# MASTER OF SCIENCE IN CHEMISTRY (NON-SEMESTER PATTERN)

(Academic Year 2021-22 onwards)


தமிழ்நாடு திறந்தநிலைப் பல்கலைக்கழகம்

**Tamil Nadu Open University**

[A State Open University established by Government of TamilNadu, Recognized by UGC-DEB, Member in Asian Association of Open Universities and Association of Commonwealth Universities]

**School of Sciences**
**Department of Chemistry**


**தமிழ்நாடு திறந்தநிலைப் பல்கலைக்கழகம்**

Tamil Nadu Open University, Chennai

சென்னை – 15

அறிவியல் புலம்

## School of Sciences

வேதியியல் துறை

## Department of Chemistry

# Master of Science in Chemistry (Non-Semester Pattern)

(Academic Year 2021-22 onwards)

**பாடத்திட்ட அறிக்கை & விரிவான பாடத்திட்டம்**

Programme Project Report (PPR) & Detailed Syllabus

SEPTEMBER 2020

# Tamil Nadu Open University

[A State Open University established by Government of Tamil Nadu, Recognized by UGC-DEB, Member in Asian Association of Open Universities and Association of Commonwealth Universities]

**No- 577, Anna Salai, Saidapet, Chennai -600015, Tamil Nadu, India**

**Prof. K.Parthasarathy**
**Vice-Chancellor**

## FOREWORD

My dear Learners, Vanakkam,

I deem it a great privilege to extend a hearty welcome to you to the Post Graduate Programme being offered by the Tamil Nadu Open University (TNOU). I also appreciate your keen interest of know about the curriculum of the Programme, in which you shall gain an enthralling experience, and pleasurable and beneficial learning.

With passing a specific act in the Tamil Nadu Legislative Assembly (TNLA) in 2002, the TNOU came into existence as a State Open University (SOU). It has been offering the socially relevant academic Programmes in diverse disciplines with due approval of the University Grants Commission (UGC) and the Distance Education Bureau (DEB), New Delhi since its inception. This Post Graduate Programme is one among the approved Programmes.

The Board of Studies, a statutory academic body of the University, consisting of the versatile scholars, eminent teachers including both internal and external, well acclaimed industrialists, outstanding alumni, and prospective learners as members, has designed the robust curriculum of this Programme. The curriculum is overhauled to be more suitable to the socio-economic and scientific needs in the modern era based on the emerging trends in the discipline of State and National as well as International level and accordingly, modified to our local context. Moreover, the whole syllabi of this Programme have special focuses on promoting the learners to the modern learning environment.

With a Credit System / Choice Based Credit System ( CBCS), this Programme is offered in semester / non-semester pattern. The Self-Learning Materials that are the mainstay of pedagogy in the Open and Distance Learning (ODL) have been developed incorporating both the traditional and the modern learning tools, like web-resources, multi-media contents, text books and reference books with a view to providing ample opportunities for sharpening your knowledge in the discipline.

At this juncture, I wish to place on record my deepest appreciations and congratulations to the Chairperson and the Members of the Board of Studies concerned for having framed the curriculum of high standard.

I would also like to acknowledge the Director, the Programme Coordinator and the members of staff of the respective School of Studies for their irrevocable contributions towards designing the curriculum of this Programme.

Last but not least, I register my profuse appreciation to Prof. S. Balasubramanian, the Director (i/c), Curriculum Development Centre (CDC), TNOU, who have compiled this comprehensive Programme Project Report (PPR) that includes the regulations and syllabi of the Programme, and also facilitated the designing in the form of e-book as well as printed book.

I am immensely hopeful that your learning at TNOU shall be stupendous, gratifying, and prosperous. Wish you all success in your future endeavours!

With regards,

Date: 05.10.2020

(K.PARTHASARATHY)

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# TAMIL NADU OPEN UNIVERSITY
## School of Sciences
## Department Of Chemistry
## Chennai-15

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**TAMIL NADU OPEN UNIVERSITY**
**SCHOOL OF SCIENCES**
**DEPARTMENT OF CHEMISTRY**
(Academic Year 2021-22 onwards)

# M.Sc. Chemistry

**Programme Project Report (PPR)**

## Programme's Mission and Objectives:

Master of Science in Chemistry Programme has been designed to provide in depth knowledge in Chemistry to those students who are not having opportunity to study in regular mode and for drop-out students from rural and urban areas of Tamil Nadu. Our Master of Science programme is a versatile degree which has been designed to understand the principles of chemistry and to develop Graduates with the key practical skills and interdisciplinary knowledge required to address today's global challenges. The Objectives of this Programme are

- To acquire broad knowledge on organic, inorganic, physical, analytical, natural products, pharmaceutical and environmental chemistry.
- To motivate critical thinking and analysis skills to solve complex chemical problems, e.g., analysis of data, synthetic logic, spectroscopy, structure and team-based problem solving, etc.
- To impart the basic analytical and technical skills to work effectively in the various fields of chemistry.
- To present scientific and technical information resulting from laboratory experimentation in both written and oral formats.
- To motivate students to go for higher studies and research in chemistry.
- To improve the self-employability of the students
- To foster a commitment to ethical and social responsibilities.

## Relevance of the Programme with HEI's Mission and Goals:

The Programme M.Sc. (Chemistry) is offered to meet current needs of aspiring youths and adult population and also create awareness about the in-depth scientific aspects to the society. This Programme aims at creating equity in education by providing opportunity to rural people for whom the Higher Education is unreachable.

**Nature of prospective target group of Learners:** Master of Science (Chemistry) is meant for students who have completed an Undergraduate Degree Programme in General Chemistry or Biochemistry or Industrial Chemistry as the main subject in part - III with Physics/ Mathematic/Botany/Zoology as one of the allied papers of any affiliated Institution/University or graduate teachers (BT assistant) are the target groups. It also targets the rural population to reach their dream of obtaining Higher Education for whom the opportunity was denied due to lack of limited number of seats available in the conventional University system.

**Appropriateness of Programme to be conducted in ODL mode to acquire specific skills and competence:** Master Degree Programme in Chemistry will meet out the present day needs of Academic and Research Institutions / Industries. As Programme outcome of the students may acquire in-depth knowledge in the Organic, Inorganic and Physical Chemistry which will motivate the students to go for higher studies/research in Chemistry and also acquire skills in the field of application oriented, life oriented, and job oriented Chemistry. Their learning needs will be addressed by providing the printed copy of 'Self Learning Materials (SLM)' and Practical classes / Examination are being conducted at the Learner Support Centres (LSCs).

**Instructional Design:**The Curriculum and the Syllabi for Master of Science in Chemistry Programme have been designed to provide in-depth knowledge in Chemistry to those students who are not having opportunity to study in regular mode and for drop-out students from rural and urban areas of Tamil Nadu. The main Objective of this Programme is to enable the students to understand the in-depth knowledge on the Chemicals, its reactions and make them relevant to the society. The course for the degree of Master of Science in Chemistry shall consist of TWO years (TWO SEMESTERS) and the medium of instruction is ENGLISH.

The Master of Science in Chemistry Programmeis offered through the Learner Support Centres which are established by Tamil Nadu Open University at affiliated Arts and Science Colleges where the same Programme is offered through Conventional Mode.

The Faculty members available at Department of Chemistry, School of Science of Tamil Nadu Open University and the faculties approved as Academic Counselors by TNOU at Learner Support Centres will be used for delivering the Master of Science Degree Programme in Chemistry.

The credits systems suggested as per UGC-ODL Regulations-2020 have been assigned to the Master of Science in Chemistry Programme. The total number of credit assigned for the Programme is 72. The Self Learning Materials (SLM) in the form of print, e-content and audio/video materials wherever required has also been developed for the Programme.

## Procedure for Admissions, Curriculum Transaction and Evaluation:

**Eligibility:** A candidate who has passed B.Sc., Degree with General Chemistry or Biochemistry or Industrial Chemistry as the main subject in part - III with Physics/Maths/ Botany/Zoology as one of the allied papers of any affiliated Institution/University accepted by syndicate shall be permitted to admission for M.Sc., chemistry programme of this University. The Programme Fee is Rs.20000/- for two years, plus Registration and other Charges. The admission are carried out by Tamil Nadu Open University and through its Regional Centres located within the State of Tamil Nadu. The Theory Counselling and the Practical Counselling classes will be conducted through the Learners Support Centres of Tamil Nadu Open University. The evaluation will be carried by Tamil Nadu Open University as based on the Continuous Internal Assessment through Assignment and External Assessment through Term End Examinations.

**Financial Assistance:** SC/ST Scholarship available as per the norms of the State Government of Tamil Nadu. Complete Admission fee waiver for the physically challenged/ differently abled persons.

**Policy of Programme delivery:** The Academic Calendar for the Programme will be available for the learners to track down the chronological events / happenings. The Counselling schedule will be uploaded in the TNOU website and the same will be intimated to the students through SMS.

**Evaluation System:** Examination to Master Degree Programme in Chemistry is designed to maintain quality / standard. Theory will be conducted by the University at the identified Examination Centres. For the Assignments, students, may be permitted to write with the help of books / materials for each Course, which will be evaluated by the Evaluators who are appointed by the University.

**Continuous Internal Assessment (CIA):Assignment:** 1 assignment for 2 credits is to be prepared by the learners. E.g. If a Course is of 6 Credits, then 3 number of Assignments are to be written by the learner to complete the continuous assessment of the course. Assignment carries 30 Marks (Average of Total no of Assignments), consists of Long Answer Questions (1000 words) for each Course.

| | | |
|---|---|---|
| Section-A | One Question out of Three Questions | 1 x 30 = 30 |
| **Total** | | **30 Marks** |

**Theory Examination:** Students shall normally be allowed to appear for theory examination by completing Practicals and Assignments. The Term End Examination shall Carry 70 marks and has PART: A, B and C and will be of 3 hours duration.

| | | |
|---|---|---|
| Section-A | Answer all FIVE questions [Each 2 marks] | 5 X 2 = 10 |
| Section-B | Answer any FOUR out of seven questions [Each 5 Marks] | 4 X 5 = 20 |
| Section-C | Answer any FOUR out of seven questions [Each 10 Marks] | 4 X 10 = 40 |
| **Total** | | 70 **Marks** |

**Question Pattern for Theory Examinations:**

Max. Marks: 70 Time: 3 hours

**PART - A (5 X 2 = 10 marks)**

Answer all FIVE questions in 50 words

[All questions carry equal marks]

1. From Block - I
2. From Block - II
3. From Block - III
4. From Block - IV
5. From Block- V

**PART - B (4 X 5 = 20 marks)**

Answer any FOUR questions out of Seven questions in 150 words

All questions carry equal marks

1. From Block - I
2. From Block - II
3. From Block - III
4. From Block - IV
5. From Block- V
6. From any Block
7. From any Block

**PART - C (4 X 10 = 40 marks)**

Answer any FOUR questions out of Seven questions in 400 words

[All questions carry equal marks]

1. From Block - I
2. From Block - II
3. From Block - III
4. From Block - IV
5. From Block - V
6. From any Block
7. From any Block

## Question Paper Pattern for Practical Examinations:

- Practical - I (Organic Estimation and Synthesis): Any ONE estimation and Any ONE synthesis.
- Practical - II (Inorganic Analysis, Estimation and Synthesis): Analysis of any TWO cations and any ONE Estimation or any ONE Preparation.
- Practical - III (Physical Chemistry Experiments): Any ONE experiment.

## Awarding of marks for Practical examinations:

Marks distribution for the external practical examinations to 100 Marks is based on the Results, Record, Procedure writing and Vivo-voce.

## Passing Minimum:

**For Theory Examination:** The candidate shall be declared to have passed the theory examination if the candidate secures not less than 32 marks in the Term End Examinations (TEE) in each theory paper and secures not less than 13 marks in the Continuous Internal Assessment (CIA) [The mark distributions in CIA will be adhere as per TNOU norms time to time] and overall aggregated marks is 50 marks in both external and internal taken together. The Candidate must secure the minimum aggregated total of 50 marks for passing in the each course.

| Continuous Internal Assessment (CIA) | | Term End Examination (TEE) | | Overall Aggregated Marks | Maximum Marks |
|---|---|---|---|---|---|
| Minimum Mark | Maximum Mark | Minimum Mark | Maximum Mark | CIA + TEE | |
| 13 | 30 | 32 | 70 | 50 | 100 |

**For Practical Examination:** The candidate shall be declared to have passed the examination if the candidate secures not less than 50 marks in the University practical examination and the mark distributions will be based on the results, record note book, procedure writing and Vivo-voce taken together is required to pass the examinations.

## Classification of Successful Candidate:

Candidates who pass all the courses prescribed and who secure

- 75% and above (in first attempt only) will be placed in the First class with Distinction.
- 60% and above in the aggregate of marks will be placed in the First Class.
- 50% and above but below 60% in the aggregate will be placed in the Second Class.

## Requirement of Laboratory and Library Resources:

The M.Sc. Chemistry Programme will be offered through the Learner Support Centres (LSCs) which are monitored/maintained by Tamil Nadu Open University. The LSC's are having the required infrastructural facilities to conduct the practical counselling classes ofall the experiments which are given in the syllabi and also have the required facilities to conduct the external practical examinations.

A well-equipped Library is available in the University Headquarters with about 24,000 books and also having many reputed research journals for reference. Further, the LSC's through which the Degree Programme is being offered,are also equipped with full-fledged library facilities related to the Chemistry courses.

## Cost estimate of the Programme and theprovisions:

| S.No | Details | Amount in Rs. |
|---|---|---|
| 1 | Programme development and launching cost (Expenditure) | -8026200 |
| 2 | Programme Fee charged for 2 years per student (Income) | -20000 |
| 3 | Examination Fee charged for 2 years (Income) per student | 9000 |
| 4 | Examination expenses per student for 2 years per student (Expenditure) | -15000 |

**Quality Assurance Mechanism & Programme Outcomes:** The Quality of the Master Degree Programme in Chemistry is maintained by adopting the curriculum suggested by the UGC. The required core courses, elective courses and practical courses are included in the Programme as per the UGC guidelines. The Curriculum of M.Sc.Chemistryin Non-Semester pattern was approved by the Board of Studies of Department of Chemistry, which was conducted on 18.06.2020. Subsequently, the Curriculum was approved by the Academic Council and Syndicate of our University. As a part of Quality assurance, the Curriculum of M.Sc.Chemistry will be updated once in three years. Also, the steps are being taken to obtain the feedback from the students and from the Academic Counsellors who are involved in delivering the programme in an effective manner.

## Programme Outcomes

On successful completion of Post Graduate Degree in Chemistry, students will have the ability to:

- Demonstrate, solve and an understanding of major concepts in all disciplines of chemistry.
- Think critically, systematically, independently to analyze the chemical problems and to draw a logical conclusion.
- Make international collaborations for students and faculty exchange and research cooperation.
- Familiarize with the emerging areas of Chemistry and their applications in various spheres of Chemical sciences and to apprise the students of its relevance in future studies.
- Create an awareness of the impact of chemistry on the environment, society, and development outside the scientific community.
- Design, carry out, record and analyze the results of chemical experiments and are familiar with standard safety practices, equipment, procedures, and techniques common to most working laboratories.
- Have global level research opportunities to pursue Ph.D. programme targeted approach of CSIR - NET examination

**Structure of the M.Sc.Chemistry Programme**

The scheme of examinations for two years shall be as follows:

| Subject | Title of the Subject | Subject Code | Credit | Examination | | |
|---|---|---|---|---|---|---|
| | | | | Mark Distribution | | Maximum Marks |
| | | | | CIA* | TEE# | |
| **IYear** | | | | | | |
| Core - I (Theory) | Organic Chemistry-I | MCHE-11 | 6 | 30 | 70 | 100 |
| Core - II (Theory) | Inorganic Chemistry-I | MCHE-12 | 6 | 30 | 70 | 100 |
| Core - III (Theory) | Physical Chemistry-I | MCHE-13 | 6 | 30 | 70 | 100 |
| Core - IV (Theory) | Analytical and Environmental Chemistry | MCHE-14 | 6 | 30 | 70 | 100 |
| Core - V (Theory) | Chemistry of Bio-Molecules and Green Chemistry | MCHE-15 | 6 | 30 | 70 | 100 |
| Core -VI (Theory) | Polymer Chemistry | MCHE-16 | 6 | 30 | 70 | 100 |
| **IIYear** | | | | | | |
| Core -VII (Theory) | Organic Chemistry-II | MCHE-21 | 6 | 30 | 70 | 100 |
| Core -VIII (Theory) | Inorganic Chemistry-II | MCHE-22 | 6 | 30 | 70 | 100 |
| Core - IX (Theory) | Physical Chemistry-II | MCHE-23 | 6 | 30 | 70 | 100 |
| Practical-I (Core) | Organic Chemistry | MCHEP-01 | 6 | - | 100 | 100 |
| Practical-II (Core) | Inorganic Chemistry | MCHEP-02 | 6 | - | 100 | 100 |
| Practical-III (Core) | Physical Chemistry | MCHEP-03 | 6 | - | 100 | 100 |
| **Total Credits = 72** | | | | **Total Marks = 1200** | | |

** Continuous Internal Assessment (CIA)*

*# Term End Examination (TEE)*

TAMIL NADU OPEN UNIVERSITY
School of Sciences
Department Of Chemistry
Chennai-15

# M. Sc. CHEMISTRY SYLLABUS
# I YEAR (Distance Mode)

| | |
|---|---|
| **Course Title** | **ORGANIC CHEMISTRY - I** |
| **Course Code** | **MCHE - 11** |
| **Course Credit** | **6** |

## COURSE OBJECTIVES

While studying the Organic Chemistry - I course, the student shall be able to:

- Define the characteristic features and applications of addition and elimination reactions
- Know about the characteristic features and applications of nucleophile and electrophilic substitution reactions
- Gain knowledge on the stereochemistry and conformational analysis of organic molecules
- Get awareness on the retro synthetic methods and important organic reagents
- Characterize the aromaticity of organic molecules

## COURSE OUTCOMES

After completion of the Organic Chemistry - I course, the student will have the ability to:

- Understand the characteristic features and applications of addition and elimination reactions
- Define the characteristic features and applications of Nucleophilic and Electrophilic Substitution reactions
- Describe the stereochemistry and conformational analysis of organic molecules
- Recognizethe retro synthetic methods and important organic reagents
- Gain knowledge on the aromaticity of organic molecules

## Block I: Addition and Elimination Reactions

**Unit-1-** Introduction to addition reactions - Electrophilic, Nucleophilic and Free radical additions - Orientation of the addition - Stereochemical factors influencing the addition

**Unit-2**-Syn and Anti, hydroboration -Epoxidation - Ozonolysis - Addition to carbonyl/ conjugated carbonyl systems and carbon-oxygen double bond - Grignard reagents - 1,2-/1,4-additions - Benzoin, Knoevenagel, and Reformatsky reactions

**Unit-3**-Introduction to elimination reactions - $E_1$, $E_2$, $E_1cB$ mechanisms - Stereochemistry for elimination reactions

**Unit-4**-Hofmann's and Zaitsev's rules - Pyrolytic cis-elimination - Chugaev reaction - Dehydration, Dehydrohalogenation - Hofmann degradation- Cope elimination.

## Block II: Nucleophilic and Electrophilic Substitution Reactions

**Unit-5**- Introduction to aliphatic nucleophilic substitution reaction - $S_N1$, $S_N2$, $S_Ni$ mechanisms - Neighbouring Group Participation - non-classical carbocations- Wagner- Meerwein and Dienone-phenol rearrangements

**Unit-6**-Introduction to aromatic nucleophilic substitution reaction:$S_N1$, $S_NAr$, Benzyne mechanism -Ullmann, Sandmeyer and Chichibabin reactions

**Unit-7**-Introduction to aromatic electrophilic substitution reaction - substitutions in thiophene and pyridine-N-oxide - Hammett equation - Taft equation

**Unit-8**-Introduction to aliphatic electrophilic substitution Reaction: $S_E2$, $S_Ei$ and $S_E1$ mechanisms -Diazonium salts - Diazoniumcoupling reactions

## Block III: Stereochemistry and Conformational Analysis

**Unit-9**-Introduction to stereoisomerism - symmetry -Enantiomers and Diastereomers - Optical activity and chirality - Types of molecules exhibiting optical activity - Elements of symmetry

**Unit-10**-Fisher's projection - D,L and R,S configurations -Absolute configuration - Molecules with more than one chiral centres – Atropisomerism-E and Z nomenclature

**Unit-11**-Stereochemistry of simple addition and elimination reactions – Stereospecific and stereoselective synthesis

**Unit-12**-Molecular chirality - Allenes, Spiranes, Biphenyls -Conformations of Cyclopentane, Cyclohexane, Cyclohexene and Fused (decalin) and Bridged (norbornane type) ring systems - Anomeric effect in cyclic compounds.

## Block IV: Synthetic Methodology

**Unit-13**-Introduction to Reterosynthesis- Disconnections – Synthons- Synthetic equivalent - Target molecules - Protection and deprotection of functional groups (R-OH, -CHO, - C=O, - $NH_2$, - COOH)

**Unit-14**-Applications of Jonesreagent, PCC, PDC, DMP, CAN, $Mn(OAc)_3$, NOCl,

**Unit-15**-Reduction: Platinum / Nickel / Palladium based heterogeneous catalysts for hydrogenation - Wilkinson's catalyst - reductions using Li/Na in liquid ammonia

**Unit-16**-Applications of $BF_3$, NBS, $NaBH_4$, $LiAlH_4$, Grignard reagent, Organozinc and Organolithium reagent

## Block V: Aromaticity

**Unit-17**-Huckel's theory of aromaticity - Concept of homoaromaticity/antiaromaticity - Aromaticity of benzenoid, heterocyclic, and non-benzenoid compounds

**Unit-18**-Aromatic character of five-, six-, seven-, and eight-membered rings - Electron occupancy in MO's and aromaticity

**Unit-19**-NMR concept of aromaticity and antiaromaticity - Systems with 2,4,8 and 10 electrons - systems of more than 10 electrons (annulenes) - Mobius aromaticity

**Unit-20**-Bonding properties of systems with $(4n+2)\pi$-electrons and $4n\pi$-electrons, alternant and non-alternant hydrocarbons (azulene type) - Aromaticity in heteroaromatic molecules - Sydnones and fullerenes

### Text Books:


1. R.K. Bansal, Organic Reaction Mechanism, I Edition.
2. P. S. Kalsi, Stereochemistry: Conformation and Mechanism, II Edition.
3. V. K. Ahluwalia, Organic Reaction Mechanism, II Edition.
4. S. N. Sanyal, Reactions, Rearrangements and Reagents
5. S.M. Mukherji and S.P. Singh, Organic Reaction Mechanism, MacMillan India Ltd., Chennai (1990) - I Edition.
6. Ernest L. Eliel, Samuel H. Wilen, Stereochemistry of Organic Chemistry, II Edition.


### Reference Books:


1. J. Miller,Advanced Organic Chemistry, III Edition
2. J. D. Roberts and M. C. Caserio, Basic principles of Organic chemistry.
3. Stanley Pines, Organic Chemistry, IV Edition
4. R.O.C. Norman and J. M. Coxon.(ELBS) Principle of organic synthesis, II Edition
5. Advanced organic chemistry (McGraw-Hill) J. March.
6. Peter Sykes,A Guide book to mechanism in organic chemistry, Pearson Edn., (2006).

**TAMIL NADU OPEN UNIVERSITY**
School of Sciences
Department Of Chemistry
Chennai-15

# M. Sc. CHEMISTRY SYLLABUS
# I YEAR (Distance Mode)

| | |
|---|---|
| **Course Title** | **INORGANIC CHEMISTRY - I** |
| **Course Code** | **MCHE - 12** |
| **Course Credit** | **6** |

## COURSE OBJECTIVES

While studying the Inorganic Chemistry - I course, the student shall be able to:

- Understand the theories and characteristic features of covalent and ionic bonding in organic molecules
- Know about the characteristics and applications of coordination chemistry
- Gain knowledge on the stereochemistry of coordination compounds
- Get awareness on the kinetics and reaction mechanism of coordination compounds
- Acquire knowledge on the coordination chemistry of lanthanides and actinides

## COURSE OUTCOMES

After completion of the Inorganic Chemistry - I course, the student will have the ability to:

- Describe the theories and characteristic features of covalent and ionic bonding in organic molecules
- Explain the characteristics and applications of coordination chemistry
- Understand the stereochemistry of coordination compounds
- Study the kinetics and reaction mechanism of coordination compounds
- Recognize the coordination chemistry of lanthanides and actinides

## Block I: Covalent and Ionic Bonding

**Unit-1-** V.B. approach to covalent bonding -Heitler, London, Pauling, Slater refinements - Hybridization and structure of molecule - VSEPR theory - Shapes of molecules - M.O. approach to covalent bonding

**Unit-2-**Symmetry and overlap of atomic orbitals - Symmetry of molecular orbitals -Sigma/ pi/ delta bondings - Bond length, bond order and bond energy

**Unit-3**-Ionic character in a covalent bond -Concept of multi centre bonding - Structure and bonding in fluorine and oxygen compounds of xenon and krypton - Bonding in simple tri atomic molecules/ions

**Unit-4**-Lattice energy and its calculations by Born-Lande and Born-Meyer equations - Determinations by Born-Haber cycle- Properties of ionic compounds.

## Block II: Coordination chemistry

**Unit-5**-Classification of complexes based on coordination numbers and possible g eometries - Bonding in coordination compounds

**Unit-6**-Crystal field splitting - CFSE - Factors affecting crystal field splitting - Splitting of d orbitals in octahedral, tetrahedral, square planar, square pyramidal and triagonalbipyramidal fields

**Unit-7**-Sigma/pi bonding in coordination compounds - Spectro chemical series - Jahn-Teller distortion-Tanabe-Sugano and Orgel diagrams - Chelate effect - Spinerls--Nephelauxetic effect

**Unit-8**-Ligand field theory - LFSE - M.O energy level diagrams for octahedral and tetrahedral complexes without and with π-bonding

## Block III: Stereochemistry of Coordination Compounds

**Unit-9**-Geometrical and optical isomerism in octahedral complexes -Resolution of optically active complexes

**Unit-10**-Determination of absolute configuration of complexes by ORD and Circular Dichroism

**Unit-11**-Stereoselectivity and conformation of chelate rings - Asymmetric synthesis catalyzed by coordination compounds.

**Unit-12**-Linkage isomerism - Electronic and Steric factors affecting linkage isomerism - Symbiosis- Hard and Soft ligands - Prussian blue and related structures– Macrocycles- Crown ethers.

## Block IV: Kinetics and Reaction mechanism of Coordination compounds

**Unit-13**- Introduction toElectron transfer reactions –Complementary and non-complementary reaction - Adiabatic and Non adiabatic electron transfer reactions- Atom transfer reactions - Outer and Inner sphere mechanism

**Unit-14**- Marcus-Hush Theory - Reactions of coordinated ligands - Thermodynamic and kinetic stability

**Unit-15**- Kinetics and mechanism of nucleophilic substitution reactions in square planar complexes -Trans effect theory

**Unit-16-** Kinetics and mechanism of octahedral substitution- Water exchange, dissociative and associative mechanisms -Racemisation reactions -Solvolytic reactions (acidic and basic).

## Block V: Coordination Chemistry of Lanthanides and Actinides

**Unit-17**-General characteristics of Lanthanides-Electronic configuration, Term symbols for lanthanide ions, Oxidation state

**Unit-18**- Lanthanide contraction - Factors influence the formation of lanthanide complexes

**Unit-19**- Electronic spectra and magnetic properties of lanthanide complexes - Lanthanide complexes as shift reagents

**Unit-20-** General characteristics of Actinides- Difference between 4f and 5f orbitals - Comparative account of coordination chemistry of lanthanides and actinides

### Text Books:


1. G. D. Tuli, SathyaPrakas, Basu, R. D. Madhan, Advanced Inorganic Chemistry, I Edition.
2. U. Wahid Malik, G. D. Tuli, R. D. Madhan, Selected Topics in Inorganic Chemistry.
3. J.E. Huheey, Inorganic Chemistry, Harper and Collins, NY, IV Edition, (1993).
4. J. D. Lee, Inorganic Chemistry
5. AshuthoshKar, Advanced Inorganic Chemistry, I Edition.
6. Puri, Sharma, Kalia, Principles of Inorganic Chemistry


### Reference Books:


1. F. A. Cotton, G.W. Wilkinson, Advanced Inorganic Chemistry- Acomprehensive Text, John Wiley and Sons, (1988).
2. K.F. Purcell, J.C. Kotz, Inorganic Chemistry WB Saunders Co., USA, (1977).
3. M.C.Shrivers, P.W Atkins, CH. Langford, Inorganic Chemistry, OUP, (1990).
4. N.N. Greenwood and Earnshaw, Chemistry of the Elements, Pergamon Press, New York (1984).
5. N. H. Ray, Inorganic Polymers, Academic Press, (1978).
6. S.F.A. Kettle, Coordination Chemistry, ELBS, (1973).
7. A.B.P. Lever, Inorganic Electronic Spectroscopy, Elsevier, New York, (1984), II Edition.
8. M.C. Day, J. Selbin, Theoretical Inorganic Chemistry, Van Nostrand Co., NY, (1974).

# TAMIL NADU OPEN UNIVERSITY
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Chennai-15

# M. Sc. CHEMISTRY SYLLABUS
# I YEAR (Distance Mode)

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|---|---|
| **Course Title** | **PHYSICAL CHEMISTRY - I** |
| **Course Code** | **MCHE - 13** |
| **Course Credit** | **6** |

## COURSE OBJECTIVES

While studying the Physical Chemistry - I course, the student shall be able to:

- Know about the concepts and importance of classical thermodynamics
- Understand the theories, terms and applications of quantum chemistry
- Gain knowledge on the kinetics of chemical reactions
- Study the terms and applications of phase rule
- Acquire knowledge on the characteristic features of electrochemistry

## COURSE OUTCOMES

After completion of the Physical Chemistry - I course, the student will have the ability to:

- Define the concepts and importance of classical thermodynamics
- Describe the theories, terms and applications of quantum chemistry
- Analyse the kinetics of chemical reactions
- Understand the terms and applications of phase rule
- Explain thecharacteristic features of electrochemistry

## Block I: Classical Thermodynamics

**Unit-1**-Thermodynamics concept: Concept of entropy, reversible and irreversible processes, Free energies

**Unit-2**-Fundamental equations for open systems - Partial molar quantities and chemical potential- Variation of Chemical potential with temperature and with pressure

**Unit-3**-Gibbs-Duhem equation - Real gases and Fugacity

**Unit-4**-Thermodynamics of ideal and non-ideal solutions: Liquid-liquid solutions - Liquid-solid solutions

## Block II: Quantum Chemistry

**Unit-5**- Quantum Theory: Inadequacy of classical mechanics - Black-body radiation - Planck's distribution - Photoelectric effect

**Unit-6**- Wave-particle duality of material particles and de Broglie's hypothesis -Dynamics of microscopic systems: Born interpretation of the wave function- Normalization - Quantization - Probability density and Uncertainty principle

**Unit-7**- Quantum mechanics: Schrodinger equations - Operator algebra: Operators - Linear and Hermitian - Eigen functions and Eigen values -Application of wave mechanics: Rigid rotor - Harmonic oscillators

**Unit-8**- Particle in a box: One and three-dimensional boxes -Distortions - quantum numbers - Orthogonization and normality -Tunneling - Perturbation theory

## Block III: Chemical Kinetics - I

**Unit-9**- Theories of Reaction Rates: Rate laws and rate constants - reaction order - determination of rate law - reactions approaching equilibrium - temperature dependence of reaction rates

**Unit-10**- Arrhenius parameters - Theories of reaction rates: Collision theory - Steady state hypotheses -Lindmann's theory of unimolecular reaction

**Unit-11**- Transition state theory - Comparison of collisions and transition state theories in simple gas reactions - Steric factor - Transmission coefficient

**Unit-12**- Elementary Reactions in Solutions: Activated complex theory - Bronsted-Bjerrum equation - Primary and secondary salt effects - Kinetic isotope effect - Potential energy surfaces.

## Block IV: Phase Rule

**Unit-13**- Introduction to Phase, Component, Degrees of freedom - Gibbs Phase rule

**Unit-14**- Three component systems -Method of plotting three component system - Stokes Roozeboom plot -Method of parallel lines

**Unit-15**-Phase behavior of three liquid components exhibiting partial miscibility - one pair, two pairs and three pairs of partial miscible liquids-Effect of temperature

**Unit-16**-Classification of phase transitions - Phase behavior of solid-liquid, liquid-solid and solid - Vapour boundaries.

## Block V: Electrochemistry

**Unit-17**- Concept of activity, activity coefficient, mean ionic activity, mean ionic activity coefficient

**Unit-18-** Debye-Huckel theory - Debye-Huckel theory of strong electrolytes - Debye-Huckel limiting law

**Unit-19-** Polarizable and Non-polarizable interfaces - Lippman Equation - Relating charge density and interfacial tension

**Unit-20-** Different models of double layer - Helmholtz-Perrin model - Gouy-Chapmann diffuse charge model and Stern model - Derivation of Butler-Volmer equation - Tafel equations.

### Text Books:


1. B. R. Puri, M. Sharma, S. Pathania, Physical Chemistry, I Edition
2. K.J. Laidler, Chemical Kinetics, II Edition
3. C.N. Banwell, Fundamentals of Molecular Spectroscopy
4. Pearson House, Fundamentals of Chemical Kinetics
5. Pearson House, Fundamentals of Quantum Chemistry
6. R.C. Srivastava, S.K. Saha, A.K. Jain,Thermodynamics, I Edition.


### Reference Books:


1. P.W. Atkins Physical Chemistry.
2. A, Frost, G. Pearson, Kinetics and Mechanism of Reaction Rates.
3. H. Eyring,Modern Chemical Kinetics.
4. R. Chang,Basic Principles of Spectroscopy.
5. J.W. Akit,NMR and Chemistry.
6. G.M. Barrow,Introduction to Molecular Spectroscopy.
7. S. Glasstone, Thermodynamics for Chemists.
8. C. Kalidas,Non – equilibrium Thermodynamics.
9. S. Glasstone,Electrochemistry.
10. Electrochemistry: P.H. Reiger
11. J.O'M Bockris, A.K.N. Reddy,Modern Electrochemistry,Vol. I:

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# M. Sc. CHEMISTRY SYLLABUS
# I YEAR (Distance Mode)

| | |
|---|---|
| **Course Title** | **ANALYTICAL AND ENVIRONMENTAL CHEMISTRY** |
| **Course Code** | **MCHE - 14** |
| **Course Credit** | **6** |

## COURSE OBJECTIVES

While studying the Analytical and Environmental Chemistry course, the student shall be able to:

- Gain knowledge on the principle, instrumentation and applications of NMR Spectroscopy
- Know about the principle, instrumentation and applications of IR Spectroscopy
- Understand the principle, instrumentation and applications of UV Vis and Mass Spectroscopy
- Get awareness on the principle and applications ORD/CD/Chromatography/Electro analytical Methods and Thermogravimetry analysis
- Study the sources and impact of pollution and laboratory hygiene rules

## COURSE OUTCOMES

After completion of the Analytical and Environmental Chemistry course, the student will have the ability to:

- Define the principle, instrumentation and applications of NMR Spectroscopy
- Explain the principle, instrumentation and applications of IR Spectroscopy
- Understand the principle, instrumentation and applications of UV Vis and Mass Spectroscopy
- Analyse he principle and applications ORD/CD/Chromatography/Electro analytical Methods and Thermogravimetry analysis
- Gain knowledge onthe pollution and laboratory hygiene rules

## Block I: NMR Spectroscopy

**Unit-1**-NMRSpectroscopy: Principle - Instrumentation - $^{1}H$ NMR: Chemical shift - Spin-spin coupling - Peak area -Homotopic/enantiotopic/diastereotopic relationships

**Unit-2-** First order/non first order spectra - Factors affecting spin-spin splitting/width of lines - Dueterium substitution - Shift reagents - Double resonance technique

**Unit-3-** $^{13}C$ NMR: Basic concepts - Comparison of H and C NMR - Fourier transformation -Chemical shift and its dependence C-C and C-H couplings

**Unit-4-** Off resonance and broad band decoupling - Application in structural elucidation for some simple molecules.

## Block II: IR Spectroscopy

**Unit-5-** IR Spectroscopy:Principle - Instrumentation - Source of IR radiations, Monochromatization, Cell and Prim materials, measuring intensities of IR radiations

**Unit-6-** Sample handling techniques - Stretching vibrations -Hooke's Law -Stretching and bending vibrations

**Unit-7-** Force constants -Fundamentals, overtone and combination bands -Fermi resonance -Effects of substitution/conjugation/bond angle/hydrogen bondingon vibrational frequencies

**Unit-8-** Detecting inter/intra-molecular hydrogen bonding - Frequencies of absorption for nitrate/sulphate/chlorate ions/ammonia/watermolecule-shift in frequencies upon coordination

## Block III: UV- Visible and Mass Spectroscopy

**Unit-9-** UV- Visible Spectroscopy**:** Principle - Instrumentation - Electronic excitation $\sigma$-$\sigma^*$, n- $\sigma^*$, n-$\pi$ and $\pi$-$\pi^*$ transitions

**Unit-10-** Solvent effect -Factors affecting position/intensity ofabsorption bands -Woodward -Fieser rules- UV spectra of dienes, polyenes and unsaturated ketones

**Unit-11-** Mass Spectrometry:Principle - Instrumentation- Parent ion, metastable ion & isotopic ions - Base peak

**Unit-12-** General rules of fragmentation - MacLafferty rearrangement - Retro Diels - Alder reaction.

## Block IV: ORD / CD / Chromatography / Electro analytical Methods and Thermogravimetry

**Unit-13-** ORD & CD: Principle- Circular birefringence -Circular dichroism -Cotton effect - Types of ORD curves-Applications of Cotton effect curves and plain dispersion curves - Octant rule - Applications for determination of conformation and configuration

**Unit-14-**Chromatography: Definition - Classifications - Principle - Practice of adsorption, partition, paper, Thin-layer, HPLC and Gas chromatographic techniques

**Unit-15-**Potentiometry: Introduction - Electrodes - Types - Reference/ Indicator/Glass/Ion-selective/Liquid membrane/Clark's electrode- Biosensor- Coulometry: Different methods - Coulometric titrations - Conductometric titrations

**Unit-16-**Voltammetry: Principles - Voltammograms - Equation of voltamogram - Modified Voltametric Methods - DPV - Cyclic Voltammetry - Amperometry - Anodic/cathodic stripping voltammetry-Thermogravimetry: TGA/DTA/DSC Instrumentation and Applications.

## Block V: Pollution and Laboratory Hygiene

**Unit-17-**Pollution: Air pollution - definition - sources of air pollution - effects of air pollutants - effects of fluorocarbons, ozone layer and green-house effect - Acid rain: Formation theory and control

**Unit-18-** Water pollution: Types - sources - industrial effluents - water sewages - inorganic pollutants - organic pollutants - water pollution control - water treatment

**Unit-19-** Radioactive pollution: Sources - nuclear traces - wastes - effect of radiation - preventive methods

**Unit-20-** Laboratory hygiene and safety rules: Common safety methods - Storage and handling of Carcinogenic chemicals, Poisonous chemicals, Easily vaporizable chemicals and Inflammable Chemicals with examples

**Text Books:**


1. R.M. Silverstein, G.C. Bassler, Spectroscopic identification of organic compounds, I Edition
2. P.S. Kalsi,Applications of spectroscopic techniques in Organic chemistry, II Edition
3. Y. R. Sharma, Organic Spectroscopy.
4. Pavia, Organic Spectroscopy,I Edition
5. V. Subramanian, A Text book of Environmental chemistry
6. Text book of Environmental chemistry -BalramPhani

## Reference Books:


1. D.H. Williams, I. Fleming, Spectroscopic methods in organic chemistry.
2. R. Drago, Physical Methods in Inorganic Chemistry, I Edition
3. D.A. Skoog, D.M. West Fundamentals of Analytical Chemistry (Holt Rinehart and Winston Inc).
4. G. D. Christain(J.W),Analytical Chemistry
5. Bobbit, Introduction to chromatography.
6. H.H. Willard, L.L. Mirrit, J.A. Dean.Instrumental Methods of analysis (CBS).
7. Chatwal, Anand, Instrumental Methods of Analysis:
8. A.I. Vogel, Instrumental Methods of Inorganic Analysis (ELBS).
9. H.A. Strobel, Chemical Instrumentation: A Systematic approach
10. R.A.Horne, Chemistry of our environment
11. A.K.De.Environmental chemistry.
12. L. Iain, Marr, S. Malcom Environmental chemical analysis.

# M. Sc. CHEMISTRY SYLLABUS
# I YEAR (Distance Mode)

| | |
|---|---|
| **Course Title** | **CHEMISTRY OF BIOMOLECULES AND GREEN CHEMISTRY** |
| **Course Code** | **MCHE - 15** |
| **Course Credit** | **6** |

**COURSE OBJECTIVES**

While studying the Chemistry of Bio-Molecules and Green Chemistry course, the student shall be able to:

- Acquire knowledge on the types, structure and applications of protein, enzymes and nucleic acid
- Understand the types, structure and applications of carbohydrates, vitamins, harmones and prostoglands
- Know about the types and applications of antibiotics, pesticides, fertilizers, petrochemicals
- Get awareness on the occurrence, classification and isolation of alkoloids, steroids, terpenoids and carotenoids
- Gain knowledge on the principles and characteristic features of Green chemistry

**COURSE OUTCOMES**

After completion of the Chemistry of Bio-Molecules and Green Chemistry course, the student will have the ability to:

- Describe the types, structure and applications of protein, enzymes and nucleic acid
- Define types, structure and applications of carbohydrates, vitamins, harmones and prostoglands
- Understand the types and applications of antibiotics, pesticides, fertilizers, petrochemicals
- Explain theoccurrence, classification and isolation of alkoloids, steroids, terpenoids and carotenoids
- Define the principles and characteristic features of Green chemistry

## Block I: Protein, Enzymes and Nucleic acid

**Unit-1-**General introduction proteins and amino acids –Nature, nomenclature and classifications of proteins

**Unit-2-**Structure of peptides - N and C-terminal analysis - Synthesis of peptides by N-protecting groups

**Unit-3-**Enzymes: General introduction - Nature/Nomenclature/classifications of proteins - An elementary treatment of enzyme - Mechanism of enzyme action - Co-enzymes

**Unit-4-**Nucleic acid: Structure - DNA and RNA - Comparison of DNA and RNA - Secondary structure of DNA - Synthesis of nucleic acid.

## Block II: Carbohydrates, Vitamins, Harmones and Prostoglands

**Unit-5-**Carbohydrates: Introduction to Monosaccharides, Disaccahaides and Polysaccharides- Classification, preparation, properties and structures

**Unit-6-** Vitamins: Classification, structure, occurrence and deficiency diseases caused by Vitamin A, B Complex, C, D, E and K

**Unit-7-** Hormones: Definition - Difference between vitamins and harmones - Reproductive Hormones

**Unit-8-** Prostoglands: Introduction - Structure, stereochemistry and synthesis of PGE1.

## Block III: Antibiotics, Pesticides, Fertilizers, Petrochemicals

**Unit-9-**Antibiotics: Definition - Applications of Penicillin, Chloromycetin, Streptomycin and Tetracycline - Definitions of analgesics, anaesthetics, antipyretics and anti-inflammatory

**Unit-10-**Pesticides: Definition - Classification - Inorganic pesticides: Lead arsenate, Paris green, Lime, sulphur, hydrocyanic acid - organic pesticides - DDT and Gammexane

**Unit-11-**Fertilizer: Definition - Classification - Role of various elements in plants growth - Natural and Chemical fertilizers - Urea, Super phosphate, Triple super phosphate and Potassium nitrate

**Unit-12-**Petrochemicals: Introduction - Origin - Composition - Chemicals from natural gas, light Naphtha, petroleum, and Kerosene - Synthetic Gasoline.

## Block IV: Alkoloids, Steroids, Terpenoids and Carotenoids

**Unit-13-** Alkaloids: Definition - Occurrence - Isolation - Synthesis/biosynthesis of morphine, Quinine, Coniine and Nicotine

**Unit-14-** Steroids: Introduction - Occurrence - Nomenclature - Synthesis and stereochemistry of Cholesterol, estrone, progesterone and testosterone

**Unit-15-** Terpenoids:Classification -Occurrence - isoprene rule -Biosynthesis/synthesis of Citral (acyclic), α-Terpeneol (monocyclic), Santonin (bicyclic)

**Unit-16-** Carotenoids:General methods of structure determination of Carotenes: α/β/γ-Carotenes.

## Block V: Green Chemistry

**Unit-17-** Green Chemistry: Definition - Need for green chemistry - Principles of green chemistry

**Unit-18-** Green synthesis - Concept of atom economy - Solvent free reactions - Aqueous phase reactions - Reactions in ionic liquids - Solid supported synthesis

**Unit-19-** Green catalysts -Phase transfer catalysts (PTC) and Biocatalysts - Microwave and Ultrasound assisted green synthesis

**Unit-20-** Evaluating the effects of Chemistry: Toxicity to humans, Toxicity to wildlife, Effects on local environment, Global environmental effects- Green chemical synthesis of Paracetamol, Ibuprofen - Applications of green chemistry

### Text Books:


1. I. L. Finar, Organic chemistry Volume 2.
2. Niranjan Das, Natural Products' Chemistry.
3. O. P. Agarwal, Natural Products Chemistry, I Edition.
4. K. AnandSolamon, Chemistry of Natural Products.


### Reference Books:


1. J. L.Jain, S.Jain, N.Jain, S. Chand,Fundamentals of Biochemistry (2005).
2. L.Stryer, J. M.Berg, J. L,Tymoczko, W.H. Freeman,Biochemistry (2004) IV Edition.
3. E. E.Conn, F. Stump, Outlines of Biochemistry, John Wiley (2006), V Edition.
4. D. L.Nelson, M.M. Cox, W.H. Freeman,Principles of Biochemistry, (2004),IV Edition.
5. A. L. Lehinger, Principles of Biochemistry, Worth Publications, II Edition.
6. L. Stryer, W. H. Freeman, Biochemistry
7. V. K. Ahluwalia, Green Chemistry,II Edition.
8. P. T. Anastas and J. C. Warner, Green chemistry Theory and Practice; Oxford University Press, New York, 2005.

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# M. Sc. CHEMISTRY SYLLABUS
# I YEAR (Distance Mode)

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|---|---|
| **Course Title** | **POLYMER CHEMISTRY** |
| **Course Code** | **MCHE - 16** |
| **Course Credit** | **6** |

## COURSE OBJECTIVES

While studying the Polymer Chemistry course, the student shall be able to:

- Understand the concepts involved in polymer chemistry
- Gain knowledge on the stereoisomerism occurs in polymer molecules
- Study thestructure and properties of polymer molecules
- Know about the characterization methods of polymer molecules
- Get awareness on the types of commercial, natural and speciality polymers

## COURSE OUTCOMES

After completion of the Polymer Chemistry course, the student will have the ability to:

- Define the concepts involved in polymer chemistry
- Explain the stereoisomerism occurs in polymer molecules
- Understand the structure and properties of polymer molecules
- Gain knowledge on the characterization methods of polymer molecules
- Acquire knowledge on the types of commercial, natural and speciality polymers

## Block I: Concepts in Polymers

**Unit-1-** Introduction to polymers and polymerization - Classification -Linear, branched and cross linked polymers

**Unit-2-** Thermoplastic and thermosetting polymers - Elastomers, Fibers and Resins - Chemical and geometrical structure of polymers

**Unit-3-** Polymerization: Chain polymerization, step growth polymerization, electrochemical, metathetical polymerization, group transfer polymerization

**Unit-4-** Techniques of polymerization - emulsion, bulk, solution and suspension.

## Block II: Stereoisomerism in Polymers

**Unit-5-** Types of stereoisomerism in polymers –Monosubstitutedethylenes(Site of steric isomerism, Tacticity)

**Unit-6-** Disubstitutedethylenes (1,1-disubstituted ethylenes, 1,2-disubstituted ethylenes), 1,3- Butadiene and 2-Substituted 1,3-Butadienes (1,2- and 3,4-Polymerizations, 1,4-Polymerizations),

**Unit-7-** Disubstitutedethylenes (1,1-disubstituted ethylenes, 1,2-disubstituted ethylenes), 1,3- Butadiene and 2-Substituted 1,3-Butadienes (1,2- and 3,4-Polymerizations, 1,4-Polymerizations),

**Unit-8-** Stereoregular polymers: Significance ofstereoregularity (isotactic, syndiotactic, and atacticpolypropenes), Cis- and trans-1,4-poly-1,3-dienes, Cellulose and amylose. Coordination polymerization: Ziegler Natta catalyst.

## Block III: Structure and Properties of Polymers

**Unit-9-** Morphology and order in crystalline polymers- Configurationsof polymer chains

**Unit-10-** Crystal structures of polymers - Strain-induced morphology

**Unit-11-** Crystalline melting point,Tm- melting points of homogeneous series, effect of chain flexibility and other steric factor,entropy and heat of fusion

**Unit-12-** The glass transition temperature, Tg, relationship between Tm and Tg - Effect of molecular weight, diluents, chemical structure, chain topology, branching and crosslinking.

## Block IV: Polymer Characterization

**Unit-13-** Average molecular weight concept - Number, weight and viscosityaverage molecular weights

**Unit-14-** Polydispersity and molecular weight distribution - The practicalsignificance of molecular weight

**Unit-15-** Measurement of molecular weights - End group, viscosity, lightscattering, osmotic and ultracentrifugation methods

**Unit-16-** Analysis and testing of polymers- Chemicalanalysis, spectroscopic methods, thermal Analysis, XRD and SEM

## Block V: Commercial, Natural and Speciality Polymers

**Unit-17-** Commercial Polymers:Polyethylene, Polyvinyl chloride, Polyamides, Polyesters, Phenolicresins, Epoxy resins and silicone polymers

**Unit-18-** Functional polymers-Fire retarding polymers andelectrically conducting polymers-Natural Polymers: Importance of natural polymers -Application and structures of starch, cellulose and chitosin derivatives

**Unit-19-**Speciality Polymers: Bio polymers - Biodegradable polymers - Biomedical polymers - Poly electrolytes - High temperature and fire retardant polymers - Polymer blend

**Unit-20-** Polymer composites -Polymer nanocomposites- IPN polymers - Electroluminescent polymers.

## Text Books:


1. V. R. Gowarikar, B. Viswanathan, J. Sridhar, Polymer Science - Wiley Eastern, 1986, I Edition.
2. G. S. Krishenbaum, Polymer Science Study Guide, Gordon Breach Science publishing, New York, 1973, I Edition.
3. P. Bahadur, N. V. Sastry, Principles of Polymer Science, Narosa Publishing House.
4. G. S. Misra – Introduction to Polymer Chemistry, Wiley Eastern Ltd.


## Reference Books:


1. F. W. Bill Meyer. Text book of polymer science, III Edition, John Wiley and sons, New York.
2. P. J. Flory. Principles of Polymer Chemistry, Cornell Press (recent edition).
3. G. Odian, Principles of Polymerization, McGraw Hill Book Company, New York, 1973.
4. A. Rudin, The Elements of Polymer Science and Engineering. Academic Press, New York, 1973.
5. C. E. H. Brawn, The Chemistry of High Polymers, Butter worth & Co., London, 1948.

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# M. Sc. CHEMISTRY SYLLABUS
# II YEAR (Distance Mode)

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|---|---|
| **Course Title** | **ORGANIC CHEMISTRY - II** |
| **Course Code** | **MCHE - 21** |
| **Course Credit** | **6** |

## COURSE OBJECTIVES

While studying the Organic Chemistry - II course, the student shall be able to:

- Understand the characteristic features and types of rearrangement and pericyclic Reactions
- Acquire knowledge on the synthesis and reactivity of heterocyclic compounds
- Get awareness on the chemistry of natural products
- Know about the concepts and applications of photochemistry organic compounds
- Study the principle, terms and applications of NMR, IR and UV-Spectroscopy

## COURSE OUTCOMES

After completion of the Organic Chemistry -II course, the student will have the ability to:

- Understand the characteristic features and types of rearrangement and pericyclic Reactions
- Define the synthesis and reactivity of heterocyclic compounds
- Explain the chemistry of natural products
- Know about the concepts and applications of photochemistry organic compounds
- Describe the principle, terms and applications of NMR, IR and UV-Spectroscopy

## Block I: Rearrang Ement and Pericyclic Reactions

**Unit-1-**Introduction to Rearrangement Reactions – Inter and intra molecular rearrangements - Rearrangement to electron deficient Carbon - 1,2 shift (Wagner- Meerwein and Pinacol-Pinacolone rearrangements)

**Unit-2-**Rearrangements from oxygen to ring carbon (FriesandClaisen rearrangements) - Rearrangements to electron deficient Nitrogen (BeckmannandSchmidt rearrangements) - Rearrangement to electron deficient Oxygen (Baeyer-Villiger)

**Unit-3**-Pericyclic Reactions: Classifications - Concerted reactions - Orbital symmetry and Concerted symmetry - Woodward and Hoffmann rules

**Unit-4**-Selection rules for electrocyclic and cycloaddition reactions - their FMO approach and correlation diagram - Sigmatropic rearrangements - 1,3, 1,5 and 1,7-hydrogen shifts - 1,3-Dipolar cycloaddition reactions - Types of dipoles

## Block II: Chemistry of Heterocycles

**Unit-5**-Introduction to heterocyclic compounds - Trivial, systematic and replacement nomenclature

**Unit-6**-Synthesis and reactivity of oxazoles, imidazoles, thiazoles, isooxazoles and aziridines

**Unit-7**-Synthesis and reactivity ofoxetanes, triazoles, pyridine, pyrazoles, isothiazoles, pyrimidines, purines, and triazines,

**Unit-8**-Synthesis and reactivity ofpyrazines, pyridazines, quinoline, isoquinoline, indole, benzofuran and benzothiophene.

## Block III: Chemistry of Natural Products

**Unit-9**-Steroids: Introduction - Partial synthesis of androsterone and testosterone (from Cholesterol)

**Unit-10**-Total synthesis: Johnson's synthesis of progesterone and Vollhardt's synthesis of estrone

**Unit-11**-Terpenoids: Introduction - Biosynthesis of menthol, camphor - Total synthesis: Takasago synthesis of menthol, Corey's synthesis of longifolene

**Unit-12**-Alkaloids: Introduction - biosynthesis of nicotine, camptothecin - Total synthesis: Corey's synthesis of epibatidine - Woodward's synthesis of reserpine.

## Block IV: Organic Photochemistry

**Unit-13**-Introduction to organic photochemistry - Basic concepts - Energy transfer - Characteristics of photoreactions

**Unit-14**-Photooxidation - Photo reduction- Photosensitization - Photoreactions of ketones and enones - Norrish Type I and II reactions - Paterno-Buchi reaction

**Unit-15**-Photochemistry of alkenes, dienes and aromatic compounds - di-π-methane rearrangement

**Unit-16**-Photochemistry of $\alpha,\beta$-unsaturated carbonyl compounds - Photolytic cycloadditions - Photolytic rearrangements - Photo additions - Barton reaction.

## Block V: NMR, IR and UV-Spectroscopy

**Unit-17-** Basic concepts and principles of NMR spectroscopy - $^{1}H$ NMR: Chemical shift - Coupling constant - Factors influencing chemical shift/coupling constant - $^{1}H$ NMR spectra of simple organic molecules [$CH_3CH_2OH$, $CH_3CH_2Cl$, $CH_3CHO$ etc.] - AX and AB spin system Nuclear Overhauser effect

**Unit-18-** $^{13}C$ NMR: Proton decoupled and off - resonance $^{13}C$ NMR spectra - Factors affecting $^{13}C$ chemical shift - $^{13}C$ NMR spectra of simple organic molecules

**Unit-19-**IR Spectroscopy: Vibrational frequencies - Identification of functional groups - Intra and inter molecular hydrogen bonding - Finger print region - Far IR region

**Unit-20-**UV spectroscopy - Electronic transitions - Types - Chromophores and Auxochromes - Factors influencing positions and intensity of absorption bands - Absorption spectra of dienes, unsaturated carbonyl compounds.

### Text Books:


1. P. Ramesh,Basic principles of Organic Stereochemistry, Madurai Kamaraj University.
2. P. S. Kalsi,Stereochemistry, II Edition.
3. D. Nasipuri, Stereochemistry of organic compounds.
4. J. D. Coyle, Organic Photochemistry; Wiley, New York, 1998.
5. G. R. Chatwal, Organic Phtochemistry; 1st Ed., Himalaya Publications house, Bangalore, 1998.
6. R.R. Gupta, M. Kumar and V.Gupta,Heterocyclic Chemistry Vol. 1-3, Springer Verlag.
7. P.S. Kalsi, The chemistry of Natural Products.
8. V.M. Parikh, Absorption spectroscopy of organic molecules,I Edition


### Reference Books:


1. J. Clayden, N. Greeves, S. Warren, and P. Wothers, Organic Chemistry; I Edition, Oxford University Press, UK, 2000.
2. T.L. Gilchrist, Longman Heterocyclic Chemistry.
3. Raymond Chang, Basic Principles of Spectroscopy, McGraw Hill Ltd., NewYork (1971).
4. R.M. Silverstein, G.C.BasslerSpectroscopic identification of organic compounds.

TAMIL NADU OPEN UNIVERSITY
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# M. Sc. CHEMISTRY SYLLABUS
# II YEAR (Distance Mode)

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|---|---|
| **Course Title** | **INORGANIC CHEMISTRY - II** |
| **Course Code** | **MCHE - 22** |
| **Course Credit** | **6** |

## COURSE OBJECTIVES

While studying the Inorganic Chemistry -II course, the student shall be able to:

- Acquire knowledge on the characteristic features and application of organo metallic chemistry
- Understand the spectral and magnetic properties of metal complexes
- Know about the applications of nuclear chemistry
- Gain knowledge on the types of mechanism involved in the inorganic reactions
- Study the non-aqueous solvents and chemistry of solid state molecules

## COURSE OUTCOMES

After completion of the Inorganic Chemistry –II course, the student will have the ability to:

- Describe thecharacteristic features and application of organo metallic chemistry
- Analyse thespectral and magnetic properties of metal complexes
- Understand the applications of nuclear chemistry
- Define the types of mechanism involved in the inorganic reactions
- Explain the non-aqueous solvents and chemistry of solid state molecules

## Block I: Organometallic Chemistry

**Unit-1-** Carbon donors: Alkyls and aryls metallation -Bonding in carbonyls and nitrosyls -Chain and cyclic donors -Synthesis, structure and bonding ofmetallocenes

**Unit-2-** Reactions: Association substitution, addition and elimination reactions, ligand protonation, carbonylation, decorboxylation, oxidative addition and fluxionality

**Unit-3-** Catalysis: Hydrogenation of olefins (Wilkinson's catalyst), hydroformylation of olefins using cobalt or rhodium catalysts (Oxo process), oxidation of olefins to aldehydes and ketones (Wacker process) polymerization (Zeigler-Natta Catalyst)

**Unit-4-** Cyclooligomerisation of acetylene using nickel catalyst (Reppe's catalyst) - Polymer - bound catalysts.

## Block II: Spectral and Magnetic Properties of Metal Complexes

**Unit-5-**UV Visible, IR and Raman spectra of simple inorganic compounds with special reference to coordination sites -NMR: NMR of $^{31}P$, $^{19}F$ -Shift reagents -Mossbauer: Mossbauer spectra of Fe and Sn systems

**Unit-6-**ESR: Introduction - Zeeman equation, g-value, nuclear hyperfine splitting- Anisotropy - g-value and hyperfine splitting constant - ESR of transition metal complexes of copper, manganese and vanadyl complex

**Unit-7-**Photo Electron Spectroscopy (UV and X-ray) -Koopman's theorem, time structure in PES, chemical shift and correlation with electronic charges

**Unit-8-**Magnetic properties of complexes: Para/Diamagnetic complexes -Molar susceptibility, Gouy method for the determination of magnetic moment of complexes - Spin only magnetic moment

## Block III: Nuclear Chemistry

**Unit-9-**Properties of nucleus - Types of nuclear forces - liquid drop/shell model of nucleus

**Unit-10-**Nuclear reactions induced by charged particles - Nuclear Cross-section - Theory of nuclear fission - Conditions for controlled fission chain reaction

**Unit-11-**Nuclear reactor and its components -Production of feed materials for nuclear reactors - Disposal of radioactive wastes

**Unit-12-**Nuclear fusion - Stellar energy - Application of radioisotopes in agriculture, industry and medicine - Neutron activation analysis - Hot atom chemistry.

## Block IV: Inorganic Reaction Mechanism

**Unit-13-**Inorganic reaction mechanism: Stabilities of complexes in aqueous solutions

**Unit-14-**Thermodynamic and determination of stability constant by Job's continuous variation method - Labile and inner complexes

**Unit-15-**Stereochemistry of substitution reactions in octahedral coordination compounds

**Unit-16-**Acid hydrolysis - Aquation and Anation reaction - Base hydrolysis -Conjugate base mechanism - Isomerization and racemisation -Trans effect.

## Block V: Non-aqueous Slvents and Solid State Chemistry

**Unit-17-**Classification of solvents -Non aqueous solvents -Typical reactions in liquid ammonia, sulphur dioxide, dinitrogen tetroxide, anhydrous hydrogen fluoride, sulphuric acid and acetic acid

**Unit-18-**HSAB concept of acids and bases - Acid, base strength and hardness and softness - Symbiosis - Theories of hardness and softness

**Unit-19-**Solid State Chemistry:Close packing of atoms and ions - FCC, HCP and BCC types of packing- Representative structures of AB and AB., types of compounds- Rock salt, calcium chloride,wurtzite, Zinc blende,rutile, fluorite,antifluorite, and nickel arsenide

**Unit-20-**Structure of Graphite and Diamond - Schotky and Frenkel defects- Nonstochiometric defects.

## Text Books:


1. SathyaPrakas, G. D. Tuli, S. K. Basu, R. D. Madhan, Advanced Inorganic Chemistry I
2. Wahid U. Malik, G. D. Tuli, R. D. Madhan, Selected Topics in Inorganic Chemistry
3. J.E. Huheey, Inorganic Chemistry, Harper and Collins, NY, IV Edition, (1993).
4. J. D. Lee, Inorganic Chemistry, I Edition
5. AshuthoshKar, Advanced Inorganic Chemistry
6. Puri, Sharma, Kalia, Principles of Inorganic Chemistry


## Reference Books:


1. J. M.Hollas, Modern Spectroscopy, John Wiley (1996),III Edition
2. R.C. Mehrotra, A. Singh.Organomettalic Chemistry, A Unified Approach,
3. Chang,R., Basic Principles of Spectroscopy, McGraw-Hill (1971).
4. U.C.Dash,Nuclear Chemistry.
5. B.G.Harvey,Nuclear Chemistry.
6. SamuvelGlastone, Source book of atomic energy.
7. R.H. Crabtree,The Organometallic Chemistry of Transition metals.
8. A. Salzer, VCH, Organometallics by Ch. Elschenbroich, 1995, II Edition.
9. Edberg,Inorganic Reaction Mechanism.
10. BasoloavdPearsor, Inorganic Reaction Mechanism.
11. R. R. Jordan,Reaction Mechanism in Inorganic Chemistry by Oxford Univ. Press, 1998. II Edition.
12. A. R. West, Solid State Chemistry and Its Applications; II Edition, John Wiley and sons, New York, 2014.

**TAMIL NADU OPEN UNIVERSITY**
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Chennai-15

# M. Sc. CHEMISTRY SYLLABUS
# II YEAR (Distance Mode)

| | |
|---|---|
| **Course Title** | **PHYSICAL CHEMISTRY - II** |
| **Course Code** | **MCHE - 23** |
| **Course Credit** | **6** |

## COURSE OBJECTIVES

While studying the Physical Chemistry -II course, the student shall be able to:

- Know about the concepts and characteristic features in statistical thermodynamics
- Understand the kinetics of chemical reactions
- Study the types, mechanism and applications of surface reaction
- Gain knowledge on the terms and applications of group theory
- Get awareness on the photochemical reactions and photochemistry of environment

## COURSE OUTCOMES

After completion of the Physical Chemistry -II course, the student will have the ability to:

- Describe the concepts and characteristic features in statistical thermodynamics
- Explain the kinetics of chemical reactions
- Understand the types, mechanism and applications of surface reaction
- Acquire knowledge on the terms and applications of group theory
- Explain the photochemical reactions and photochemistry of environment

## Block I: Statistical Thermodynamics

**Unit-1-**Concept of ensembles: Canonical ensembles - Grand Canonical ensembles - Thermodynamic quantities - Boltzmann distribution - Bose-Einstein - Fermi-Dirac distributions

**Unit-2-**Partition functions: Molecular, Translational, rotational and vibrational partition functions

**Unit-3-**Ideal mono atomic and diatomic gases - Classical partition functions - Thermodynamic properties and Chemical equilibrium

**Unit-4-**Linear response theory - Irreversible processes -Onsager's law - Entropy production - Non-equilibrium stationary states.

## Block II: Chemical Kinetics - II

**Unit-5-**Solution and gas phase kinetics: Chain reactions and its rate laws - Hydrogen-bromine reaction - chain-branching explosion reactions

**Unit-6-** Polymerization kinetics: stepwise and chain polymerizations. Homogeneous catalysis: Features of acid-base catalysis

**Unit-7-**Enzymes: Michaelis-Menten mechanism of enzyme catalysis - Catalytic efficiency of enzymes - Mechanisms of enzyme inhibition

**Unit-8-**Fast reaction kinetics: Relaxation methods (T- and P-jump methods) - Stopped flow methods - Shockwave technique - Flash photolysis.

## Block III: Surface Reactions

**Unit-9-**Introduction to surface reactions -Frendlich adsorption isotherm - Langmuir adsorption isotherm - BET

**Unit-10-**Determination of surface area - Adsorption coefficient and its significance - Mechanism of heterogeneous catalysis

**Unit-11-**Unimolecular and bimolecular surface reactions - Langmuir-Hinshelwood mechanism - Langmuir-Rideal mechanism - Catalysis by metals and semiconductor oxides.

## Block IV: Group Theory

**Unit-12-**Symmetry elements and symmetry operations - Centre of symmetry - Plane and its types of Symmetry - Proper and Improper axis of Symmetry

**Unit-13-**Principal axis and subsidiary axes - The concept of groups - Assigning Point groups with illustrative examples

**Unit-14-**Symmetry operations and order of a group - Group theoretical rules (Group postulates) - Reducible and irreducible representations

**Unit-15-**Matrix representations of symmetry operations - Construction of Character Tables for $C_{2v}$ and $C_{3v}$ point group molecules - Great Orthogonality theorem and its proof.

## Block V: Photochemistry

**Unit-16-**Absorption of light and nature of electronic spectra - electronic transition - Frank-Condon principle - Selection rules- Photodissociation, Predissociation

**Unit-17-**Photochemical reactions: Photoreduction, photooxidation, photodimerization, photochemical substitution, photoisomerization

**Unit-18-**Photochemistry of environment: Green-house effect - Joblonski diagram - Photophysical process in electronically excited molecules by different types of pathways

**Unit-19-**Fluorescence - Phosphorescence - Internal conversion- Intersystem crossing

**Unit-20-**Photosensitization -Chemiluminences- Lasers - Fluorescence quenching: Concentration quenching - Stern-Volmer equation - Solar energy storage and conversion.

## Text Books:


1. B. R. Puri, M. Sharma, S. Pathania, Physical Chemistry, I Edition.
2. K.J. Laidler, Chemical Kinetics, I Edition.
3. C.N. Banwell, Fundamentals of Molecular Spectroscopy, II Edition.
4. Pearson House, Fundamentals of Chemical Kinetics.
5. Pearson House, Fundamentals of Quantum Chemistry.
6. R.C. Srivastava, S.K. Saha, A.K. Jain,Thermodynamics.
7. N.N. Dass, Symmetry and Group Theory for Chemists, Asian Books Pvt. Ltd (2004).
8. M. S.Gopinathan, V.Ramakrishnan, Group Theory in Chemistry, Vishal Publishers (2006).
9. Veera Reddy, Symmetry and spectroscopy.


## Reference Books:


1. Kinetics and Mechanism of Reaction Rates: A.Frost and G. Pearson.
2. Modern Chemical Kinetics: H. Eyring
3. Theories of Reaction Rates: K.J. Laidler, H. Eyring and S. Glasston
4. J.N. Bradly Fast Reactions:
5. CaldinFast Reactions in Solutions:
6. P.W. Atkins, Physical Chemistry, W.H. Freeman (1997) VI Edition.
7. Puri, B.R., Sharma, L.R., and Pathania, M.S., Principles of Physical Chemistry, Vishal Publishing Co. (2011), IV Edition.
8. K.L. Kapoor, A Text Book of Physical Chemistry, Vol. 3, Macmillan India (2005), II Edition.
9. K.J.Laidler, Chemical Kinetics, Dorling Kingsley (2007).
10. J.Rajaraman,J. Kuriacose, Kinetics and Mechanism of Chemical Transformations, McMillan (2008).

# TAMIL NADU OPEN UNIVERSITY
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# M. Sc. CHEMISTRY SYLLABUS
# II YEAR (Distance Mode)

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|---|---|
| **Course Title** | **ORGANIC ESTIMATION AND SYNTHESIS** |
| **Course Code** | **MCHEP - 01** |
| **Course Credit** | **6** |

## COURSE OBJECTIVES

While studying the Organic Estimation and Synthesis practical course -I, the student shall be able to:

- Know about the basic terms and concepts involved in the estimation and synthesis of an organic compound.
- Gain knowledge on the estimation of an organic compound.
- Understand the single stage preparation methods involving various types of reactions for the synthesis of organic compounds.

## COURSE OUTCOMES

After completion of the Organic Estimation and Synthesis practical course -I, the student will have the ability to

- Describe the basic terms and concepts involved in the estimation and synthesis of an organic compound.
- Estimate the given organic compounds using various methods of estimation.
- Synthesize the organic compounds using various types of organic reactions in a single stage method

## ORGANIC ESTIMATION AND SYNTHESIS

**I. Organic Estimation:** Estimation of Phenol, Aniline and Glucose.

**II. Organic Synthesis:** One stage preparations involving various types of reactions (Any four synthesis can be selected).

1. Oxidation: Adipic acid by chromic acid oxidation of Cyclohexanol.
2. Aldol condensation: Dibenzal acetone from Benzaldehyde.
3. Sandmeyer reaction: p- Chlorotoulene from p-Toluidine.

4. Cannizzaro reaction: 4-chlorobenzyldehyde as a substrate.
5. Aromatic Electrophilic substitutions:

(i) Synthesis of p-Nitroaniline and - Synthesis of p-Bromoaniline.

| University Practical Examination | Mark Distribution |
|---|---|
| Estimation | 40 |
| Synthesis | 40 |
| Record | 10 |
| Viva voce | 10 |
| Total | 100 |

## Text and Reference Books:


1. N.S. Gnanapragasam and B. Ramamoorthy, “Organic Chemistry Lab Manual” (2006), S. Visvanathan Printers & Publishers.
2. Experiments and Techniques in Organic Chemistry, D.Pasto, C. Johnson and M.Miller, PrenticeHall.
3. H.Middleton, Adward Arnold, Systematic Qualitative Organic Analysis,
4. H.Clark, AdwardArnold,.Handbook of Organic Analysis-Qualitative and Quantitative,
5. Vogel’s Textbook of Practical Organic Chemistry, A.R. Tatchell, John Wiley.

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# M. Sc. CHEMISTRY SYLLABUS
# II YEAR (Distance Mode)

| | |
|---|---|
| **Course Title** | **INORGANIC ANALYSIS, ESTIMATION AND PREPARATION** |
| **Course Code** | **MCHEP - 02** |
| **Course Credit** | **6** |

## COURSE OBJECTIVES

While studying the Inorganic Analysis, Estimation and Preparation practical course -II, the student shall be able to:

- Acquire knowledge on the basic terms and concepts involved in the semi-micro qualitative analysis of inorganic ions, estimation and preparation of inorganic compounds.
- Understand the analysis of mixture two common cations and less common cations using semi-micro qualitative analysis method.
- Know about the estimation of inorganic metal ions using photoelectric colorimetry method.
- Gain knowledge on the preparation of inorganic compounds using various synthetic procedures.

## COURSE OUTCOMES

After completion of the Inorganic Analysis, Estimation and Preparation practical course -II, the student will have the ability to:

- Describe the basic terms and concepts involved in the semi-micro qualitative analysis of inorganic ions, estimation and preparation of inorganic compounds.
- Analyse the mixture two common cations and less common cations using semi-micro qualitative analysis method
- Estimate theinorganic metal ions using photoelectric colorimetry method.
- Prepare the inorganic compounds using various synthetic procedures.

## INORGANIC ANALYSIS, ESTIMATION AND PREPARATION

**I. Semi-micro qualitative analysis:** Analysis of mixture two common cations (Pb, Bi, Ca, Cd, Fe, Cr, Al, Co, Ni, Mn, Zn, Ba, Sr, Ca, Mg,) and two less common cations (W, Tl, Se, Te, Mo, Ce, Th, Zr, Ti, V, U, Li).

**II. Estimation:** Estimation of copper, nickel and Iron ions using photoelectric colorimeter.

**III. Preparation:** Any four preparations from the following:

- Potassium tris (oxalate) aluminate (III) trihydrate
- Potassium tris (oxalato) chromate (III) trihydrate
- Tris (thiourea) copper (I) chloride
- Tris sodium hexanitrocobaltate (III)
- Chloropentammine cobalt (III) chloride
- Bis (acetylacetonato) copper (II)

| University Practical Examination | Mark Distribution |
|---|---|
| Qualitative Inorganic Analysis | 25 |
| Estimation | 25 |
| Preparation | 30 |
| Record | 10 |
| Viva voce | 10 |
| Total | 100 |

### Text and Reference Books:


1. W. G. Palmer,Experimental Inorganic Chemistry, I Edition.
2. A. I. Vogel,A text book of Quantitative Inorganic Analysis.
3. V. V. Ramanujam, Inorganic Semimicro Qualitative Analysis; III Edition,NationalPubs, London, 1988.
4. G. Svehla, Text Book of Macro and Semimicro Qualitative InorganicAnalysis; V Edition, Longman group Ltd, London, 1987.
5. A. I. Vogel, Text Book of Quantitative Inorganic Analysis; VI Edition,Longman,New Delhi, 2000.

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# M. Sc. CHEMISTRY SYLLABUS
# II YEAR (Distance Mode)

| | |
|---|---|
| **Course Title** | **PHYSICAL CHEMISTRY EXPERIMENTS** |
| **Course Code** | **MCHEP - 03** |
| **Course Credit** | **6** |

## COURSE OBJECTIVES

While studying the Physical chemistry experiments practical course -III, the student shall be able to:

- Know about the basic terms, concepts applications of physcial chemistry experiments such as conductometric, surface tension adsorption, kinetic, partition-coefficient measurements, potentiometric and redox titrations
- Gain knowledge onthe determination of cell constant, verification of Ostwald dilution law for weak acetic acid andconductometric titrations ofacids and bases.
- Understand the surface tension of the pure solvents
- Know about the determination of partition – coefficient for the given mixture
- Get awareness on the verification of Freundlich adsorption isotherm forthe given mixture
- Acquire knowledge on the kinetics of Hydrolysis and Determination of rate constant for the reaction.
- Understand the potentiometric titrations of the given acid and base.
- Know about the redox titrations of the given mixture.

## COURSE OUTCOMES

After completion of the Physical chemistry experimentspractical course -III, the student will have the ability to:

- Describethe basic terms, concepts applications of physcial chemistry experiments such as conductometric, surface tension adsorption,kinetic, partition-coefficient measurements, potentiometric and redox titrations
- Determine the cell constant, verify the Ostwald dilution law for weak acetic acid and conductometric titrations of acids and bases.

- Measurement the surface tension of the pure solvents
- Determine the partition – coefficient for the given mixture
- Determine the Freundlich adsorption isotherm forthe given mixture
- Measurement the kinetics of Hydrolysis and Determination of rate constant for the reaction.
- Determine the potentiometric titrations of the given acid and base.
- Determine the redox titrations of the given mixture.

## PHYSICAL CHEMISTRY EXPERIMENTS

From experiments provided, any five experiments can be selected.

1. **Conductometric Measurements:**

   (i) Determination of cell constant
   (ii) Verification of Ostwald dilution law for weak acetic acid
   (iii) Conductometric titrations - strong acid against strong base
   (iv) Conductometric titrations - weak acid against strong base

2. **Surface Tension Measurements:** Surface tension of pure solvents

3. **Partition - Coefficient:** Determination of partition – coefficient for $I_2$ between water and $CCl_4$

4. **Adsorption Measurements:** Verification of Freundlich adsorption isotherm for acetic acid on charcoal.

5. **Kinetic Measurement:**
   (i) Kinetics of Hydrolysis of Methylacetate in the presence of HCl.
   (ii) Determination of rate constant for the reaction between potassium persulphate and potassium iodide.

6. **Potentiometric titrations:** Acid Base titration - Titration of strong acid against strong base.

7. **Redox titration:** Titration of $FeSO_4$ against $K_2Cr_2O_7$.

| University Practical Examination | Mark Distribution |
|---|---|
| Procedure | 25 |
| Manipulation | 25 |
| Result | 30 |
| Record | 10 |
| Viva voce | 10 |
| Total | 100 |

## Text and Reference Books:


1. B.D. Khosla, V.C. Garg and A. Khosla,Senior Practical Physical Chemistry.
2. V. Athawale and P. Mathur, Experimental Physical Chemistry.
3. B. Vishwanathan, P.S. Raghavan, Practical Physical Chemistry.
4. P.S. Sindhu,Practical in Physical Chemistry.