V
COURSE NAME: Chemistry of Natural Products	**COURSE CODE:**
SEMESTER: IV	**MARKS:**100
CREDITS: 3	**TOTAL HOURS:**60
THEORY	

COURSE OBJECTIVE:

To create awareness about the chemistry of biomolecules and their reactions.

COURSE OUTCOMES:

On completion of the course the students will be able to

1. Explain the fundamental concept to nucleic acids and its functioning.
2. Propose the total synthesis of peptide and to elucidate the structure of various steroids.
3. Write the synthesis of camphor α, β-carotenoids and lycopene.
4. Outline the synthesis of complex organic compounds like morphine, cocaine, reserpine and synthesis of flavones isoflavones and anthocyanin.
5. Gain expertise in the bio synthesis of cholesterol terpenoids alkaloids amino acids and bile acid.

UNIT– I: Nucleic acids (10 hours)

Pyrimidine and purine bases-synthesis of Adenine, Guanine, Thymine, Cytosine and Uracil. Structure and role of nucleic acid – nucleoside, nucleotide and poly nucleotides –DNA and RNA–structure, types–biological functions–genetic code.

UNIT– II: Proteins and Steroids (15 hours)

Proteins-classification, Merrifield synthesis, end group analysis, structure and biological functions.Steroids-Diel's hydrocarbon, synthesis of bile acid. Structural elucidation of cholesterol-conversion of cholesterol into estrone, testosterone and progesterone. Synthesis

of equilenin.

UNIT–III: Terpenoids and Carotenoids (15 hours)

Classification, occurrence, general methods of determining structure - isoprene rule. Synthesis of the following molecules – α and β- Carotene, lycopene, zingiberene eudesmol and santonin.

UNIT– IV: Alkaloids and Anthocyanins (10 hours)

Total synthesis of cocaine, morphine, reserpine and quinine. Flavones, isoflavones, anthocyanins (Synthesis only). Structural elucidation of lysergic acid.

UNIT– V: Biosynthesis (10 hours)

General principles involved in the biosynthesis of amino acids, alkaloids, steroids and terpenoids. Biosynthesis of cholestrol, prostaglandin, phenanthrene alkaloids and bile acids.

PRESCRIBED BOOKS:

1. I.L. Finar, Organic chemistry, Vol-II, ELBS Publication, 5th Edition,1986.
2. O.P.Agarwal, Organic Chemistry of Natural Products, Krishna Prakashan Media Pvt Ltd. 42nd Edition, 2011.
3. Gurdeep R.Chatwal, Organic chemistry of Natural products, Himalaya Publishing House, 2005.

REFERENCE BOOKS:

L.A.Pacquette, Principles of Modern Heterocyclic Chemistry, Benjamin Cummings Publishing Co, London, 1978.

E-LEARNING RESOURCES:

1. www.epathshala.nic.in
2. www.nptel.ac.in
3. http:/swayam.gov.in

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

Section	Question Component	Numbers	Marks	Total
Section- A	MCQ:1-10 , Fillup : 11-15 , T/F:16-20 Answer all questions	1 – 20	1	**20**
Section-B	Short Answer/ Problems	21–28	7	**35**

	Answer any 5 out of 8 questions.			
Section- C	Essay Answer any 3 out of 5 questions	29– 33	15	**45**
TOTAL MARKS				**100**

BREAK UP OF QUESTIONS

Unit	Section A	Section B	Section C
I	4	2	1
II	4	1	1
III	4	2	1
IV	4	2	1
V	4	1	1
TOTAL	**20**	**8**	**5**

PSO – CO mapping

	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	3	3	3	3	3
CO 2	3	3	3	3	3
CO 3	3	3	3	3	3
CO 4	3	3	3	3	3
CO 5	3	3	3	3	3
Ave.	3	3	3	3	3

PSO-CO Question paper mapping

CO No.	COURSE OUTCOME	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Explain the fundamental concept to nucleic acids and its functioning.	PSO1, PSO3	K1, K2, K3
CO2	Propose the total synthesis of peptide and to elucidate the structure of various steroids.	PSO1, PSO3, PSO 4, PSO 5	K1, K2, K3
CO3	Write the synthesis of camphor α,β-carotenoids and lycopene	PSO1, PSO3	K1, K3, K4
CO4	Outline the synthesis of complex organic compounds like morphine, cocaine,	PSO1, PSO3, PSO4	K1, K3, K5
CO5	Gain expertise in the bio synthesis of cholesterol terpenoids alkaloids amino acids and bile acid	PSO1, PSO4, PSO5	K1, K2, K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

PROGRAMME: M.Sc. CHEMISTRY	**BATCH:** 2024 - 26
PART:	**COURSE COMPONENT:** CORE ELECTIVE -V
COURSE NAME: Nanochemistry and its applications	**COURSE CODE:**
SEMESTER: IV	**MARKS:** 100
CREDITS: 3	**TOTAL HOURS:** 60
THEORY	

COURSE OBJECTIVE:

To introduce the recent advancements in the field of materials science viz. nanochemistry and its applications.

COURSE OUTCOME:

On completion of the course the students will be able to

1. Explain the basics of nano chemistry.
2. Describe the synthetic methods of nanomaterials.
3. Demonstrate the characterization methods of various nanomaterials.
4. Investigate the chemistry of metal and carbon based nanomaterials.
5. Demonstrate the various applications of nanomaterials and utilize their knowledge to develop novel nanomaterials during their research in the future.

UNIT - I: Nanomaterials - Introduction, classification and properties (12 hours)

Nanomaterials- Classification based on dimensions -1D, 2D, 3D and 0D. Shell structures, semiconductors, composites. Size dependent properties of nanomaterials. Mechanical, physical and chemical properties. Host-Guest Complexation: Introduction, Nature of supramolecular interactions, Type of host - guest complexes, Structure of complexes.

UNIT II: Synthesis of nanomaterials (10 hours)

Bottom up (physical and chemical techniques) and top down methods (mechanical methods and lithography). Wet and dry method, Self- Assembly-Self Assembled Monolayers (SAM) - Vapour deposition method – Laser ablation method, Chemical Vapour Deposition (CVD), Sol-gel pyrolysis method, combustion method and Microwave assisted synthesis.

UNIT III: Metal, Carbon and Polymer based Nanomaterials (12 hours)

Metal based nanomaterials: Noble metals – Ag, Au, Pd, Pt, metal oxide nanomaterials – ZnO, TiO_2, CeO_2 and iron oxides and quantum dots. Carbon based nanomaterials: Fullerenes, graphene, carbon nanotube (CNT), and carbon quantum dots. Functionalization of CNT,

electronic, vibrational, mechanical and optical properties of carbon nanomaterials. Synthesis of nanomaterials – Carbon, Metal, polymer-based materials and dendrimer composites.

UNIT IV: Characterization of Nanomaterials (12 hours)

XRD - powder diffraction - Structural characterization – Debye Scherer formula – crystallite size calculation–Morphology - Scanning Electron Microscopy (SEM/ FESEM), Transmission Electron Microscopy (TEM/HRTEM) – Crystallite size and SAED pattern. Scanning probe microscopy (SPM)- Atomic Force Microscopy (AFM), Scanning Tunneling microscopy (STM). Optical characterization - UV-Vis and Photoluminescence Spectroscopy.

UNIT-V: Application of Nanomaterials (14hours)

Energy-fuel cells, hydrogen storage, nanophosphors for High Definition TV, Next-Generation Computer Chips, Quantum electronic devices - CNT based applications and Field Emission Display - Biochemical sensor, smart materials.Nanocatalysis. Biological applications – diagnostic and imaging, targeted drug delivery - Nano coatings and paintings. Cosmetic applications. Ferroelectric materials, molecular electronics and nanoelectronics, applications of polymer and its composites. Nanotoxicology and Green Nanochemistry.

PRESCRIBED BOOKS:

1. B.S. Murty, P. Shankar, Baldev Raj, B B Rath, James Murday; Textbook of Nanoscience and Nanotechnology, 2013.
2. T. Pradeep, A Textbook of Nanoscience and Nanotechnology, Springer publishing service, 2017.
3. P. I. Varghese, T. Pradeep, A Textbook of Nanoscience and Nanotechnology, Tata McGraw-Hill Education, 2003.
4. Dinesh C Agrawal, Introduction to Nanoscience and Nanomaterials, World Scientific Publisher, 2013.

REFERENCE BOOKS:

1. M. Wilson, K. Kannangara, G Smith, M. Simmons, B. Raguse, Nanotechnology: Basic science and Emerging technologies, Overseas Press India Pvt. Ltd, New Delhi, 1st Edition,2005.
2. C.N.R. Rao, A. Muller, A.K.Cheetham (Eds), The chemistry of nanomaterials: Synthesis, properties and applications, Wiley VCH, Weinheim, 2004.
3. Kenneth J. Klabunde (Eds), Nanoscale Materials Science, John Wiley & Sons, Inc., 2001.
4. C.S.S.R.Kumar, J.Hormes, C.Leuschner, Nanofabrication towards biomedical applications, Wiley –VCH Verlag GmbH & Co, Weinheim, 2004.

5. W. Rainer, Nano Electronics and information Technology, Wiley, 2003.
6. K.E. Drexler, Nano systems, Wiley, 1992.
7. G.Cao, Naostructures and Nanomaterials: Synthesis, properties and applications, Imperical College Press, 2004

E-LEARNING RESOURCES:

1. https://www.chemicalforums.com/
2. https://nptel.ac.in/
3. https://chem.libretexts.org/
4. http://www.ilpi.com/genchem/web.html#12
5. http://www.zyvex.com/nano/
6. https://www.instanano.com/
7. https://www.azonano.com/nanotechnology-equipment-index.aspx
8. http://www.e-booksdirectory.com/listing.php?category=238

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

Section	Question Component	Numbers	Marks	Total
Section- A	MCQ:1-10, Fill in: 11 -15 T/F:16-20 Answer all questions	1 – 20	1	20
Section-B	Short Answer /Problems Answer any 5 out of 8 questions	21–28	7	35
Section- C	Essay Answer any 3 out 5 questions	29– 33	15	45
TOTAL MARKS				**100**

BREAK UP OF QUESTIONS

Unit	Section A	Section B	Section C
I	4	2	1
II	4	1	1
III	4	1	1
IV	4	2	1
V	4	2	1
Total	**20**	**8**	**5**

PSO-PO mapping.

	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	2	2	3	3	3
CO 2	3	3	2	3	3
CO 3	2	3	3	2	3
CO 4	3	2	3	3	2
CO 5	3	3	2	2	3
Ave.	2.6	2.6	2.6	2.6	2.8

PSO-CO-question paper mapping

CO No.	**COURSE OUTCOME**	**PSOs ADDRESSED**	**COGNITIVE LEVEL (K1 to K6)**
CO1	Explain the basics of nano chemistry.	PSO1, PSO3	K1, K2, K3
CO2	Describe the synthetic methods of nanomaterials.	PSO1, PSO3, PSO 4, PSO 5	K1, K2, K3
CO3	Demonstrate the characterization methods of various nanomaterials	PSO1, PSO3	K1, K3, K4
CO4	Investigate the chemistry of metal and carbon based nanomaterials.	PSO1, PSO3, PSO4	K1, K3, K5
CO5	Demonstrate the various applications of nanomaterials and utilize their knowledge to develop novel nanomaterials during their research in the future.	PSO1, PSO4, PSO5	K1, K2, K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

PROGRAMME: M.Sc. CHEMISTRY	**BATCH:** 2024
PART:	**COURSE COMPONENT:** CORE ELECTIVE -III
COURSE NAME : Electroanalytical Chemistry Practical	**COURSE CODE:**
SEMESTER: III & IV	**MARKS:** 100
CREDITS: 3	**TOTAL HOURS:** 60
PRACTICAL	

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COURSE OBJECTIVE:

To help the students to understand and apply the concepts of electroanalytical chemistry.

COURSE OUTCOMES:

On completion of the course the students will be able to

1. Explain the principle of conductivity, potentiometry and colorimetry experiments.
2. Determine equivalent conductance of strong electrolytes and dissociation constant of weak acid by conductometric method.
3. Determine the strength of unknown solutions by potentiometric and conductometric methods.
4. Determine pH and K_a for weak acid by potentiometric method.
5. Determine the strength of unknown solutions by colorimetry.

UNIT–I: Conductometric Experiments

1. Determination of equivalent conductance of strong electrolytes and verification of Debye-Huckel-Onsager equation.
2. Determination of dissociation constant of weak electrolyte using Ostwald's dilution law.
3. Conductometric titration between simple and mixture of strong and weak acids and base and precipitation titration involving a single halide.

UNIT–II: Potentiometric Experiments

4. Determination of pH and calculation of pKa.
5. Determination of solubility product of sparingly soluble salt.
6. Potentiometric titrations between simple and mixture of strong and weak acids and base.
7. Redox Titrations by EMF measurements
8. Precipitation titration of mixture of halides by EMF measurements.

UNIT–III: Colorimetric Experiments

9. Photoelectric method: Estimation of iron, nickel, manganese and copper.
10. *Determination of Cr^{2+} and Mn^{2+} ions present in water sample by Colorimetry.(*For CIA only)

REFERENCE BOOKS:

1. B.Viswanathan and P.S.Raghavan, Practical Physical Chemistry, Viva books, 2012.
2. B.D.Khosla, V.C.Garg and A.Khosla, Senior Practical Physical chemistry, S.Chand and Co., New Delhi, 2011.
3. P.S.Sindu, Practical Physical Chemistry-A modern Approach, MacMillan India Ltd, 1st Edition, 2006.
4. C.W.Garland, J.W.Nibler and D.P.Shoemaker, Experiments in Physical Chemistry, Tata McGraw-Hill, NewYork, 8th Edition, 2003.
5. A.M.Halpern,G.C.McBane,Experiments in Physical Chemistry,W.H.Freeman and Co, New York, 3rd Edition, 2003.

PSO – CO mapping

	PSO 1	PSO2	PSO3	PSO 4	PSO 5
CO 1	3	3	3	3	3
CO 2	3	3	3	3	3
CO 3	3	3	3	3	3
CO 4	3	2	3	2	3
CO 5	3	2	3	3	3
Ave	3	2.6	3	2.8	3

PROGRAMME: M.Sc. CHEMISTRY	**BATCH:** 2024 - 26
PART:	**COURSE COMPONENT:** CORE ELECTIVE- IV
COURSE NAME: Analytical Chemistry Practical	**COURSE CODE:**
SEMESTER: III & IV	**MARKS:**100
CREDITS: 3	**TOTAL HOURS:** 60
PRACTICAL	

COURSE OBJECTIVE

To impart the quantitative estimation of organic compounds, mixture of inorganic metal ions and spectral interpretations of organic compound and inorganic complexes.

COURSE OUTCOMES:

On completion of the course the students will be able to

1. Analyze the complex chemical matrices with appropriate method.
2. Carryout the quantitative estimation of organic and inorganic compounds.
3. Interpret all spectral analytical data for molecular identification.
4. Involve in the root cause analysis and find out the errors.
5. Develop new analytical methods for complex matrices.

Unit-I: Estimations (Any Four)

1. Estimation of aniline
2. Estimation of phenol
3. Estimation of glucose (Bertrand's Method)
4. Saponification of fat or oil.
5. Iodine value of an oil.

Unit-II: Spectral Interpretation of Organic Compounds –UV, IR, PNMR and Mass Spectra

1. 1,3,5-Trimethylbenzene
2. Pinacolone
3. Benzylbromide
4. Phenylacetone
5. Isopropylalcohol
6. 2-N,N-Dimethylamino ethanol
7. 4-Picoline

8. Cinnamaldehyde

Unit-III: Spectral Interpretation of Inorganic Compounds

1. ^{31}P NMR Spectra of methylphosphate
2. ^{31}P NMR Spectra of HPF_2
3. ^{19}F NMR Spectra of CIF_3
4. ^{1}H NMR Spectra of Tris (ethylthioacetoacetanato) cobalt (III)
5. Expanded high resolution NMR spectra of (N-propyl isonitroso acetylacetoneiminato) (acetylacetoneiminato)Nickel(II)
6. ESR Spectra of the aqueous $ON(SO_3)_2^{2-}$ion.
7. ESR Spectra of the H atoms in CaF_2
8. ESR Spectra of the $[Mn(H_2O)_6]^{2+}$ion
9. ESR Spectra of the bis(salicyladiminato) copper (II)
10. IR Spectra of the sulphato ligand
11. IR Spectra of the nitro and nitrito pentaminecobalt (III)chloride
12. IR Spectra of the dimethylglyoxime ligand and its Nickel (II)complex.
13. IR Spectra of carbonyls
14. Mossbauer spectra of $FeSO_4.7H_2O$
15. Mossbauer spectra of $FeCl_3$
16. Mossbauer spectra $[Fe(CN)_6]^{3-}$
17. Mossbauer spectra $[Fe(CN)_6]^{4-}$

Unit- IV: Quantitative Analysis of Complex Materials

To impart the techniques of analysis of alloys; preparation and analysis in Organic complexes.

(a) Analysis of Alloys

1. Analysis of copper and nickel from copper-nickel alloy.
2. Estimation of copper and zinc in brass.
3. Estimation of iron and nickel in stainless steel.
4. Estimation of iron and magnesium from the mixture.

(b) Analysis of Inorganic Complex Compounds:
(for internal assessment only)

1. Preparation of cis and trans potassiumbis (oxalato) diaquochromate and analysis of each of these for chromium.

2. Preparation of potassiumtris(oxalato) aluminate (III) and analysis for iron and oxalate.

REFERENCE BOOKS:

1. J. Mendham, R.C.Denney, J. Basset and G.H.Jeffery, Vogel's Textbook of quantitative Inorganic Analysis, 4th Edition ELBS, Longmann,1978.
2. A.I.Vogel, Text Book of Practical Organic Chemistry, ELBS, London, 5th Edition, l989.

PSO-CO mapping

	PSO 1	**PSO2**	**PSO3**	**PSO 4**	**PSO 5**
CO 1	3	3	3	3	3
CO 2	3	3	3	2	3
CO 3	3	3	3	3	3
CO 4	3	3	3	3	3
CO 5	3	3	3	3	3
Ave	3	3	3	2.8	3

PROGRAMME: M.Sc. CHEMISTRY	**BATCH:** 2024 - 26
PART:	**COURSE COMPONENT:** ELECTIVE (EDE-1)
COURSE NAME: Nutrition and Dietetics	**COURSE CODE:**
SEMESTER: II	**MARKS:**100
CREDITS: 3	**TOTAL HOURS:** 45
THEORY	

COURSE OBJECTIVE:

To introduce the students to the principle of human nutrition, to understand the relationship between Nutrition and human wellbeing and to understand the modifications in nutrients and dietary requirements for various diseases.

COURSE OUTCOMES:

On completion of the course the students will be able to

1. Acquire knowledge about importance of nutrition and diseases caused by malnutrition.
2. Get an awareness on role of vitamins in diet.
3. Gain knowledge on types of diets for various diseases.
4. Get an awareness on role of water in diet.
5. Gain knowledge on types of diets for various diseases.

Unit-I: **Nutrition** **(9 hours)**

Food pyramid –Development of Nutrition as a Science-Definition of Nutrition. Under nutrition, over nutrition and malnutrition. protein energy malnutrition -kwashiorkor, Marasmus and Mrasmic Kwashiorkor. Assimilation of food-digestion, absorption, transport, utilization of nutrients in the body

Unit-II: Vitamins **(9 hours)**

Fat soluble vitamins – vitamin A, D, E and K – function effects of deficiency, sources, requirements, units of measurement and hyper vitaminosis. Function, effects of deficiency. Water soluble vitamins- sources and requirements, ascorbic acid, thiamine, riboflavin and Niacin. Importance of folic acid, Vitamin B12 pyridoxine, Biotin and Pantothanic acid to the body.

Unit-III: Minerals **(9 hours)**

Distribution in the body, functions, food sources, requirements and effects of deficiency of calcium, phosphorous, Iron and iodine. Trace elements in human nutrition - copper, iron, zinc-functions, food sources, requirements and effects of deficiency. Selenium and vitamin E relationship. Chromium and glucose tolerance factor.

Unit-IV: Water **(9 hours)**

Distribution of water in the body, water intake and loss, exchange of water in the body, composition of body fluids.

Unit-V: Dietetics **(9 hours)**

Role of Dietician, Basic concepts in Diet Therapy, Routine Hospital Diets. Regular diet, light diet, soft diet, full liquid diet and tube feeding. Modifications of Diet – Febrile conditions, infections and surgical conditions. Diets of gastro intestinal disorders, renal diseases, liver diseases, obesity, cardiovascular disorders and diabetes mellitus. Geriatrics-Role of diet.

PRESCRIBED BOOKS:

1. S. R. Mudambi, M. V. Rajagopal, Fundamentals of Foods, Nutrition and Diet Therapy, New age international publishers, 5th Edition, 2007
2. Harbans Lal, Food and Nutrition, CBS Publishers & Distributors, 1st edition, 2021.
3. Antia, F.P. "Clinical Dietetics and Nutrition", 2nd Ed, Oxford University Press, Delhi, reprinted in 2009.

REFERENCE BOOKS:

1. Dr. Susan A. Lanham, Thomas R. Hill, Alison M. Gallagher, Hester H. Vorster, Introduction to Human Nutrition by, Wiley-Blackwell, 3rd Edition, 2019,
2. Martin Eastwood, Principles of Human Nutrition, Wiley-Blackwell, 2nd Edition, 2003.
3. H.-D. Belitz, Werner Grosch, Food Chemistry Springer Science & Business Media, 4thedition, 2009.

E-LEARNING RESOURCES:

1. http://nptel.ac.in
2. mooc.org
3. http://www.ch.ic.ac.uk/achemlab/symmetry/

GUIDELINES TO THE QUESTION PAPER SETTERS
QUESTION PAPER PATTERN

Section	Question Component	Numbers	Marks	Total
Section- A	MCQ:1-10 , Fill in : 11 -15 T/F:16-20 Answer all questions	1 – 20	1	20
Section-B	Short Answer /Problems Answer any 5 out of 8 questions	21–28	7	35
Section- C	Essay Answer any 3 out 5 questions	29– 33	15	45
TOTAL MARKS				**100**

BREAK UP OF QUESTIONS

Unit	Section A	Section B	Section C
I	4	2	1
II	4	1	1
III	4	2	1
IV	4	2	1
V	4	1	1
Total	**20**	**8**	**5**

PSO – CO mapping

	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	3	1	3	2	3
CO 2	3	1	3	2	3
CO 3	3	1	3	2	3
CO 4	3	1	3	2	3
CO 5	3	1	3	2	3
Ave.	3	1	3	2	3

PSO-CO-question paper mapping

CO No.	COURSE OUTCOME	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Acquire knowledge about importance of nutrition and diseases caused by malnutrition	PSO 1 PSO 3	K1 to K3
CO2	Get an awareness on role of vitamins in diet	PSO 1, PSO 3, PSO 4,	K1 to K3
CO3	Gain knowledge on types of diets for various diseases.	PSO 1, PSO 3, PSO 4,	K1 to K4
CO4	Get an awareness on role of water in diet.	PSO 1, PSO 2, PSO 3, PSO 4, PSO 5	K1 to K3
CO5	Gain knowledge on types of diets for various diseases	PSO 1, PSO 2, PSO 3, PSO 4, PSO 5	K1 to K4

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

PROGRAMME: M.Sc. CHEMISTRY	**BATCH:** 2024 - 26
PART:	**COURSE COMPONENT:** ELECTIVE (EDE-2)
COURSE NAME: Applied Chemistry	**COURSE CODE:**
SEMESTER: II/III	**MARKS:**100
CREDITS: 3	**TOTAL HOURS:** 45
THEORY	

COURSE OBJECTIVE:

To gain knowledge on chemical industries, food science, polymers, pharmaceuticals and nanomaterials.

COURSE OUTCOME:

On completion of the course the students will be able to

1. Gain knowledge on fuels, fertilizers and water technology.
2. Detect adulterants in food and get awareness about artificial sugar and beverages.
3. Differentiate various polymer materials.
4. Acquire knowledge on various diseases and drugs.
5. Understand the concepts of nanomaterials.

UNIT I: Chemical industries (9 hours)

Fuels: Fuels - types of fuels with examples - liquid fuels - gaseous fuels –nuclear fuels. Energy-sources of energy – renewable and non-renewable energies-non-conventional energies. Fertilizers: Definition, requirement of a fertilizer,

Classification of fertilizers; Urea, ammonium sulphate, NPK fertilizer, superphosphate, triple superphosphate (uses only).

Water Technology: Sources of water, soft and hard water, methods of removal of hardness, Purification techniques - zeolite method, reverse osmosis and ion exchange.

UNIT II: Food science (9 hours)

Food and Nutrition - Sources of food, types; Carbohydrates, Proteins, Fats, Minerals and vitamins (sources and their physiological importance) – Balanced diet

-Food adulteration-contamination of Wheat, Rice, Milk, Butter, Ghee etc., with clay stones, water and toxic chemicals – Detection of adulterated foods by simple analytical techniques. Artificial sugar viz., saccharin, Aspartame and cyclamate. Beverages – soft drinks – soda -fruit juices – alcoholic beverages examples.

UNIT III: Polymer science **(9 hours)**

Classification of polymers-biopolymers and biodegradable polymers. Plastics, polythene, PVC, Bakelite, polyesters, melamine - formaldehyde resins -Freon, Teflon-(uses only). Building materials - cement, ceramics, glass and refractories - definition, composition and application only.

UNIT IV: Pharmaceutical products **(9 hours)**

Definition and Uses of each: Anaesthetics – General and local (Chloroform, diethylether); Analgesics – Narcotic and synthetic; Antipyretics (aspirin, paracetamol and ibuprofen) and anti-inflammatory agents (diclofenac, celecoxib). Antibiotics: penicillin, streptomycin and chloramphenicol. (Structures not required) Cancer and Diabetes– Causes and treatment**.**

UNIT V: Nanomaterials. **(9 hours)**

Definitions - Nano, nanoscience, and nano technology. Nano in nature –difference between bulk and nanomaterials-challenges in nanotechnology. Applications of Nanotechnology - Nanomedicine: diagnosis, biocompatible nanomedical materials. Industrial applications of nanomaterials: nano coatings and nanotextiles as antibacterial and anti - odour agents in deodorant/antiperspirant, shaving/depilatory products, foot powder, oral care.

PRESCRIBED BOOKS:

1. M. Swaminathan, Food Science and Experimental Foods, Ganesh and Company,1979.
2. Jayashree Ghosh, Fundamental Concepts of Applicated Chemistry, S. Chand & Co. Publishers,2nd Edition, 2006.
3. S. Lakshmi, Pharmaceutical Chemistry, S.Chand & Sons, New Delhi, 3rd Edition,1995.
4. V. R. Gowariker, N. V. Viswanathan and Jayader Sreedhar, Polymer Science,Wiley
5. Eastern Ltd., New Delhi, 2012
6. V. Veeraiyan, Text book of Ancillary Chemistry, Highmount publishing house, Chennai, 1st Edition, 2009.
7. S.Vaithyanathan, Text book of Ancillary Chemistry; Priya Publications, Karur, 2006

REFERENCE BOOKS:

1. M. Swaminathan, Food Science and Experimental Foods, Ganesh and Company,1979.
2. Jayashree Ghosh, Fundamental Concepts of Applicated Chemistry, S. Chand & Co. Publishers,2nd Edition, 2006.
3. S. Lakshmi, Pharmaceutical Chemistry, S.Chand & Sons, New Delhi, 3rd Edition,1995.

4. V. R. Gowariker, N. V. Viswanathan and Jayader Sreedhar, Polymer Science,Wiley Eastern Ltd., New Delhi, 2012
5. V. Veeraiyan, Text book of Ancillary Chemistry, Highmount publishing house, Chennai, 1st Edition, 2009.
6. S.Vaithyanathan, Text book of Ancillary Chemistry; Priya Publications, Karur, 2006.

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

Section	Question Component	Numbers	Marks	Total
Section- A	MCQ:1-10, Fill in: 11 -15 T/F:16-20 Answer all questions	1 – 20	1	20
Section-B	Short Answer /Problems Answer any 5 out of 8 questions	21–28	7	35
Section- C	Essay Answer any 3 out 5 questions	29– 33	15	45
TOTAL MARKS				**100**

BREAK UP OF QUESTIONS

Unit	Section A	Section B	Section C
I	4	2	1
II	4	2	1
III	4	1	1
IV	4	2	1
V	4	1	1
Total	**20**	**8**	**5**

PSO – CO mapping

	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	3	1	3	2	3
CO 2	3	1	3	2	3
CO 3	3	1	3	2	3
CO 4	3	1	3	2	3
CO 5	3	1	3	2	3
Ave.	3	1	3	2	3

PSO-CO-question paper mapping

CO No.	COURSE OUTCOME	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Gain knowledge on fuels, fertilizers and water technology.	PSO 1,PSO 2 PSO 3	K1 to K3
CO2	Detect adulterants in food and get awareness about artificial sugar and beverages.	PSO 1, PSO 3, PSO 4,	K1 to K3
CO3	Differentiate various polymer materials.	PSO 1, PSO 3, PSO 4,	K1 to K4
CO4	Acquire knowledge on various diseases and drugs.	PSO 1, PSO 2, PSO 3, PSO 4, PSO 5	K1 to K3
CO5	Understand the concepts of nanomaterials.	PSO 1, PSO 2, PSO 3, PSO 4, PSO 5	K1 to K4

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

PROGRAMME: M.Sc. CHEMISTRY	**BATCH:** 2024 - 26
PART:	**COURSE COMPONENT:** ELECTIVE (EDE-3)
COURSE NAME: Environmental Chemistry	**COURSE CODE:**
SEMESTER: II/III	**MARKS:** 100
CREDITS: 3	**TOTAL HOURS:** 45
THEORY	

COURSE OBJECTIVE:

To gain knowledge about types of environmental pollution and waste management and also on disaster management and green chemistry

COURSE OUTCOME:

On completion of the course the students will be able to

1. Identify various pollutions and its hazards.
2. Demonstrate the types of waste and their management.
3. Understand the facts of toxicology and global warming.
4. Apply the green chemical concepts in existing chemical reactions.
5. Create an awareness on disaster management and emergency preparedness.

UNIT–1: Environmental Pollution **(9 hours)**

Air Pollution - sources – oxides of nitrogen, sulphur, ozone, hydrocarbons and particulate matter - effects and control measures - Air quality and emission standards. Water Pollution sources – organic, inorganic and heavy metals – Effects- Eutrophication – Transport of pollutants in the aquatic ecosystem - control measures of Ocean, Oil and Ground water pollution - Soil Pollution sources - Industrial, Domestic, Agricultural - Effects of soil pollutants on plants, animals and ground water - Radioactive pollution – sources- radioactive elements, Effects of radiation on surrounding environment and control measures.

UNIT–2: Waste Management **(9 hours)**

Wastes – sources - Global scenario of wastes - Waste collection, Storage and segregation - Transportation and disposal methods of hazardous waste. Control measures and Impacts of biomedical and e-wastes in environment. Plastic wastes: Sources, Facts & figures of plastic waste scenarios in National & International - Effect of plastic wastes on environment. Different steps in the treatment of industrial waste- equalization, neutralization, sedimentation, oil separation,

floatation, coagulation.

UNIT- 3: Environmental Toxicology and Current Issue (9 hours)

Environmental Toxicology and Pharmacokinetics -Toxic effects and dose response relationship - a brief idea of carcinogens and non-carcinogens, Biotransformation, Biomarker, Xenobiotics, Toxicity due to Hydrocarbons and pesticides. Global warming -Greenhouse effect, Ozone layer depletion and climate change–Facts and figures of current global warming scenarios in the world –Remedial measures.

UNIT-4: Energy and Green Technologies (9 hours)

Energy– renewable, non-renewable energy sources, Geothermal, wind, Tidal, solar, nuclear and bio energy –Waste as renewable sources of energy- conversion of methane in to synthetic gas, factors effecting methane formation-Green Chemistry-Principles of green chemistry – inception and evolution - Importance of solvents - catalysts and their role - biological alternatives –Green Technologies in pharmaceutical, polymer, textile agrochemical industry.

UNIT- 5: Environmental Quality and Disaster Management (9 hours)

Basic concepts of sustainable development - Guidelines for the preparation of environmental impact statement - Environmental quality standards International organization for standardization - ISO 14000, 19000 and 22000 standards and certification, Environmental safety – Risk management and emergency preparedness -Earthquakes, Tsunami, Landslides, Cyclones, Floods, and Forest fires predictions, Forecasting and mitigation measures of environmental hazards.

PRESCRIBED BOOKS:

1. B.K. Sharma, Environmental Chemistry, Goel Publishing House,12th Edition, 2011.
2. Asim K.Das, Environmental Chemistry with Green Chemistry, Books and Allied (P) Ltd, Arun, 1st Edition, 2010.
3. P.S. Sindhu, Environmental Chemistry, New Age International publishers,2nd Edition, 2010.

REFERENC BOOKS:

1. Bhide and Sundaresan, Solid Waste Management in Developing Countries Indian National Scientific Documentation Center, New Delhi, 2000.
2. George Tehobanaglous- Milary Theiren and Samuel, Avigil Integrated Solid Waste Management, McGraw Hill Inc, 1993.
3. John Pitchel, Waste Management Practices, Municipal, Hazardous,and

Industrial, Taylor & Francis Group, LLC, 2005.
4. Thomous S. Spiro and William M. Stiglicini, Chemistry of the Environment, Prentice Hall of India Pvt. Ltd., 2002.
5. Bregman JI Environmental Impact Statements, Lewis Publishers, London,1999.
6. Canter LW , Environmental Impact Assessment, McGraw Hill, NewYork, 1996.
7. Khanal SK, Surampalli RY, ZhangTC, Lamsal BP,Tyagi RD, Kao CM, Bioenergy and Biofuel from Biowastes and Biomass, American Society of Civil Engineers, Virginia,USA, 2010.
8. Lee S and Shah YT, Biofuels and Bioenergy: Processes and Technologies, CRC Press, BocaRaton, FL, USA, 2013.

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

Section	Question Component	Numbers	Marks	Total
Section- A	MCQ:1-10, Fill in: 11 -15 T/F:16-20 Answer all questions	1 – 20	1	20
Section-B	Short Answer /Problems Answer any 5 out of 8 questions	21–28	7	35
Section- C	Essay Answer any 3 out 5 questions	29– 33	15	45
TOTAL MARKS				**100**

BREAK UP OF QUESTIONS

Unit	Section A	Section B	Section C
I	4	2	1
II	4	2	1
III	4	1	1
IV	4	2	1
V	4	1	1
Total	**20**	**8**	**5**

PSO – CO mapping

	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	3	1	3	2	3
CO 2	3	1	3	2	3
CO 3	3	1	3	2	3
CO 4	3	1	3	2	3
CO 5	3	1	3	2	3
Ave.	3	1	3	2	3

PSO-CO-question paper mapping

CO No.	**COURSE OUTCOME**	**PSOs ADDRESSED**	**COGNITIVE LEVEL (K1 to K6)**
CO1	Gain knowledge on fuels, fertilizers and water technology.	PSO 1, PSO 2 PSO 3	K1 to K3
CO2	Detect adulterants in food and get awareness about artificial sugar and beverages.	PSO 1, PSO 3, PSO 4,	K1 to K3
CO3	Differentiate various polymer materials.	PSO 1, PSO 3, PSO 4,	K1 to K4
CO4	Acquire knowledge on various diseases and drugs.	PSO 1, PSO 2, PSO 3, PSO 4, PSO 5	K1 to K3
CO5	Understand the concepts of nanomaterials.	PSO 1, PSO 2, PSO 3, PSO 4, PSO 5	K1 to K4

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

PROGRAMME: M.Sc. CHEMISTRY	**BATCH:** 2024 - 26
PART:	**COURSE COMPONENT:** ELECTIVE (EDE-4)
COURSE NAME: Forensic Science	**COURSE CODE:**
SEMESTER: II/III	**MARKS:**100
CREDITS: 3	**TOTAL HOURS:** 45
THEORY	

COURSE OBJECTIVE:

To gain knowledge about types of poisons, explosives, forgery, tracking and fire investigation.

COURSE OUTCOME:

On completion of the course the students will be able to

1. Study of poisons, mode of action, detection and estimation of poisons, Basics of pesticides and insecticides.
2. Acquiring knowledge about classification and characteristics of explosives, chemical synthesis of explosives like TNT, RDX, post blast residue collection and analysis.
3. Investigation of crimes, forged signatures, checking original currency notes, detection of gold purity
4. Investigation of tracks and traces, DNA finger printing for tissue identification, detecting steroid consumption in athletes and race Horses.
5. Study of chemistry of fire, types, fire scene patterns, collection of arson evidence, investigation of clue materials.

UNIT-1: Poisons and Pesticides (9 hours)

Definition of poisons, types of poisons – metal, synthetic chemical, biochemical, gaseous poisons. Mode of ingestion–oral, inhalation, intravenous. Action and impact on human health. Detection of poisons - carbon monoxide, cyanide, ethanol and formaldehyde. Metallic poison–Reinch test –Marsch Berzelius and Gutzeit tests.

UNIT-2: Explosives (9 hours)

Classification of explosives–low explosives and high explosives, homemade explosives, military explosives. Common explosives-TNT, PETN and RDX. Explosion process, post blast residue collection and analysis.

UNIT-3: Forgery and Counterfeiting (9 hours)

Forgery in documents, different types of forged signatures - simulated and traced forgeries, detection of forgery - uses of ultraviolet rays, comparison of type written letters, checking silver line watermark in currency notes, alloy analysis using AAS to detect counterfeit coins - detection of gold purity in 22 carat ornaments – detecting gold plated jewels-authenticity of diamond

UNIT-4: Tracks and Traces (9 hours)

Foot prints - costing of foot prints - residue prints, walking pattern or tyre marks – miscellaneous traces and tracks, glass fracture, tool marks, paints, fibers. Analysis of biological substances - blood, semen, saliva, urine and hair - Cranial analysis (head and teeth) DNA Finger printing for tissue identification in dismembered bodies –detecting steroid consumption in athletes and race horses.

UNIT-5: Arson and fire investigation (9 hours)

Chemistry of fire, conditions for fire and fire scene patterns. Location of point of ignition. Recognition of type of fire. Searching the fire scene.Collection and preservation of arson evidence. Analysis of fire debris. Analysis of ignitable liquid residue. Scientific investigation and evaluation of clue materials. Information from smoke staining.

REFERENCE BOOKS:

1. T.H.James, Forensic Sciences, Stanley Thornes Ltd,1987.
2. Sopfestein, Richard Saferstin and Criminalistics-An Introduction to Forensic Science (College Version), Printice Hall, 8th Edition, 2003.
3. Almirall JR and Furton K G, Fire scene evidence, CRC Press, 2004.
4. Redsicker DR and Cannor JJ , Practical:Fire and arson investigation,Routledge, 2nd Edition,1996.

GUIDELINES TO THE QUESTION PAPER SETTERS
QUESTION PAPER PATTERN

Section	Question Component	Numbers	Marks	Total
Section- A	MCQ:1-10 , Fill in : 11 -15 T/F:16-20 Answer all questions	1 – 20	1	20
Section-B	Short Answer /Problems Answer any 5 out of 8 questions	21–28	7	35
Section- C	Essay Answer any 3 out 5 questions	29– 33	15	45
TOTAL MARKS				**100**

BREAK UP OF QUESTIONS

Unit	Section A	Section B	Section C
I	4	2	1
II	4	2	1
III	4	1	1
IV	4	2	1
V	4	1	1
Total	20	**8**	5

PSO – CO mapping

	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	3	1	3	2	3
CO 2	3	1	3	2	3
CO 3	3	1	3	2	3
CO 4	3	1	3	2	3
CO 5	3	1	3	2	3
Ave.	3	1	3	2	3

PSO-CO-question paper mapping

CO No.	COURSE OUTCOME	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Study of poisons, mode of action, detection and estimation of poisons, Basics of pesticides and insecticides	PSO 1, PSO 2 PSO 3	K1 to K3
CO2	Acquiring knowledge about classification and characteristics of explosives, chemical synthesis of explosives like TNT, RDX, post blast residue collection and analysis.	PSO 1, PSO 3,	K1 to K4
CO3	Investigation of crimes, forged signatures, checking original currency notes, detection of gold purity.	PSO 1, PSO 3, PSO 4,	K1 to K4
CO4	Investigation of tracks and traces, DNA finger printing for tissue identification, detecting steroid consumption in athletes and race horses.	PSO 1, PSO 2, PSO 3, PSO 4, PSO 5	K1 to K3
CO5	Study of chemistry of fire, types, fire scene patterns, collection of arson evidence, investigation of clue materials.	PSO 1, PSO 2, PSO 3, PSO 4, PSO 5	K1 to K4

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

SOFT SKILL COURSES

PROGRAMME: M.Sc. CHEMISTRY	**BATCH**: 2024 - 26
PART: -	**COURSE COMPONENT:** SOFT SKILL - I
COURSE NAME: Communication and Presentation Skills	**COURSE CODE:**
SEMESTER: I	**MARKS:**100
CREDITS: 2	**TOTAL HOURS:** 30
THEORY	

COURSE OBJECTIVE:

To build communication skills for personal and professional development.

COURSE OUTCOMES:

1. Students will demonstrate the ability to listen to others actively, understand diverse perspectives, and paraphrase key points accurately, enhancing their comprehension skills in various personal and professional contexts.
2. Students will be able to articulate thoughts, ideas, and information clearly and concisely, using appropriate language and structure to convey messages effectively in both written and verbal communication.
3. Students will develop confidence in expressing opinions, asserting boundaries, and advocating for themselves and others, enhancing self-assurance and effectiveness in interpersonal and group communication.
4. Students will learn to adapt their communication style and approach based on the audience, context, and purpose of communication, fostering flexibility and versatility in interacting with diverse individuals and groups.
5. Students will acquire techniques for resolving conflicts, managing disagreements, and negotiating mutually beneficial outcomes through effective communication strategies, promoting constructive problem-solving and collaboration in personal and professional settings.

UNIT I: Essentials of Effective Communication (6 Hours)

Communication Skills-LSRW- Characteristic features of LSRW-Consequences of Ineffective Communication-Impact of technology on Communication

UNIT II: Types of Communication (6 Hours)

Verbal Communication – Non-verbal Communication- Visual Communication - Written Communication-Group Communication-Digital Communication-Formal and Informal Communication-Vertical-Horizontal-Diagonal Grapevine

UNIT III: Barriers in Communication (6 Hours)

Physical Barriers - Language Barriers - Social and Cultural Barriers - Psychological Barriers - Semantic Barriers - Interpersonal Barriers - Technological Barriers- Means to overcome the various barriers to Communication.

UNIT IV: Etiquettes and Ethical Practices in Communication (6 Hours)

Active Listening - Clarity and Conciseness - Professional Tone - Timeliness - Constructive Feedback-Transparency-Professionalism-Accountability-Confidentiality-Cultural Sensitivity-Emotional Intelligence-Empathy-Social Intelligence-Social Etiquettes- Appreciation and Gratitude

UNIT V: Presentation Skills (6 Hours)

Types of Presentation- Preparing a presentation-Do's and Don'ts while giving a presentation-Managing tools for presentation-Using Prompts-Making effective uses of Audio/Visual aids during presentation-Dealing with Questions, Interruptions and Pauses- Practical: Participating in Mock presentations

PRESCRIBED BOOKS:

1. Monippally, Matthukutty, M. Business Communication Strategies. New Delhi: Tata McGraw-Hill Publishing Company Ltd., 2001.
2. Peter, Francis. (2012) Soft Skills and Professional Communication. New Delhi: Tata McGraw Hill.
3. Raman, Meenakshi & Prakash Singh (2012) Business Communication Oxford University Press

REFERENCE BOOKS:

1. Gallo, Maria. D (2018) Stop Lecturing Start Communicating: The Public Speaking Survival Guide for Business Kindle Edition
2. Hasson, Gill. (2012) Brilliant Communication Skills. Great Britain: Pearson Education.
3. Patil, Shailesh (2020) Handbook on Public Speaking, Presentation & Communication Skills: Principles & Practices to create high impact presentations & meaningful conversations, Chennai, Notion Press Media Pvt Ltd.

E-LEARNING RESOURCES:

1. https://uwaterloo.ca/centre-for-teaching-excellence/catalogs/tip-sheets/effective-communication-barriers-and-strategies
2. https://www.coursera.org/articles/presentation-skills
3. https://positivepsychology.com/how-to-improve-communication-skills/

PROGRAMME: M.Sc. CHEMISTRY	**BATCH:** 2024 - 26
PART: --	**COURSE COMPONENT:** SOFT SKILLS - II
COURSE NAME: Personality Enrichment	**COURSE CODE:**
SEMESTER: II	**MARKS:**100
CREDITS: 2	**TOTAL HOURS:** 30
THEORY	

COURSE OBJECTIVE:

To enable students to acquire and exhibit leadership qualities and work effectively by applying conflict resolution strategies and collaborative problem-solving.

COURSE OUTCOMES:

1. Students will demonstrate an understanding of various personality theories and assessments, leading to increased self-awareness.
2. Students will acquire effective verbal and non-verbal communication skills, including active listening and providing constructive feedback.
3. Students will exhibit leadership qualities, understand diverse leadership styles, and effectively work within teams by applying conflict-resolution strategies and collaborative problem-solving
4. Students will develop resilience, coping mechanisms, and stress reduction techniques to successfully navigate personal and academic challenges.
5. Students will demonstrate cultural intelligence, cross-cultural communication skills, and an understanding of global issues, fostering a sense of global citizenship.

UNIT I

Self-Actualization (6 Hours)

SWOC Analysis- Self Regulation-Self Evaluation, Self-Monitoring, Self- Criticism, Self- Motivation, Self-awareness and Reflection: Reflective practices- Journaling and self-assessment exercises.

UNIT II

Interpersonal Skills (6 Hours)

Effective Communication: Verbal and non-verbal communication - Active listening skills- Feedback and constructive criticism- Building Empathy and Emotional Intelligence: Negotiation Skills

UNIT III

Leadership and Teamwork (6 Hours)

Leadership Skills: Leadership styles- Goal-setting and decision-making- Motivation and influence- Team Dynamics: Team building activities- Conflict resolution- Collaborative problem-solving

UNIT IV

Stress and Time Management (6 Hours)

Definition of Stress, Types of Stress, Symptoms of Stress, Stress coping ability, Stress Inoculation Training, Time Management and Work-Life Balance: Self-discipline Goal-setting

UNIT V

Cultural Competence and Global Awareness (6 Hours)

Cultural Intelligence: Understandi1. ng diversity- Cross-cultural communication- Global citizenship and social responsibility- Ethics and Integrity: Personal and professional ethics- Decision-making in ethical dilemmas

PRESCRIBED BOOKS:

1. Goleman, Daniel (2006) *Emotional Intelligence*, Bantam Books.
2. Linden, Wolfgang (2004) *Stress Management From Basic Science to Better Practice*- University of British Columbia, Vancouver, Canada.
3. Richard L. Hughes; Katherine Colarelli Beatty; David L. Dinwoodie (2022) Becoming a Strategic Leader, Wiley (2012) Leading with Cultural Intelligence Saylor Foundation.

REFERENCE BOOKS:

1. Meyer, Erin (2014) The Culture Map: Breaking Through the Invisible Boundaries of Global Business, Public Affairs.
2. Pittino, Daniel (2022) The Concise Leadership Textbook: Essential Knowledge and Skills for Developing Yourself as a Leader
3. Radtke, Laura (2022) Principles of Leadership & Management, Fanshawe College, Ontario.
4. Wentz, Fredrick H. (2012) *Soft skills Training –A workbook to develop skills for employment,* Create Space Independent Publishing Platform.

E-LEARNING RESOURCES:

1. https://www.helpguide.org/articles/stress/stress-management.htm
2. https://www.skillsyouneed.com/
3. https://greatergood.berkeley.edu/quizzes/take_quiz/stress_and_anxiety
4. https://www.switchboard.app/learn/article/teamwork-leadership-skills
5. https://kpu.pressbooks.pub/interculturalizingcurriculum/chapter/chapter-1/

PROGRAMME: M.Sc. CHEMISTRY	**BATCH**: 2024 - 26
PART:	**COURSE COMPONENT:** SOFT SKILLS - III
COURSE NAME: Employability Skills	**COURSE CODE:**
SEMESTER: III	**MARKS:**100
CREDITS: 2	**TOTAL HOURS:** 30
THEORY	

COURSE OBJECTIVE:

To cultivate a comprehensive set of Employability Skills, encompassing both Technical Expertise and Soft Skills essential for Professional Success.

COURSE OUTCOMES:

1. Students will understand the overall advancement and development in the Global Job Market by envisaging its impact on prospective employees
2. Students will acquire the much-needed skill sets to prepare themselves to be competent and confident
3. Students will obtain global perspectives on diverse work cultures to handle different environments by not losing their individuality.
4. Students will focus on being mentally and physically fit in accomplishing their goals in their preferred workplaces.
5. Students will understand the proper drafting format of a Resume/CV and the different online portals available for job seekers.

UNIT I -Introduction to Global Perspectives in Employment (6 Hours)

Globalization- Market Expansion- Diversity and Inclusion- Competitive Advantage- Cultural Sensitivity- Adaptability- Innovation and Creativity- Risk Management- Career Advancement

UNIT II - Key Employability Skills in a Global Context (6 Hours)

Cross-cultural Communication- Language Proficiency- Flexibility- Global Awareness- Interpersonal Skills, Problem-solving and Critical Thinking- Teamwork- Global Business Acumen- Digital Literacy- Resilience and Persistence

UNIT III -Understanding Diverse Work Environments (6 Hours)

Diversity- Inclusive Practices- Communication Styles- Team Dynamics- Conflict Resolution- Cultural Sensitivity- Work Practices- Job Hopping- Moon Lighting- Training and Development- Leadership Commitment- Continuous Learning

UNIT IV -Employers' Expectations from Employees (6 Hours)

Job Competence- Required Skill Sets- Reliability and Accountability- Initiative and Proactivity- Adaptability and Flexibility- Teamwork and Collaboration- Professionalism and Ethical Conduct, Customer Focus, Progressive Learning and Development- Adherence to Policies and Procedures,

Contribution to Organizational Culture

UNIT V -Navigating International Job Markets (6 Hours)

Network Globally- Advertisements- Overseas Appointments- knowledge of International Labour Laws- Do's and Don'ts of Migrant Workers- Skilled Labour- Utilize Online Job Portals- Customize your Resume/CV- Preparedness for Remote Interviews and Assignments- Awareness: Health, Insurance, Foreign Exchange

PRESCRIBED BOOKS:

1. Covey, Stephen (2004) *Seven Habits of Highly Effective People: Powerful Lessons in Personal Change*, Free press.
2. Wiesinger, Susan & Ralph Beliveau (2023) *Digital Literacy: A Primer on Media, Identity, and the Evolution of Technology*

REFERENCE BOOKS:

1. Hasson, Gill (2012) *Brilliant Communication Skills*. Great Britain: Pearson Education.
2. Trought, Frances. Dr. Brilliant (2017) *Employability Skills*, 2nd Edition Pearsons Business.
3. Soft Skills Training: A workbook to develop skills for employment, 2012
4. https://bharatskills.gov.in/pdf/EmployabilitNew.pdf

E-LEARNING RESOURCES:

1. https://www.sydney.edu.au/careers/students/career-advice-and-development/employability-skills.html
2. https://www.careers.ox.ac.uk/develop-your-employability-skills
3. https://www.careers.ox.ac.uk/boosting-your-employability
4. https://builtin.com/diversity-inclusion/types-of-diversity-in-the-workplace
5. https://www.coursera.org/articles/employability-skills

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PROGRAMME: M.Sc. CHEMISTRY	**BATCH**: 2024 - 26
PART: --	**COURSE COMPONENT:** SOFT SKILL -IV
COURSE NAME: Advanced Computing Paradigms	**COURSE CODE:**
SEMESTER: IV	**MARKS:**100
CREDITS: 2	**TOTAL HOURS:** 30
THEORY	

COURSE OBJECTIVE:

To provide a deep understanding and practical experience in emerging methodologies in IT.

COURSE OUTCOMES:

1. Ability to do advance data processing using Excel.
2. Competency to represent data efficiently using Excel and Chat GPT
3. Adeptness to integrate AI Tools with Microsoft word and Microsoft Power point and to Translate documents using AI.
4. Skill to use the open source design tool Canva
5. Ability to efficiently visualize data using Tableau.

Unit – I **(6 Hours)**

Excel: Cell Reference -Types of Cell Reference -Ranges, Named Ranges, Functions- Sum, Average, Max, Min, Count, Count A, Count Blank- Logical Functions- If and Nested If Functions, If with AND, OR, NOT, Count, If.

Unit – II **(6 Hours)**

Conditional Formatting: PivotTables-Basic PivotTable Data, Insert a Pivot Table, Lookup Functions–Excel with Chat GPT.

Unit – III **(6 Hours)**

AI Tools: Integrating Chat GPT in Microsoft Word, AI tool for PowerPoint Presentation - ANUVADINI: Voice & Document AI Translation Tools.

Unit – IV **(6 Hours)**

Introduction to Open Source Design Tools - Canva: What is Canva? - Logging into Canva - Choosing a Carleton templates - Canva Editor - Open and edit your design - Using the Canva sidebar - Save and download your design piece - Share your design.

Unit – V **(6 Hours)**

Tableau – Introduction- Adding Data Sources in Tableau – Data Types - Working with Measures and Dimensions – Working with Marks - - Creating Charts – Bar Chart – Line Chart- Maps.

References:

1. https://www.w3schools.com/excel/
2. https://anuvadini.aicte-india.org/
3. https://d31kydh6n6r5j5.cloudfront.net/uploads/sites/158/2020/06/Canva-Userguide.pdf
4. Tableau – Visual Analytics with Tableau – Alexander Loth.