# MAHENDRA ARTS & SCIENCE COLLEGE
## (Autonomous)

Affiliated to Periyar University, Salem.
Accredited by NAAC with 'A' Grade & Recognized u/s 2(f) and 12(B) of the UGC Act 1956
Kalippatti – 637 501, Namakkal (Dt), Tamil Nadu.

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## DEPARTMENT OF CHEMISTRY

### Number of Courses Focusing on Employability/ Entrepreneurship/ Skill Development

**Programme: M.Sc. Chemistry**

| S. No. | Year | Total No. of Courses | Employability (1) | Entrepreneurship (2) | Skill development (3) | Total No. of Courses (1+2+3) |
|---|---|---|---|---|---|---|
| 1 | 2020-2021 | 35 | 2 | - | 9 | 11 |
| 2 | 2019-2020 | 40 | 1 | - | 9 | 10 |
| 3 | 2018-2019 | 39 | 1 | - | 6 | 7 |
| 4 | 2017-2018 | 39 | 1 | - | 6 | 7 |
| 5 | 2016-2017 | 19 | 1 | - | 3 | 4 |

Head of the Department
HOD, Department of Chemistry
MAHENDRA ARTS & SCIENCE COLLEGE
Kalippatti (PO.), Namakkal (Dt.)

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## DEPARTMENT OF CHEMISTRY

**List of Courses Focusing on Employability/ Entrepreneurship/ Skill Development (Regulations – 2019)**

**Programme: M.Sc. Chemistry**

| S. No. | Course Name | Course Code | Employability | Entrepreneurship | Skill development |
|---|---|---|---|---|---|
| 1 | Elective-I-Dye Chemistry | M19PCHE01 | - | - | ✓ |
| 2 | Elective-I-Polymer Chemistry | M19PCHE02 | ✓ | - | |
| 3 | Elective-II-Water Chemistry | M19PCHE05 | - | - | ✓ |
| 4 | Practical-I-Inorganic Qualitative Analysis | M19PCHP01 | - | - | ✓ |
| 5 | Practical-II-Physical Chemistry Experiments-I | M19PCHP02 | - | - | ✓ |
| 6 | Practical-III-Inorganic Estimation and Preparation | M19PCHP03 | - | - | ✓ |
| 7 | Practical-IV-Organic Estimation and Preparation | M19PCHP04 | - | - | ✓ |
| 8 | Elective-III-Textile Chemistry | M19PCHE09 | ✓ | - | |
| 9 | Practical-V-Organic Analysis | M19PCHP05 | - | - | ✓ |
| 10 | Practical-VI-Physical Chemistry Experiments-II | M19PCHP06 | - | - | ✓ |
| 11 | Practical-VII-Inorganic and Organic preparation | M19PCHP07 | - | - | ✓ |

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## DEPARTMENT OF CHEMISTRY

**List of Courses Focusing on Employability/ Entrepreneurship/ Skill Development (Regulations – 2019)**

**Programme: M.Sc. Chemistry**

| S.No. | Name of the Course | Course Code | Employability/ Entrepreneurship/ Skill development | Year of introduction (during the last five years) |
|---|---|---|---|---|
| 1. | Elective-I-Dye Chemistry | M19PCHE01 | Skill development | 2019 - 2020 |
| 2. | Elective-I-Polymer Chemistry | M19PCHE02 | Employability | 2019 - 2020 |
| 3. | Elective-II-Water Chemistry | M19PCHE05 | Skill development | 2019 - 2020 |
| 4. | Practical-I-Inorganic Qualitative Analysis | M19PCHP01 | Skill development | 2019 - 2020 |
| 5. | Practical-II-Physical Chemistry Experiments-I | M19PCHP02 | Skill development | 2019 - 2020 |
| 6. | Practical-III-Inorganic Estimation and Preparation | M19PCHP03 | Skill development | 2019 - 2020 |
| 7. | Practical-IV-Organic Estimation and Preparation | M19PCHP04 | Skill development | 2019 - 2020 |
| 8. | Elective-III-Textile Chemistry | M19PCHE09 | Employability | 2020 - 2021 |
| 9. | Practical-V-Organic Analysis | M19PCHP05 | Skill development | 2020 - 2021 |
| 10. | Practical-VI-Physical Chemistry Experiments-II | M19PCHP06 | Skill development | 2020 - 2021 |
| 11. | Practical-VII-Inorganic and Organic preparation | M19PCHP07 | Skill development | 2020 - 2021 |

**Head of the Department**
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## MASTER OF SCEINCE

## SYLLABUS FOR M.Sc. CHEMISTRY

## OUTCOME BASED EDUCATION - CHOICE BASED CREDIT SYSTEM

***For the students admitted from the Academic Year 2019-2020 onwards***

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(Autonomous)
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# MAHENDRA ARTS & SCIENCE COLLEGE
## (Autonomous)
## (Affiliated to Periyar University)

## Department of Chemistry

## M.Sc. Chemistry Degree Programme

**I- PREAMBLE**

Chemistry is a fundamental science and has contributed immensely to the improvement of the life of human beings by providing many of human requirements and essentialities. The developments in chemistry during last few decades are phenomenal. It is also seen that these developments are crossing the traditional vertical boundaries of scientific disciplines. New branches of chemistry are emerging and gaining importance, such as bioorganic chemistry, materials chemistry, nano - chemistry, computational chemistry, etc. A chemist cannot isolate himself from other disciplines. Thus, after a long span of more and more specialization in post graduate syllabi, a symbiotic interdisciplinary approach now seems to be more relevant. The practice of Chemistry over a span of more than a century has also created concomitant and perhaps unavoidable impacts of human environment. The chemical industry is now pressurized 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. The principles and applications of chemistry should be learnt on this background.

**II- PROGRAMME OBJECTIVES**

To develop

1. Human Values and Social Responsibilities in the context of learning Chemistry
2. Positive approach towards Environment and Ecology from the Chemistry perspective
3. Extension of Chemistry in the social context for solving social issues
4. Entrepreneurial Skills to start their own industries / business in core chemistry and applied chemistry fields
5. Analytical and Experimental Skills of the students capable of doing higher-level research works in the emerging fields of chemistry.

## III- PROGRAMME OUTCOMES

1. Graduates are prepared to be creators of new knowledge leading to innovation and entrepreneurship employable in various sectors such as private, government, and research organizations.
2. Graduates are trained to evolve new technologies in their discipline.
3. Graduates are groomed to engage in lifelong learning process by exploring their knowledge independently.
4. Graduates are framed to design and conduct experiments /demos/create models to analyze and interpret data.
5. Graduates ought to have the ability of effectively communicating the findings of Chemical sciences; incorporating with existing knowledge.

## IV- REGULATIONS

These regulations shall take effect from the academic year 2019-2020, i.e, for students who are to be admitted to the first year of the course during the academic year 2019-20 and thereafter.

### 1. Eligibility for Admission:

A candidate who has passed B.Sc., Chemistry degree of this University or any other University accepted by the Syndicate equivalent thereto, subject to such condition as may be prescribed therefore are eligible for admission to M.Sc., Degree programme and shall be permitted to appear and qualify for the Master of Science (M.Sc.) Degree Examination in Chemistry of this University.

### 2. Duration of the Programme:

The candidates shall complete all the courses of the programme in 2 years from the date of admission. The programme of study shall consist of four semesters and a total period of two years with a minimum of 90 credits. The programme of study will comprise the course according to the syllabus.

### 3. Programme of Study:

The Programme of study for the PG degree courses of all branches shall consist of the following:

i. Core courses
ii. Electives courses
iii. Extra Disciplinary Course
iv. Project
v. Enhancement Compulsory Courses

**4. Examinations**

The Programme of study shall be based on semester pattern with Internal Assessment under Choice Based Credit System.

The examinations for all the papers consist of both Internal (Continuous Internal Assessment - CIA) and External (End Semester) theory examinations. The theory examinations shall be conducted for three hours duration at the end of each semester. The candidates failing in any subject(s) will be permitted to appear for the same in the subsequent semester examinations.

## V- STRUCTURE OF THE PROGRAMME

### SEMESTER: I

| Course Category | Title of the Course | Course Code | Hrs / Week | | No. of Credits | Max. Mark | | |
|---|---|---|---|---|---|---|---|---|
| | | | L | P | | Int. | Ext. | Total |
| CORE COURSE-I | STEREOCHEMISTRY AND REACTION MECHANISM | M19PCH01 | 5 | - | 4 | 25 | 75 | 100 |
| CORE COURSE-II | CHEMISTRY OF INORGANIC COMPOUNDS | M19PCH02 | 5 | - | 4 | 25 | 75 | 100 |
| CORE COURSE-III | CHEMICAL KINETICS AND QUANTUM CHEMISTRY | M19PCH03 | 5 | - | 4 | 25 | 75 | 100 |
| ELECTIVE COURSE-I | ELECTIVE-I-Dye chemistry<br><br>ELECTIVE-I-Polymer chemistry | | 5 | - | 4 | 25 | 75 | 100 |
| CORE PRACTICAL –I | PRACTICAL-I - INORGANIC QUALITATIVE ANALYSIS | M19PCHP01 | - | 5 | 3 | 40 | 60 | 100 |
| CORE PRACTICAL-II | PRACTICAL-II – PHYSICAL CHEMISTRY EXPERIMENTS –I | M19PCHP02 | - | 5 | 3 | 40 | 60 | 100 |
| **Total** | | | **20** | **10** | **22** | **180** | **420** | **600** |

**SEMESTER: II**

| Course Category | Title of the Course | Course Code | Hrs / Week | | No. of Credits | Max. Mark | | |
|---|---|---|---|---|---|---|---|---|
| | | | L | P | | Int. | Ext. | Total |
| CORE COURSE-IV | ORGANIC SPECTROSCOPY | M19PCH04 | 5 | - | 4 | 25 | 75 | 100 |
| CORE COURSE-V | THERMODYNAMICS AND GROUP THEORY | M19PCH05 | 5 | - | 4 | 25 | 75 | 100 |
| *ELECTIVE COURSE-II | ELECTIVE-II – water chemistry | | 4 | - | 4 | 25 | 75 | 100 |
| CORE PRACTICAL –III | PRACTICAL-III – INORGANIC ESTIMATION AND PREPARATION | M19PCHP03 | - | 5 | 3 | 40 | 60 | 100 |
| CORE PRACTICAL-IV | Practical-IV – ORGANIC ESTIMATION AND PREPARATION | M19PCHP04 | - | 5 | 3 | 40 | 60 | 100 |
| EXTRA DISCIPLINARY COURSE | EDC | | 4 | - | 4 | 25 | 75 | 100 |
| ENHANCEMENT COMPULSORY COURSE | HUMAN RIGHTS | M19PHR01 | 2 | - | 2 | 25 | 75 | 100 |
| COMPREHENSIVE EXAMINATION– I | | M19PCHC01 | - | - | 1 | 100 | - | 100 |
| **Total** | | | **20** | **10** | **25** | **305** | **495** | **800** |

***Note:** Open Book examination to be conducted for this course.

**SEMESTER: III**

| Course Category | Title of the Course | Course Code | Hrs / Week | | No. of Credits | Max. Mark | | |
|---|---|---|---|---|---|---|---|---|
| | | | L | P | | Int. | Ext. | Total |
| CORE COURSE-VI | ORGANIC SYNTHESIS AND REARRANGEMENTS | M19PCH06 | 5 | - | 4 | 25 | 75 | 100 |
| CORE COURSE-VII | ORGANOMETALLIC CHEMISTRY | M19PCH07 | 5 | - | 4 | 25 | 75 | 100 |
| CORE COURSE-VIII | ELECTROCHEMISTRY AND PHOTOCHEMISTRY | M19PCH08 | 5 | - | 4 | 25 | 75 | 100 |
| ELECTIVE COURSE-III | ELECTIVE-III- Textile chemistry | | 5 | - | 4 | 25 | 75 | 100 |
| CORE PRACTICAL – V | PRACTICAL-V – ORGANIC ANALYSIS | M19PCHP05 | - | 5 | 3 | 40 | 60 | 100 |
| CORE PRACTICAL-VI | PRACTICAL-VI - PHYSICAL CHEMISTRY EXPERIMENTS – II | M19PCHP06 | - | 5 | 3 | 40 | 60 | 100 |
| **Total** | | | **20** | **10** | **22** | **180** | **420** | **600** |

**SEMESTER: IV**

| Course Category | Title of the Course | Course Code | Hrs / Week | | No. of Credits | Max. Mark | | |
|---|---|---|---|---|---|---|---|---|
| | | | L | P | | Int. | Ext. | Total |
| CORE COURSE-IX | PERICYCLIC REACTION AND NATURAL PRODUCTS | M19PCH09 | 5 | - | 4 | 25 | 75 | 100 |
| CORE COURSE-X | SOLID STATE AND NUCLEAR CHEMISTRY | M19PCH10 | 5 | - | 4 | 25 | 75 | 100 |
| *CORE COURSE-XI | RESEARCH METHODOLOGY | M19PCH11 | 5 | - | 4 | 25 | 75 | 100 |
| CORE PRACTICAL –VII | PRACTICAL-VII - INORGANIC AND ORGANIC PREPARATION | M19PCHP07 | - | 5 | 3 | 40 | 60 | 100 |
| PROJECT | PROJECT | M19PCHPR1 | - | 10 | 5 | 40 | 60 | 100 |
| COMPREHENSIVE EXAMINATION –II | | M19PCHC02 | - | - | 1 | 100 | - | 100 |
| Additional 1 Credit to be provided for SWAYAM / MOOC | | | - | - | - | - | - | - |
| **Total** | | | **15** | **15** | **21** | **255** | **345** | **600** |

***Note:** Open Book examination to be conducted for this course.

**Summary of Credits, Hours and Mark Distribution**

| Course Category | Credits | | | | Total Credits | Total Hours | No. of Courses | Max. Marks |
|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | | | | |
| **Core** | 18 | 14 | 18 | 15 | 65 | 90 | 18 | 1800 |
| **Elective** | 4 | 4 | 4 | - | 12 | 14 | 3 | 300 |
| **EDC** | - | 4 | - | - | 4 | 4 | 1 | 100 |
| **Project** | - | - | - | 5 | 5 | 10 | 1 | 100 |
| **Human Rights** | - | 2 | - | - | 2 | 2 | 1 | 100 |
| **Comprehensive Examination** | - | 1 | - | 1 | 2 | - | 2 | 200 |
| **Total** | 22 | 25 | 22 | 21 | 90 | 120 | 26 | 2600 |

**ELECTIVE SUBJECTS FOR M.Sc. CHEMISTRY STUDENTS**

| Semester | ELECTIVE – I | |
|---|---|---|
| I | **Course Title** | **Course Code** |
| | Dye Chemistry | M19PCHE01 |
| | Polymer Chemistry | M19PCHE02 |
| | Green Chemistry | M19PCHE03 |
| | Bioorganic & Medicinal Chemistry | M19PCHE04 |
| **ELECTIVE – II** | | |
| II | **Course Title** | **Course Code** |
| | Water Chemistry | M19PCHE05 |
| | Nano Chemistry | M19PCHE06 |
| | Applied Catalysis | M19PCHE07 |
| | Computational Quantum Chemistry | M19PCHE08 |
| **ELECTIVE – III** | | |
| III | **Course Title** | **Course Code** |
| | Textile Chemistry | M19PCHE09 |
| | Material Science | M19PCHE10 |
| | Nuclear Chemistry | M19PCHE11 |
| | Chemistry of Industrial Products | M19PCHE12 |

## EXTRA DISCIPLINARY COURSES FOR OTHER MAJOR STUDENTS

| Semester | Course Title | Course Code |
|---|---|---|
| II | EDC - Health Chemistry | M19ECH01 |
| | EDC - Drug Discovery | M19ECH02 |
| | EDC - Chemical Instrumentation | M19ECH03 |

## VI- SCHEME OF EXAMINATION

### 1. Question Paper Pattern for Theory Examination

Time: Three Hours Maximum Marks: 75

**Part A: (10 x 1 = 10)**
Answer ALL Questions
(Objective Type - Two Questions from each unit)

**Part B: (5 x 2 = 10)**
Answer ALL Questions
(One Question from each unit)

**Part C: (5 x 5 = 25)**
Answer ALL Questions
(One Question from each unit with internal choice)

**Part D: (3 x 10 = 30)**
Answer Any Three out of Five Questions
(One Question from each unit)

### 2. Question Paper Pattern for Practical Examination

**QUESTION PATTERN**

| | | |
|---|---|---|
| Practical | : | 50 Marks |
| Viva Voce | : | 05 Marks |
| Record | : | 05 Marks |
| Total | : | 60 Marks |

### 3. Distribution of Marks:

The following are the distribution of marks for external and internal for End Semester Examinations and continuous internal assessment and passing minimum marks for Theory/Practical / Project course of PG programme.

| ESE | EA | Passing | CIA | Passing | Total | Passing |
|---|---|---|---|---|---|---|

| | Total | Minimum for EA | Total | Minimum for CIA | Marks Allotted | Minimum for ESE |
|---|---|---|---|---|---|---|
| **Theory** | 75 | 38 | 25 | 12 | 100 | 50 |
| **Practical** | 60 | 30 | 40 | 20 | 100 | 50 |
| **Project** | 60 | 30 | 40 | 20 | 100 | 50 |

The following are the Distribution of marks for the Continuous Internal Assessment in Theory / Practical courses of PG programme.

**THEORY**

EVALUATION OF INTERNAL ASSESSMENT

Test : 10 Marks
Seminar : 05 Marks
Assignment : 05 Marks
Attendance : 05 Marks
---
Total : 25 Marks
---

The Passing minimum shall be 50% (12 Marks) out of 25 Marks.

**PRACTICAL**

EVALUATION OF INTERNAL ASSESSMENT

Test 1 : 15 Marks
Test 2 : 15 Marks
Record : 10 Marks
---
Total : 40 Marks
---

The Passing minimum shall be 50% (20 Marks) out of 40 Marks.

**PROJECT**

EVALUATION OF INTERNAL ASSESSMENT

Review 1 : 10 Marks
Review 2 : 10 Marks
Review 3 : 10 Marks
Pre-Viva : 10 Marks
---
Total : 40 Marks
---

The Passing minimum shall be 50% (20 Marks) out of 40 Marks.

**4. Passing Minimum:**

The Candidates shall be declared to have passed the examination if he/she secures not less than 50 marks in total (CIA mark + Theory Exam mark) with minimum of 38 marks in the End Semester Theory Examinations.

The Candidates shall be declared to have passed the examination if he/she secures not less than 50 marks in total (CIA mark + Practical Exam mark) with minimum of 30 marks in the End Semester Practical Examinations.

**5. Submission of Record Note Books for Practical Examination:**

Candidates appearing for practical examinations should submit a bonafide record note books prescribed for practical examinations. The candidates failed to submit the record book shall not be permitted to appear for the practical examinations

**6. Project**

The following guidelines to be followed for the Project with Viva-voce:

1. The project should be valued for 60 marks by an external examiner; however the Viva-Voce examination should be conducted by both the external examiner appointed by the College and the internal examiner/guide/teacher concerned.
2. The Project report may consist minimum of 60 pages.
3. The candidate has to submit the Project Report 20 days before the commencement of the VI Semester Examinations.
4. A candidate who fails in the Project/Dissertation or is absent may resubmit the report, on the same topic, with necessary modification / correction / improvements in the subsequent Even Semester Examinations for evaluation and shall undergo viva-voce Examination.

**VII- NOTE**

**a) SWAYAM / MOOC – Free Online Education**

SWAYAM / MOOC is an instrument for self-actualization providing opportunities for a life-long learning. Here the student can choose from hundreds of courses, virtually every course taught at the college level, offered by the best teachers in India and elsewhere.

The students can choose an online SWAYAM / MOOC course during their period of study which will earn an extra credit and it will be transferred to the academic records of the students.

**b) Comprehensive Examination**

This examination is conducted at the end of every year. Mode of the examination is online. The questions are of objective type and they cover the entire year's syllabus.

**SEMESTER - I**

| CORE COURSE-I | **M.Sc. Chemistry** | **2019-2020** |
|---|---|---|
| M19PCH01 | **STEREOCHEMISTRY AND REACTION MECHANISM** | |
| Credits: 4 | | |

**Objectives**

This course focuses on the concepts of stereochemistry and organic reaction and their mechanism in organic chemistry.

**Course Outcomes**

On the successful completion of the course, students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Understand the stereo chemical orientation of molecules and its relation to reactivity. | K2 |
| CO2 | Extract the basic electronic concept of organic chemistry and methods of determination of reaction mechanism. | K1 |
| CO3 | Gain the knowledge of aromaticity and electrophilic, nucleophilic substitution organic reactions and their mechanism. | K4 |
| CO4 | Sketch the aliphatic and electrophilic, nucleophilic substitution organic reactions and their mechanism. | K3 |
| CO5 | Get fundamental idea of addition and elimination reactions and their mechanism in important organic reaction. | K2 |

**UNIT I**

Stereochemistry: Interconversion of perspective, Fischer, Sawhorse and Newman structures; Cram's and Prelog's rules. D, L and R, S - notations; Cahn-Ingold-Prelog rules, absolute and relative configurations; configurations of allenes, spiranes, biphenyls, cyclooctene and helicene.

Conformation and reactivity: Conformational analysis of disubstituted cyclohexanes and their stereochemical features - Conformation and reactivity of cyclohexanols (oxidation and acylation), cyclohexanones (reduction) and cyclohexane carboxylic acid derivatives (esterification and hydrolysis). Conformation and stereochemistry of cis and trans decalins.

Geometrical and optical isomerism of disubstituted cyclopropane, cyclobutane and cyclopentanes. Identification of enantiotropic, homotropic, diastereotropic hydrogens and prochiral carbons – Stereospecific and stereoselective synthesis.

**UNIT II**

Structure, Reactivity and Intermediates: Electron displacement and structure – reactivity correlation: Resonance, field effects, hyperconjugation, steric effects, steric inhibition of resonance. Quantitative treatment of field and resonance effects – Hammett and Taft treatments. Acidity of carboxylic acids and phenols, basicity of aliphatic and aromatic bases.

Study and description of organic reaction mechanisms: Non-kinetic methods – Energy profile diagrams, intermediate versus transition state, identification of products, Cross-over experiments, Stereochemical studies. Kinetic methods – kinetic isotopic effects, salt effects, solvent effect, solvent isotopic effects, kinetic and thermodynamic controlled product. Hammond postulates.

**UNIT III**

Aromatic Electrophilic substitution: Mechanism, orientation and reactivity – Quantitative treatment of reactivity in the substrate and reactivity of the electrophiles. Mechanistic interpretations of second substitution, the ortho/para ratio, ipso attack, third substitution, orientation and reactivity of other ring systems like polycyclic aromatic hydrocarbons, diazonium coupling, Vilsmeir reaction, Gattermann - Koch reaction.

Aromatic Nucleophilic substitution: $S_NAr$, $S_N1$, benzyne and $SR_N1$ mechanisms, Reactivity – effect of substrate structure, leaving group and nucleophile. Von Richter and Smiles rearrangements.

**UNIT IV**

Aliphatic Nucleophilic substitution: Substitution at $sp^3$ carbon atom: $SN_1$ and $SN_2$ mechanisms, ion pair in $SN_1$. Factors influencing $SN_1$ and $SN_2$ reactions – substrate, leaving group, nucleophile and solvent effects, ambident substrates and nucleophiles – regioselectivity. Border line cases - intermediate mechanism, Mixed $SN_1$ and $SN_2$ mechanisms. Neighboring group participation, non-classical carbocations. $S_Ni$ mechanism, Allylic rearrangements. Substitution at a trigonal carbon atom: the tetrahedral mechanism, formation of acid derivatives, cleavage of esters and N-acylation reactions.

Aliphatic Electrophilic substitution: Mechanisms - $SE_1$, $SE_2$ and $SE_i$ Substitution by double bond shifts; other mechanism: addition – elimination

and cyclic mechanism. Electrophilic substitution via enolization, Stork – enamine reaction.

**UNIT V**

Elimination Reactions: E1, E2 and $E_1CB$ mechanisms, competition between elimination and substitution, orientation of product formation, stereochemistry of E2 reactions, intermolecular pyrolytic eliminations, the Chugaev reaction, Cope elimination.

Addition reactions: Electrophilic addition to alkenes, mechanism, effect of structure, isotope effects, orientation and stereochemistry, the nature of the intermediates, Ozonolysis, hydroboration, additions to dienes, alkynes (halogenation and hydrogenation) and allenes, Diels-Alder reaction, 1,3 dipolar additions.

Nucleophilic addition to multiple bonds: Mannich reactions, Aldol and related reactions, Stobbe, Cannizzaro reaction, Darzens, Thorpe, Wittig reaction and benzoin condensation.

**TEXT BOOKS**

| S. No | Title of the Book | Author | Publishing Company | Year |
|---|---|---|---|---|
| 1. | Advanced Organic Chemistry, Part A: Structure and Mechanisms. | F. A. Carey & R. A. Sundberg | Springer, New York, 5th Edn. | 2007 |
| 2. | Stereochemistry of Organic Compounds. Principles and Applications | D. Nasipuri | Wiley Eastern Limited, New Delhi, 2nd Edn. | 1994 |
| 3. | Advanced Organic Chemistry | J. March & M Smith | John-Wiley and sons, 5th Edn. | 2001 |
| 4. | Stereochemistry of carbon compounds | P. S. Kalsi | New Age International Publishers, 3rd Edn. | 1995 |

**REFERENCE BOOKS**

| S.No | Title of the Book | Author | Publishing Company | Year |
|---|---|---|---|---|
| 1. | Stereochemistry of Carbon Compounds. | E. L. Eliel | Tata-McGraw Hill | 2000 |
| 2. | Organic Chemistry. Vol-1 | I. L. Finar | Pearson Education Asia, 5th Edn. | 1975 |
| 3. | Organic Chemistry. Vol-2 | I. L. Finar | Pearson Education Asia, 6th Edn. | 2004 |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | S | S | M | M | M |
| **CO2** | M | S | M | S | M |
| **CO3** | S | M | S | S | M |
| **CO4** | M | M | S | S | S |
| **CO5** | M | S | M | M | S |

**S**- Strong; **M**-Medium.

**SEMESTER - I**

| CORE COURSE-II | **M.Sc. Chemistry** | **2019-2020** |
|---|---|---|
| M19PCH02 | **CHEMISTRY OF INORGANIC COMPOUNDS** | |
| Credits: 4 | | |

**Objectives**

This course focuses on the knowledge about the bonding theory, bonding properties and inorganic compounds with Boron, Silicon, Phosphorous, Nitrogen, Sulphur, Noble gases and Halogen compounds.

**Course Outcomes**

On the successful completion of the course, students will be able to

| **CO Number** | **CO Statement** | **Knowledge Level** |
|---|---|---|
| CO1 | Recognize the basics of atomic structure and chemical bonding. | K1 |
| CO2 | Acquire knowledge on acid base concepts and non aqueous solvent. | K3 |
| CO3 | Devise the properties and uses of Boron and silicon compounds. | K3 |
| CO4 | Illustrate the properties and uses of Nitrogen, Phosphorous, Sulphur and halogens compounds | K4 |
| CO5 | Get idea on the properties and uses of polyanions, clathrates and cage compounds. | K2 |

**UNIT I**

Atomic Structure: Atom, orbital electrons, concept of wave-functions, quantum numbers and spin, shape of orbital and their radial distribution functions, electronic configuration of atoms, Aufbau principle, Pauli Exclusion Principle, and Hund's rule.

Bonding and structure: Types of bonds, orbital symmetry and overlaps, concept of MO and VB theory, concept of hybridization, the extent of d orbital participation in molecular bonding, bond energy and covalent radii, concept of resonance, bond moment and molecular dipole moment, polarizing power and polarizability, Fajan's rules, Van der Waals forces, hydrogen bonding.

**UNIT II**

Acid-base concept: Bronsted acids and bases, Lewis acids and bases, solvent system concept, HSAB principle.

Non– Aqueous Solvents: Classification of solvents – Properties of ionizing solvents – General study of typical reactions - liquid Ammonia, Sulphur dioxide, Dinitrogen tetroxide, Anhydrous Hydrogen fluoride, Sulphuric acid and Acetic acid – Solution in fused salts.

**UNIT III**

Compounds of Boron: Synthesis, properties and structures of Boron compounds: Boron hydrides (small boranes and their anions, B1-B4), boron nitride, borazines, carboranes, metalloboranes, metallocarboranes.

Compounds of Silicon: Synthesis, properties and structures of Silicon compounds: silicates, silicones, zeolites.

**UNIT IV**

Nitrogen, Phosphorous, Sulphur and halogens compounds: Hydrides, oxides and oxy acids of Nitrogen, Phosphorous, Sulphur and halogens; phosphazines, sulphur-nitrogen compounds, inter halogen compounds, pseudo halogens.

**UNIT V**

Poly anions and isopoly anions of Phosphorous, Vanadium, Chromium, Molybdenum and Tungsten, heteropoly anions of Molybdenum and Tungsten. Clathrates (noble gases, phosphazines) hydrogen bonding in clathrates, Phosphorous and Oxygen cage compounds.

**TEXT BOOKS**

| S. No | Title of the Book | Author | Publishing Company | Year |
|---|---|---|---|---|
| 1 | Text book of Inorganic Chemistry | P.L. Soni & M. Katyal | Sulan Chand & Sons. | 1986 |
| 2 | Modern Inorganic Chemistry | S. Satya Prakash | S. Chand and Company Ltd. | 2003 |
| 3 | Advanced Inorganic Chemistry | Gurdeep Raj | Goel Publishing house | 1986 |
| 4 | Selected Topics in Inorganic Chemistry | U. Malik, G.D. Tuli & R.D. Madan | S. Chand and Company Ltd. | 2001 |

**REFERENCE BOOKS**

| S. No | Title of the Book | Author | Publishing Company | Year |
|---|---|---|---|---|
| 1 | Inorganic Chemistry: Principles, Structure and Reactivity | J. E. Huheey | Harper and Row, 3rd Edn. | 1983 |
| 2 | Inorganic Chemistry | D. F. Shriver, P.W. Atkins & C.H. Langford | ELBS, 2nd Edn. | 1994 |
| 3 | Physical chemistry | R.A. Alberty & R.J. Silbey | Wiley | 1999 |
| 4 | Inorganic Chemistry | G.L. Miessler & D.A. Tarr | Pearson Education | 2004 |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | S | S | M | M | M |
| **CO2** | M | S | S | S | M |
| **CO3** | S | M | S | M | M |
| **CO4** | M | M | S | S | S |
| **CO5** | M | S | M | M | S |

**S**- Strong; **M**-Medium.

**SEMESTER - I**

| CORE COURSE-III | **M.Sc. Chemistry** | **2019-2020** |
|---|---|---|
| M19PCH03 | **CHEMICAL KINETICS AND QUANTUM CHEMISTRY** | |
| Credits: 4 | | |

**Objectives**

The aim of this course is to expose the students to the knowledge in chemical kinetics and quantum chemistry.

**Course Outcomes**

On the successful completion of the course, students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Know about the topic of chemical kinetics and their applications. | K1 |
| CO2 | Interpret the reaction concept in chemical kinetics | K2 |
| CO3 | Gain the idea of quantum chemistry | K2 |
| CO4 | Apply quantum chemistry to physical models. | K3 |
| CO5 | Appraise the quantum mechanics to atomic and molecular systems. | K4 |

**UNIT I**

Chemical Kinetics: Theories of Reaction rates – Arrhenius theory – effect of temperature on reaction rate – Hard – Sphere collision theory of reaction rates – molecular beams – Reaction cross section – effectiveness of collisions – Probability factor.

Transition state theory of reaction rates – Potential energy surface – Partition functions and activated complex – Eyring equation – Comparison of collision theory and activated complex theory – Estimation of free energy, enthalpy and entropy of activation and their significance.

**UNIT II**

Kinetics of complex reactions: Reversible reactions, Consecutive reactions, Parallel reactions and Chain reactions – General treatment of chain reaction – Chain length – Rice Herzfeld mechanism – explosion limits.

Study of Fast reactions: Luminescence and energy transfer process – Study of kinetics by relaxation methods - temperature and pressure jump methods - Stopped flow technique, flash photolysis and Crossed molecular beam method.

**UNIT III**

Kinetics of surface reactions: Physical and chemical adsorption – adsorption isotherms – types of adsorption isotherms – Langmuir adsorption isotherm

B.E.T theory for multilayer adsorption – measurement of surface area – Mechanism of heterogeneous catalytic reactions – the adsorption coefficient and its significance.

**UNIT IV**

Quantum Chemistry: Black body Radiation – Photoelectric effect – De Broglie equation – Heisenberg's uncertainty principle – Compton Effect. Operators and commutation relations – quantum mechanical postulates.

Schrodinger equation and its solution to the problem of a particle in one and three dimensional boxes – Harmonic oscillator – Rigid rotor.

**UNIT V**

Schrodinger equation for Hydrogen atom – arriving solution for energy and wave function – origin of quantum numbers and their physical significance – Probability distribution of electrons.

Approximation methods: Perturbation and Variation methods – application of Variation method to Hydrogen and Helium atom – Spin - Orbit interaction – L-S coupling and J-J coupling – Term symbols and spectroscopic states. Ground state term symbols for simple atoms.

**TEXT BOOKS**

| S. No | Title of the Book | Author | Publishing Company | Year |
|---|---|---|---|---|
| 1 | Kinetics and mechanism of chemical transformation | J. Rajaram & J.C. Kuriacose | Macmillan India Ltd | 1993 |
| 2 | Chemical Kinetics | K.J. Laidlar | Harper and Row Newyork | 1987 |
| 3 | Quantum chemistry | D.A. McQuarrie | University science books, Mill Valley, California | 1983 |
| 4 | Quantum Chemistry | R.K. Prasad | Wiley Eastern, New Delhi | 1992 |

**REFERENCE BOOKS**

| S. No | Title of the Book | Author | Publishing Company | Year |
|---|---|---|---|---|
| 1. | Physical Chemistry | W.J. Moore | Orient Longman, London | 1972 |
| 2. | Kinetics and Mechanism | R. G. Frost & Pearson | Wiley, Newyork | 1961 |
| 3. | Kinetic systems | C. Capellos & B.H.J. Bielski | Willey Interscience, Newyork | 1968 |
| 4. | Chemical Kinetics | G. M.Harris | D.C. Heath and Co. | 1966 |
| 5. | Quantum chemistry | I. N. Levine | Allyn and Bacon, Boston | 1983 |
| 6. | Contemporary Quantum Chemistry: An Introduction | J. Goodman | Plenum Press, Newyork | 1977 |
| 7. | Elements of Quantum theory | F.J. Bockhoff | Addison Wesley, Reading, Mass | 1976 |
| 8. | Physical Chemistry | P.W. Atkins | Oxford University Press, Oxford. | 1990 |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | S | S | M | M | M |
| **CO2** | M | M | S | M | M |
| **CO3** | S | M | S | S | M |
| **CO4** | M | M | S | S | S |
| **CO5** | M | S | M | M | S |

**S**- Strong; **M**-Medium.

**SEMESTER - I**

| CORE PRACTICAL-I | **M.Sc. Chemistry** | **2019-2020** |
|---|---|---|
| M19PCHP01 | **PRACTICAL-I - INORGANIC QUALITATIVE ANALYSIS** | |
| Credits: 3 | | |

**Course Outcomes**

On successful completion of the course students will be able to

1. Acquire knowledge about the mixture of cations.
2. Create awareness on eco-friendly approach in the analysis.
3. Analyze ions qualitatively even in the mixture.

**Qualitative analysis**

Qualitative analysis employing semi micro methods and spot tests of mixture containing two familiar and two less familiar cations from the following: W, Pb, Se, Te, Mo, Cu, Bi, Cd, Ce, Zr, V, Mn, Al, Ni, Co, Zn, Ba, Sr, Li, and Mg. (Insoluble and interfering anions may be avoided). – **Minimum 8 mixtures.**

**TEXT BOOKS**

| S. No | Title of the Book | Author | Publishing Company | Year |
|---|---|---|---|---|
| 1. | Vogel's qualitative Inorganic analysis | G. Svehla | Orient Longman, 6th Edition, | 1987 |
| 2. | Basic Principles of Practical Chemistry | V. Venkateswaran, R. Veeraswamy, A.R.Kulandaivelu | Sultan Chand & sons, New Delhi, 2nd Edn. | 1997 |
| 3. | Inorganic Semimicro Qualitative analysis. | V.V. Ramanujam | National Publishing Co | 1971 |

**REFERENCE BOOKS**

| S. No | Title of the Book | Author | Publishing Company | Year |
|---|---|---|---|---|
| 1. | Vogel's Text book of quantitative inorganic analysis | J. Basset, R.C. Denney, G.H. Jeffery and J. Mendham | ELBS/Longman, England, 4th Edn. | 1986 |
| 2. | Experimental Inorganic Chemistry | W.G. Palmer | Van Nostrand Reinhold Co., London | 1972 |
| 3. | An advanced course in practical Inorganic Chemistry | D.N. Grindley | Butterworths | 1964 |

**SEMESTER - I**

| CORE PRACTICAL-II | **M.Sc. Chemistry** | **2019-2020** |
|---|---|---|
| M19PCHP02 | **PRACTICAL-II- PHYSICAL CHEMISTRY EXPERIMENTS-I** | |
| Credits: 3 | | |

**Course outcomes**

On successful completion of the course students will be able to

1. Study the kinetics of some reactions.
2. Learn the technique of sketching phase diagram of some binary systems.
3. Develop practical skill in conductometric titration experiments.
4. Understand experimental knowledge on kinetics and electro chemistry.

**DETAILED LIST OF EXPERIMENTS**

1. Study the kinetics of acid hydrolysis of an ester, determination of the temperature coefficient of the reaction and determination of the activation energy of the hydrolysis of ethyl acetate.
2. Study the kinetics of the reaction between acetone and iodine in acidic medium by half-life method and determine the order with respect to iodine and acetone.
3. Study of the rate of saponification of ethyl acetate by sodium hydroxide conductometrically and determine the order of the reaction.
4. Determination of association factor of benzoic acid in benzene by distribution method.
5. Construction of phase diagram for a simple binary system (naphthalene – phenanthrene and benzophenone – diphenylamine)
6. Construction of the phase diagram of the three component of partially immiscible liquid systems (DMSO – Water – Benzene; Water-Benzene – Acetic acid; Ethyl alcohol – Benzene – Water; Acetone-Chloroform – Water; Chloroform – Acetic acid-Water).
7. Determination of equivalent conductance of a weak acid at different concentrations and verify Ostwald's dilution law and calculation of the dissociation constant of the acid.
8. Determination of equivalent conductivity of a strong electrolyte at different concentrations and examine the validity of the DHO theory as limiting law at high dilutions.

9. Conductometric Acid – Base titrations of a mixture of HCl and $CH_3COOH$ against Sodium hydroxide.
10. Compare the relative strength of acetic acid and monochloro acetic acid by conductivity method.

**TEXT BOOKS**

| S. No | Title of the Book | Author | Publishing Company | Year |
|---|---|---|---|---|
| 1. | Advanced Experimental Chemistry, Vol I. | J.N. Gurtu and R.Kapoor | S. Chand & Co. Ltd., New Delhi | 1980 |
| 2. | College Practical Chemistry | V.K. Ahluwalia, Sunitha Dhingra and Adarsh Gulate | Universities Press (India) Pvt Ltd. | 2008 |
| 3. | Basic Principles of Practical Chemistry | V. Venkateswaran, R. Veeraswamy & A.R. Kulandaivelu | New Delhi, Sultan Chand & sons, 2nd Edn. | 1997 |

**REFERENCE BOOKS**

| S. No | Title of the Book | Author | Publishing Company | Year |
|---|---|---|---|---|
| 1. | Findlay's Practical Physical Chemistry | B.P. Levitt | Longman, London, 9th Edn. | 1985 |
| 2. | Experimental Physical Chemistry | F. Daniels | New York, McGraw Hill, 7th Edn. | 1970 |
| 3. | Practical Physical Chemistry | A. Findlay | London, Longman, 7th Edn. | 1959 |

**SEMESTER - II**

| CORE COURSE-IV | **M.Sc. Chemistry** | **2019-2020** |
|---|---|---|
| M19PCH04 | **ORGANIC SPECTROSCOPY** | |
| Credits: 4 | | |

**Objectives**

This course focuses on the concepts of spectroscopy and dealt with the applications in the structural elucidation of compounds.

**Course Outcomes**

On the successful completion of the course, students will be able to

| **CO Number** | **CO Statement** | **Knowledge Level** |
|---|---|---|
| CO1 | Quote thebasic principles and application of UV-Visible, IR spectroscopy. | K2 |
| CO2 | Sketch the structure of organic compounds by $^{1}H$ NMR spectroscopy. | K3 |
| CO3 | Elucidate the structure of organic compounds by $^{13}C$, $^{19}F$, $^{31}P$ NMR spectroscopy. | K4 |
| CO4 | Identify the basics of advanced NMR and EPR techniques. | K2 |
| CO5 | Acquire knowledge on the mass spectroscopy. | K3 |

**UNIT I**

UV-Visible spectroscopy: Terminology, classification of electronic transitions. Effect of substituent and conjugation on the spectra of alkenes. Woodward – Fisher rules for polyenes and enones. Electronic spectra of carbonyl compounds. Effect of solvent on π – π* and n – π* transitions. Electronic spectra of benzene and its derivatives.

IR spectroscopy: Theory and principle, Vibrational frequencies of alkanes, alkenes, alkynes, aromatic compounds, alcohols, ethers, phenols amines and carbonyl compounds (ketones, aldehydes, esters, amides, acids, anhydrides). Effect of solvent and hydrogen bonding on the vibrational frequencies in alcohols. Raman spectroscopy: stokes and antistokes line – Mutual exclusion principle.

**UNIT II**

Nuclear Magnetic Resonance Spectroscopy: Introduction- Nuclear spin and nuclear parameters - Nuclear spin states. The mechanism of absorption (resonance condition). Calculation of resonance frequency. Population densities of nuclear spin states. Relaxation processes.

Deshielding and shielding. Chemical shift - Factors affecting chemical shift - Magnetic anisotropy. Continuous wave and pulsed Fourier methods of recording NMR spectra. Spin – spin coupling and splitting of NMR signals. Spin – spin interactions – AX, $AX_2$, $AX_3$, AMX and AB types. Coupling constant. Intensities of multiplets – Pascal's triangle.

Geminal and vicinal coupling. Karplus equation and Karplus curve. First and second order coupling of AB systems. Spin decoupling methods. Double resonance. Applications in structural elucidation.

**UNIT III**

Carbon–13 NMR Spectroscopy: The carbon – 13 nucleus, carbon – 13 chemical shift. Proton coupled and proton decoupled carbon – 13 spectra. Nuclear overhauser effect. Problems with integration in carbon -13 spectra. Off resonance decoupling. Applications. Introduction to $^{19}F$, $^{31}P$ NMR spectra

**UNIT IV**

Advanced NMR Techniques: Pulse sequences, spins and magnetization vectors. The DEPT experiment. Determining the number of attached hydrogens. Two – dimensional spectroscopic methods. COSY, ROSY, NOESY technique.

ESR Spectroscopy: Theory – hyperfine interactions – Spin densities – McConnel relationship – selection rules in ESR – 'g' value and coupling constants.

**UNIT V**

Mass Spectrometry: Introduction, principle and instrumentation. Ion production – electron impact, chemical ionization, field desorption and fast atom bombardment techniques. High resolution mass spectrometry – base, molecular ion, parent ion, fragmentation ion, metastable and isotopic- peaks. Factors affecting fragmentation, ion analysis and ion abundance.

Mass spectral fragmentation of organic compounds (hydrocarbons, aromatic compounds, alcohols, carbonyl compounds, acids and esters). McLafferty rearrangement - Determination of molecular weight and molecular formula.

**TEXT BOOKS**

| S.No | Title of the Book | Author | Publishing Company | Year |
|---|---|---|---|---|
| 1. | Vibrational spectroscopy: theory and Applications | D.N. Sathyanarayana | New-Age International Publishers, New Delhi | 2000 |
| 2. | Electronic Absorption Spectroscopy and related techniques | D.N. Sathyanarayana | Universities Press, Bangalore | 2001 |
| 3. | Applications of absorption Spectroscopy to Organic Compounds | J.R. Dyer | Prentice – Hall, New Delhi | 1969 |
| 4. | Organic Mass Spectroscopy | K.R. Dass and E.P. James | IBH New Delhi | 1976 |
| 5. | Organic Spectroscopy | W. Kemp | ELBS London | 1975 |

**REFERENCE BOOKS**

| S. No | Title of the Book | Author | Publishing Company | Year |
|---|---|---|---|---|
| 1. | Physical methods in Inorganic chemistry | R.S. Drago | Affiliated East-West Press Pvt. Ltd., New Delhi | 1965 |
| 2. | Infrared Spectra of Inorganic and co-ordination Compounds | K. Nakamoto | Wiley-Interscience, New York | 1970 |
| 3. | Spectrometric Identification of Organic Compounds | R.M. Silverstein and W.P. Webster | Wiley & Sons | 1999 |
| 4. | Principles of | D.A. Skoog, S.J. Holler, | Saunders College Publishing, London, | 1998 |

| | | | | |
|---|---|---|---|---|
| | Instrumental Analysis | T.A. Nilman | 5th Edn. | |
| 5. | Introduction To Spectroscopy | Donald L. Pavia, Gary M. Lampman and George S. Keiz | Harcourt Brace College Publishers, 2nd Edn. | 1996 |
| 6. | Physical Methods for Chemists | R.S. Drago | Saunders College Publishing, New York, 2nd Edn. | 1992 |
| 7. | Mass Spectrometry – Analytical Chemistry By Open Learning | R. Davies, M. Frearson and E. Prichard | John Wiley and Sons, New York | 1987 |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | S | S | M | M | M |
| **CO2** | M | S | S | S | M |
| **CO3** | S | M | S | S | M |
| **CO4** | M | M | S | S | S |
| **CO5** | M | S | M | M | S |

**S**- Strong; **M**-Medium.

**SEMESTER - II**

| CORE COURSE-V | **M.Sc. Chemistry** | **2019-2020** |
|---|---|---|
| M19PCH05 | **THERMODYNAMICS AND GROUP THEORY** | |
| Credits: 4 | | |

**Objectives**

The aim of this course is to expose the students with the knowledge in thermodynamics and group theory.

**Course Outcomes**

On the successful completion of the course, students will be able to

| **CO Number** | **CO Statement** | **Knowledge Level** |
|---|---|---|
| CO1 | Know about the applications of statistical thermodynamic. | K2 |
| CO2 | Understand the Thermodynamics concept of ideal, real gases and gas mixtures and partial molar properties. | K1 |
| CO3 | Study the various methods of Irreversible Thermodynamics. | K2 |
| CO4 | Relate the application of group theory to chemical system. | K3 |
| CO5 | Apply the group theory in various spectroscopic prediction and interpretation. | K4 |

**UNIT I**

Statistical thermodynamics: Objectives – concept of thermodynamical and mathematical probabilities – Distribution of distinguishable and non – distinguishable particles. Maxwell – Boltzmann, Bose - Einstein and Fermi - Dirac statistics - comparisons

Partition Functions: Evaluation of Translational, Vibrational, Rotational and Electronic partition Function – Thermodynamic Functions in terms of partition Function – Application of partition Function to monoatomic and diatomic gases – Statistical expression for equilibrium constant – Calculation of Equilibrium Constant from Partition Function.

**UNIT II**

Thermodynamics of ideal and real gases: Gas mixtures – Standard states for gases, liquids, solids and components of solutions – Fugacity – definition – Methods of determination of fugacity – Variation of fugacity with temperature and pressure – Determination of activities and activity coefficient.

Partial molar properties – Gibbs – Duhem equation – Partial molar free energy (Chemical Potential) – Determination of chemical potential [Direct Method and Method of Intercepts] and partial molar volume – variation of chemical potential with Temperature and Pressure.

**UNIT III**

Irreversible Thermodynamics: Postulates of Local equilibrium – Entropy production – Entropy Production in Heat flow – Entropy production in matter flow – Progogine's principle of minimum entropy production – Forces and Fluxes – Linear force – flux relation – phenomenological equation – microscopic reversibility and Onsager's reciprocity relations.

Electro kinetic phenomena – diffusion – Non – equilibrium stationary states.

**UNIT IV**

Group Theory: Symmetry elements and symmetry operations – Point groups – Determination of point group – comparison of Molecular symmetry with Crystallographic symmetry. Reducible and irreducible representation – Direct product representation – Great orthogonality theorem and its consequences.

Character Table and their uses.

**UNIT V**

Symmetry selection rules for vibrational, Electronic and Raman Spectra – determination of representation of vibrational modes in non-linear molecules such as $H_2O$, $CH_4$, $XeF_4$, $SF_6$ and $NH_3$.

Symmetry of Hybrid orbitals in non-linear molecule ($BF_3$, $CH_4$, $XeF_4$, $PCl_5$ and $SF_6$) – Electronic spectra of formaldehyde.

**REFERENCE BOOKS**

| S. No | Title of the Book | Author | Publishing Company | Year |
|---|---|---|---|---|
| 1. | Physical Chemistry | W.J. Moore | Orient Longman, London | 1972 |
| 2. | Thermodynamics of Steady state | K.G. Den beigh | Meklien and Co., London | 1951 |
| 3. | Elements of Chemical Thermodynamics | L.K. Nash | Addison Wesley | 1962 |
| 4. | Chemical Application of Group Theory | F.A. Cotton | John Wiley and Sons Inc., Newyork | 1971 |

**TEXT BOOKS**

| S. No | Title of the Book | Author | Publishing Company | Year |
|---|---|---|---|---|
| 1. | Thermodynamics for chemists | S.Glasstone | Affiliated East West press, New Delhi | 1960 |
| 2. | Thermodynamics for students of chemistry | J. Rajaram & J.C. Kuriacose | Lal Nagin Chand, New Delhi | 1986 |
| 4. | Group theory in chemistry | V. Ramakrishnan & M.S. Gopinathan | Vishal Publications | 1988 |
| 5. | Group theory and its application to chemistry | K.V. Raman | Tata McGraw Hill Publishing Co | 1990 |
| 6. | Advanced Physical Chemistry | Gurudeep Raj | Goel Publishing House, Meerut | 2008 |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | S | S | M | M | M |
| **CO2** | M | S | S | S | M |
| **CO3** | S | M | S | S | M |
| **CO4** | M | M | S | S | S |
| **CO5** | M | S | M | M | S |

**S**- Strong; **M**-Medium.

**SEMESTER - II**

| CORE PRACTICAL-III | **M.Sc. Chemistry** | **2019-2020** |
|---|---|---|
| M19PCHP03 | **PRACTICAL-III - INORGANIC ESTIMATION AND PREPARATION** | |
| Credits: 3 | | |

**Course Outcomes**

On successful completion of the course students will be able to

1. Acquire the quantitative skills in volumetric analysis.
2. Estimate the amount of different metals in the given solutions.
3. Develop practical skill in the preparation of complexes.
4. Execute the idea about recrystalisation.

**A. Quantitative analysis of the following mixture**

1) Iron and magnesium
2) Iron and nickel
3) Copper and nickel
4) Calcium and barium
5) Calcium and magnesium

**B. Preparation of the following compounds**

1. Potassium trioxalatoaluminate (III) trihydrate
2. Tristhioureacopper (I) chloride
3. Potassium trioxalatochromate (III) trihydrate
4. Sodium bis (thiosulphato) cuprate (I)
5. Tetramminecopper (II) sulphate.

**TEXT BOOKS**

| S. No | Title of the Book | Author | Publishing Company | Year |
|---|---|---|---|---|
| 1. | Vogel's qualitative Inorganic analysis | G. Svehla | Orient Longman, 6th Edition. | 1987 |
| 2. | Inorganic Semimicro Qualitative analysis. | V.V. Ramanujam | National Publishing Co | 1971 |
| 3. | Fundamental of Analytical Chemistry | D. A. Skoog, D. M. West & F. J. Holler | Harcourt Asia | 2001 |

**REFERENCE BOOKS**

| S. No | Title of the Book | Author | Publishing Company | Year |
|---|---|---|---|---|
| 1. | Vogel's Text book of quantitative inorganic analysis | J. Basset, R.C. Denney, G.H. Jeffery and J. Mendham | ELBS/Longman, England, 4th Edn. | 1986 |
| 2. | Experimental Inorganic Chemistry | W.G. Palmer | Van Nostrand Reinhold Co., London | 1972 |
| 3. | An advanced course in practical Inorganic Chemistry | D.N. Grindley | Butterworths | 1964 |

**SEMESTER - II**

| CORE PRACTICAL-IV | **M.Sc. Chemistry** | **2019-2020** |
|---|---|---|
| M19PCHP04 | **PRACTICAL-IV- ORGANIC ESTIMATION AND PREPARATION** | |
| Credits: 3 | | |

**Course outcomes**

On the successful completion of the course, student will be able to

1. Know the fundamental strategies of organic estimation.
2. Estimate the amount of organic compound in the given solutions.
3. Learn the determination of physical constants of organic compounds.
4. Develop practical skill in the preparation of complexes.
5. Execute the idea about recrystalisation.

**A. Quantitative Analysis**

1. Phenol and aniline.
2. Ketones (ethyl methyl ketone).
3. Sugars (Glucose)
4. Ascorbic acid (Vitamin-C tablets)
5. Amino groups (aniline)
6. Nitro groups (aromatic nitro compounds)
7. Amino acids (Glycine)

**B. Preparation involving single stage**

1. Benzoic acid from ethyl benzoate
2. Acetanilide from aniline
3. Acetyl salicyclic acid from salicyclic acid
4. 2,4,6-Tribromoaniline from aniline
5. p-Bromoacetanilide from acetanilide
6. m-Dinitro benzene from nirobenzene
7. Picric acid from phenol
8. 2-Naphthylbenzoate from 2-naphthol.

**TEXT BOOKS**

| S. No | Title of the Book | Author | Publishing Company | Year |
|---|---|---|---|---|
| 1. | Organic Chemistry – Lab manual | N.S. Gnanapragasam and G. Ramamurthy | S.Viswanathan Co. Pvt. Ltd | 1998 |
| 2. | Vogel's Textbook of Practical Organic Chemistry, | B.S. Furniss, A.J.Hannaford, P.W. Smith, A.R.Tatchell | ELBS /Longman, London, 7th Edn. | 1984 |
| 3. | Basic Principles of Practical Chemistry | V. Venkateswaran, R. Veeraswamy, A.R. Kulandaivelu | New Delhi, Sultan Chand & sons, 2nd Edn. | 1997 |

**REFERENCE BOOKS**

| S. No | Title of the Book | Author | Publishing Company | Year |
|---|---|---|---|---|
| 1. | Text book of Practical Organic Chemistry | Vogel | ELBS/Longman, England, 2nd Edn. | 1986 |
| 2 | Organic Chemistry Lab Manual | Ganapragasm and Ramamurthy | S. Vishwanathan Printers and Publishers (P) Ltd., Chennai, 2nd Edn. | 2007 |
| 3 | Advanced Experimental Chemistry. | J.N. Gurtu and R. Kapoor | S. Chand and Co. | 1987 |

**SEMESTER - III**

| CORE COURSE-VI | **M.Sc. Chemistry** | **2019-2020** |
|---|---|---|
| M19PCH06 | **ORGANIC SYNTHESIS AND REARRANGEMENTS** | |
| Credits: 4 | | |

**Objectives**

This course focuses on the concepts of various types of reactions, rearrangements and their synthetic utility in organic chemistry.

**Course Outcomes**

On the successful completion of the course, students will be able to

| **CO Number** | **CO Statement** | **Knowledge Level** |
|---|---|---|
| CO1 | Understand the concepts of heterocyclic chemistry | K1 |
| CO2 | Learn the basic knowledge in formation of carbon-carbon single bonds and C-C π bonds | K2 |
| CO3 | Recognize the basic knowledge in oxidation and reduction reactions | K1 |
| CO4 | Connect the details of organic synthesis by disconnection approach. | K4 |
| CO5 | Use the details of rearrangement and organic synthesis in organic reactions. | K3 |

**UNIT I**

Synthesis and reactions of indole, imidazole, thiazole, pyridines, pyrimidine, pyridazine, pyrazine, chromans, chromons, coumarins, carbazoles, uracil, uric acid and xanthines.

Addition to carbon-hetero atom multiple bonds: Mechanisms of metal hydride reduction of carbonyl compounds, acids, esters and nitriles; addition of Grignard reagents and organolithium reagents to carbonyl compounds; mechanisms of formation of hydrates, acetals, oximes and hydrazones on carbonyl compounds, Wittig reaction.

**UNIT II**

Formation of C-C single bonds using organometallic reagents: organolithium, organomagnesium, organocopper, organozinc, organoboron, organosilicon and palladium catalysed coupling reactions.

Formation of carbon-carbon π bonds: Wittig olefination - Horner-Wadsworth-Emmons reactions - Peterson olefination - Julia olefination - The Shapiro reaction - Gilbert's reagent.

**UNIT III**

Oxidation Reactions: Chromium and manganese reagents ($CrO_3$, $K_2Cr_2O_7$, PCC, PDC, Sarret reagent, Jones reagent, $MnO_2$, $KMnO_4$),Oxygen (singlet and triplet), ozone, peroxides and peracids, lead tetraacetate, periodic acid.$OsO_4$, $SeO_2$, NBS, chloramine-T, Sommelet oxidation, Oppenauer oxidation, Fenton's reagent, Sharpless epoxidation.

Reductions: Catalytic hydrogenation (homogeneous and heterogeneous) catalysts (Pt, Pd, Rh-C, Ni, Ru), Wilkinson catalyst, $LiAlH_4$, $NaBH_4$, DIBAL-H, Sodium cyanoborohydride, dissolving metal reactions (Birch reduction). Leukart reaction (reductive amination) Diboraneas reducing agent, Meerwein-Ponndorf-Verley reduction, Wolff-Kishner reduction, Clemensen reduction, tributyltinhydride, stannous chloride, Bakers yeast. Suzuki coupling, Heck reaction, Negishi reaction.

**UNIT IV**

Basic Principles of Synthesis of Aromatic Compounds - Disconnection Approach – Functional Group Inter conversions – Synthons – Aromatic Electrophilic and Nucleophilic Substitutions – Strategy I (The order of Events – Some Guidelines) – One-Group CX Disconnections – Strategy II (Chemoselectivity, some Guidelines) – Two-Group Disconnections– Strategy III (Polarity Reversal, Cyclization) – Amine Synthesis (Salbutamol, Fenfluramine) – Protecting the Functional Groups – synthesis of a sweetening agent (Asp-Phe-OMe). General Strategy of Choosing a Disconnection– Stereoselectivity – Regioselectivity– Alkene synthesis – Use of Acetylenes - Group C-C Disconnections (Alcohols, Carboxylic acids, Carbonyl compounds).

**UNIT V**

Rearrangements: Types of rearrangements: Nucleophilic; free radical and electrophilic reactions Mechanisms, Nature of migration; migratory ability and memory effects, ring enlargement and ring contraction.

Rearrangements Reactions: Wagner-Meerwin and related reactions, Benzil-benzilic acid, Favorskii, Hoffmann and related rearrangements, Beckmann, Neber, Baeyer-Villiger, Stevens, Claisen rearrangements, boron-carbon migration, Non-1,2-rearrangements, Fischer-indole synthesis, Arndt-Eistert synthesis - expansion and contraction of rings.

**TEXT BOOKS**

| S. No | Title of the Book | Author | Publishing Company | Year |
|---|---|---|---|---|
| 1 | Text book of Organic Chemistry | P.L. Soni | Sulan Chandans Son | 1986 |
| 2 | Advanced Organic Chemistry | Arun Bhal, B.S. Bahl | S. Chand and Company Ltd. | 2003 |
| 3 | Principles of Organic Chemistry | M.K. Jain | Vishal Publishing Co. | 2017 |
| 4 | Organic Chemistry | Wade | Pearson Education, 6th Edn. | 2007 |
| 5 | Organic Chemistry | Morrison and Boyd | Pearson Education, 7nd Edn. New Delhi. | 2014 |
| 6 | Organic Chemistry | P. Y. Bruice | Pearson Education, 3rd Edn. | 2006 |

**REFERENCE BOOKS**

| S. No | Title of the Book | Author | Publishing Company | Year |
|---|---|---|---|---|
| 1. | Heterocyclic Chemistry | T. L. Gilchrist | Longman Press | 1989 |
| 2. | Heterocyclic Chemistry | J. A. Joule and K. Mills | John-Wiley, 4th Edn. | 2010 |
| 3. | Modern Methods in Organic Synthesis | Carruthers | Academic Presistry, Vol. 1 and 2 | 2002 |
| 4. | Organic Synthesis: The Disconnection Approach | Stuart Warren | Wiley-India, New Delhi | 2007 |
| 5. | Advanced Organic Chemistry | J. March and M Smith | John-Wiley and sons, 5th Edn. | 2001 |
| 6. | Advanced Organic Chemistry, Vol. 1 and 2 | F. A. Carey and R. Sundberg | Springer US | 2002 |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | S | S | M | M | M |
| **CO2** | M | S | S | S | M |
| **CO3** | S | M | S | S | M |
| **CO4** | M | M | S | S | S |
| **CO5** | M | S | M | M | S |

**S**- Strong; **M**-Medium.

**SEMESTER - III**

| CORE COURSE-VII | **M.Sc. Chemistry** | **2019-2020** |
|---|---|---|
| M19PCH07 | **ORGANOMETALLIC CHEMISTRY** | |
| Credits: 4 | | |

**Objectives**

This course makes student to know the concepts, theories, mechanism and application of organometallic compound.

**Course Outcomes**

On the successful completion of the course, students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Learn the basic concepts of Organometallic chemistry on metal carbonyls and nitrosyl complexes | K2 |
| CO2 | Gain knowledge on Metal – alkyl, alkylidene, alkylidyne complexes. | K1 |
| CO3 | Summarize the metal - Alkene and alkyne complexes | K2 |
| CO4 | Illustrate Cyclopentadienyl and arene complexes and their importance. | K4 |
| CO5 | Relate the applications of Organometallic compounds in homogeneous catalytic reactions | K3 |

**UNIT I**

Organometallic compound: Definition-18 electron rule - effective atomic number rule - classification of organometallic compounds - the metal carbon bond types - ionic bond – sigma covalent bond - electron deficient bond - delocalised bond - dative bond.

Metal carbonyl complexes: Synthesis - structure and reactions of metal carbonyls - the nature of M- CO bonding- binding mode of CO and IR spectra of metal carbonyls - metal carbonyl anions - metal carbonyl hydrides - metal carbonyl halides - metal carbonyl clusters - Wades rule and isolobal relationship. Metal nitrosyls - dinitrogen complexes - dioxygen complexes.

**UNIT II**

Metal alkyl complexes: stability and structure - synthesis by alkylation of metal halides - by oxidative addition - by nucleophilic attack on coordinated ligands - metal alkyl and 18 electron rule - reactivity of metal alkyls - M-C bond

cleavage reactions - insertion of CO to M-C bonds - double carbonylation - insertions of alkenes and alkynes - insertions of metals with C-H bonds.

Alkylidene and alkylidyne complexes: synthesis of alkylidene complexes in low oxidation states and in high oxidation states - bonding in alkylidene complexes - synthesis and bonding in alkylidyne complexes - reactivity of alkylidene and alkylidyne complexes.

**UNIT III**

Alkene complexes: synthesis by ligand substitution, reduction and metal atom synthesis - bonding of alkenes to transition metals - bonding in diene complexes - reactivity of alkene complexes - ligand substitution - reactions with nucleophiles - olefin hydrogenation - hydrosilation - Wacker process - C-H activation of alkenes.

Alkyne complexes: synthesis, bonding and reactivity alkyne complexes - cobalt catalysed alkyne cycloaddition.

**UNIT IV**

Cyclopentadienyl complexes: metallocenes - synthesis of metallocenes - bonding in metallocenes - reactions of metallocenes - $Cp_2Fe/Cp_2Fe^+$ couples in biosensors - metallocene halides and hydrides - stereospecific polymerisation of 1-alkenes - cyclopentadiene as a non-spectator ligand - monocyclopentadienyl (half-sandwich) complexes - bent sandwich complexes - bonding in bent sandwich complexes.

Allyl complexes: Synthesis and structures of allyl complexes. Arene complexes: synthesis, structure and reactivity of arene complexes - multidecker complexes.

**UNIT V**

Organometallic compounds in homogeneous catalytic reactions - coordinative unsaturation - acid-base behaviour reaction - migration of atoms or groups from metal to ligand - insertion reaction - reactions of coordinated ligands - catalytic reactions of alkenes - isomerisation of alkenes - hydrogenation - hydroformylation and hydrosilation of alkenes - alkene polymerisation and oligomerisation - fluxional molecules. Asymmetric synthesis - Olefins metathesis in organic synthesis – Palladium catalysed cross coupling reactions in organic synthesis.

**TEXT BOOKS**

| S. No | Title of the Book | Author | Publishing Company | Year |
|---|---|---|---|---|
| 1 | Text book of Inorganic Chemistry | P.L. Soni, M. Katyal | Sulan Chandans Son | 1986 |
| 2 | Modern Inorganic Chemistry | S. Satya Prakash | S. Chand and Company Ltd. | 2003 |
| 3 | Advanced Inorganic Chemistry | Gurdeep Raj | Goel Publishing house | 1986 |
| 5 | Selected Topics in Inorganic Chemistry | U. Malik, G.D. Tuli, R.D. Madan | S. Chand and Company Ltd. | 2001 |
| 6 | Concise Coordination Chemistry | R. Gopalan, V. Ramalingam | Vikas Publishing house | 2001 |
| 7 | A New Concise Inorganic Chemistry | J. D. Lee | ELBS, 3rd Edn. | 1987 |

**REFERENCE BOOKS**

| S.No | Title of the Book | Author | Publishing Company | Year |
|---|---|---|---|---|
| 1. | Organometallics, complexes with transition metal-carbon –bonds | Bockmann | Oxford science publications, Oxford | 1996 |
| 2. | Basic organometallic chemistry | J. Haiduc and J. J. Zuckerman | Walter de Gruyter, Brelin | 1985 |
| 3. | Inorganic Chemistry - Priciples of structure and reactivity | J. E. Huheey | Harper International Edition, Harper and Rone New York | 1978 |
| 4. | Advanced Inorganic Chemistry | F. A. Cotton and G. Wilkinson | Fourth Edition | 1980 |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | S | S | M | M | M |
| **CO2** | M | S | M | S | M |
| **CO3** | S | M | S | S | M |
| **CO4** | M | M | S | S | S |
| **CO5** | M | S | M | M | S |

**S**- Strong; **M**-Medium.

**SEMESTER - III**

| CORE COURSE-VIII | **M.Sc. Chemistry** | **2019-2020** |
|---|---|---|
| M19PCH08 | **ELECTROCHEMISTRY AND PHOTOCHEMISTRY** | |
| Credits: 4 | | |

**Objectives**

The aim of this course is to expose the students to understand the electrochemistry and photochemistry and its application.

**Course Outcomes**

On the successful completion of the course, students will be able to

| **CO Number** | **CO Statement** | **Knowledge Level** |
|---|---|---|
| CO1 | Know about the concept of Ionics and Electrical double layer. | K2 |
| CO2 | Understand the concepts ofElectrode kineticsand their applications. | K2 |
| CO3 | Study the various storage devices Batteries, Fuel cells and corrosion related to real world problems. | K4 |
| CO4 | Relate the Photochemistry Laws and applied in Photochemical processes. | K3 |
| CO5 | Learn the basic principles of Photochemical Reactions and Radio chemistry and its applications to solar energy applications. | K1 |

**UNIT I**

Ionics: Electrochemistry of solution, ionic atmosphere – Ion-solvent and Ion-Ion interaction, Debye – Huckel – Onsagar equation. Ionic migration and diffusion, thermodynamics of galvanic cells, equilibrium electrode potential, thermodynamics of electrochemical cells.

Electrical double layer: theories of double layer structure diffuse double layer theory of Helmholtz, Gouy-Chapmann and the stern model, Electro capillary phenomenon, influence of double layer on charge transfer processes.

**UNIT II**

Electrode kinetics: types – Reference Electrode, polarizable and Non-polarizable Electrode, working Electrode - types, current potential relationship, Buttler-volmer and Tafel equations, overpoential- types, hydrogen evolution and Oxygen reduction reaction.

Theory, principle and Instrumentation and applications of cyclic voltammetry, polarography, ampherometry and coulometry.

**UNIT III**

Batteries: Primary and secondary Batteries – Ni-Cd, Mn-Li Batteries. Fuel cells: $H_2$-$O_2$ Fuel cells, direct methanol fuel cells, super capacitor.

Corrosion: Different types, influence of environment, Evan diagram, Pourbaix diagram, corrosion rate measurement, corrosion monitoring techniques and prevention.

**UNIT IV**

Laws of Photochemistry: Interaction of Electromagnetic radiation with Matter - Types of excitations – Laws of Photochemistry – Grothus and Draper law – Lambert and Beer's law – Einstein law – Quantum yield.

Photo primary processes, fate of the excited molecule – State energy diagrams – Fluorescence – Fluorescence life times – phosphorescence life times – Quenching – Stern – Volmer equation – Inter molecular processes – Photosensitisation – Predissociation – Fluorescence and Singlet – Triplet state and phosphorescence emission.

**UNIT V**

Photochemical Reactions: Light absorption – Experimental techniques – Electronic transitions – Frank – Condon principle – Jablonski diagrams – Intersystem crossing – Energy transfer – Molecular orbital view of excitation – The Geometry of excited states.

Radiation chemistry: Radioactive and non-radioactive transsions – properties of photochemically excited states – excited states, acidity constant, excimers and exciplexes – Pulse radiolysis, photovoltaic cells and solar cells, solar energy conversion.

**TEXT BOOKS**

| S. No | Title of the Book | Author | Publishing Company | Year |
|---|---|---|---|---|
| 1. | Electrochemistry-Principles and Applications | B.Viswanathan, S. Sundaram, R. Venkataraman, K. Rengarajan and P.S. Raghavan | S. Viswanathan Printers and Publishers Pvt., Ltd | 2007 |
| 2. | Modern Electrochemistry | J.O.M. Bockris and A.K.N. Reddy | Plenum Press, New York | 1970 |
| 3. | Fundamentals of Photochemistry | K.K.Rohatgi & Mukherjee | New age International publications, Reprint | 2002 |
| 4. | Physical Chemistry | Robert A. Alberty | Wiley Eastern Limited Reprint, 6th Edn. | 1987 |

**REFERENCE BOOKS**

| S.No | Title of the Book | Author | Publishing Company | Year |
|---|---|---|---|---|
| 1. | Principles and Application of Electrochemistry | D.R. Crow | Chapmann Hall, London | 1988 |
| 2. | Theoretical Electrochemistry | L. Antropov | Mir Publications, Moscow | 1972 |
| 3. | An Introduction to Electrochemistry | S. Glasstone | East West Press | 1967 |
| 4. | Modern Molecular photochemistry | N.J. Turro | Benjamin Cummings | 1965 |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | S | S | M | M | M |
| **CO2** | M | S | S | S | M |
| **CO3** | S | M | S | S | M |
| **CO4** | M | M | S | S | S |
| **CO5** | M | S | M | M | S |

**S**- Strong; **M**-Medium.

**SEMESTER - III**

| CORE PRACTICAL-V | **M.Sc. Chemistry** | **2019-2020** |
|---|---|---|
| M19PCHP05 | **PRACTICAL-V - ORGANIC ANALYSIS** | |
| Credits: 3 | | |

**Course Outcomes**

On successful completion of the course students will be able to

1. Understand the separation techniques and systematic analysis of organic mixtures.
2. Distinguish between aromatic – aliphatic and saturated – unsaturated compounds.
3. Learn the determination methods of physical constants of organic compound.

**Micro Qualitative Analysis of an organic binary mixture**

1. Pilot separation
2. Bulk separation
3. Analysis of organic compounds.
4. Derivatization.
5. Determination of melting and boiling points.

**(Minimum 8 Mixtures)**

**TEXT BOOKS**

| S. No | Title of the Book | Author | Publishing Company | Year |
|---|---|---|---|---|
| 1. | Organic Chemistry – Lab manual | N.S. Gnanapragasam and G. Ramamurthy | S.Viswanathan Co. Pvt. Ltd | 1998 |
| 2. | Vogel's Textbook of Practical Organic Chemistry, | B.S. Furniss, A.J.Hannaford, P.W.Smith, A.R.Tatchell | ELBS /Longman, London, 7th Edn. | 1984 |
| 3. | Basic Principles of Practical Chemistry | V. Venkateswaran, R. Veeraswamy, A.R.Kulandaivelu | New Delhi, Sultan Chand & sons, 2nd Edn. | 1997 |

**REFERENCE BOOKS**

| S. No | Title of the Book | Author | Publishing Company | Year |
|---|---|---|---|---|
| 1. | Text book of Practical Organic Chemistry | Vogel | ELBS/Longman, England, 4th Edn. | 1986 |
| 2 | Organic Chemistry Lab Manual | Ganapragasm and Ramamurthy | S. Vishwanathan Printers and Publishers (P) Ltd., Chennai, 2nd Edn. | 2007 |
| 3 | Advanced Experimental Chemistry. | J.N. Gurtu and R. Kapoor | S. Chand and Co. | 1987 |

**SEMESTER - III**

| CORE PRACTICAL-VI | **M.Sc. Chemistry** | **2019-2020** |
|---|---|---|
| M19PCHP06 | **PRACTICAL-VI- PHYSICAL CHEMISTRY EXPERIMENTS – II** | |
| Credits: 3 | | |

**Course outcomes**

On successful completion of the course students will be able to

1. Develop practical skill in conductometric and potentiometic titrations.
2. Understand experimental knowledge on kinetics and electro chemistry.
3. Learn the determination methods of physical constants of substances.

**LIST OF EXPERIMENTS**

1. Determination of the activity coefficient of an electrolyte at different molalities by emf measurements.
2. Determination of the dissociation constant of acetic acid by titrating it with sodium hydroxide using quinhydrone as an indicator electrode and calomel as a reference electrode.
3. Determination of the strength of a given solution of KCl using differential potentiometric titration technique.
4. Determination of the pH of the given solutions with the help of the indicators using buffer solutions and by colorimetric method.
5. Determination of the pH of a given solution by emf method using hydrogen electrode and quinhydrone electrode.
6. Determination of the composition and instability constant of a complex by mole ratio method.
7. Solubility and solubility products by emf method.
8. Determination of solubility product of Silver bromide and calculate its solubility in water and 0.1 M and 0.01 M $KBrO_3$ using Debye- Huckel limiting law.
9. Determination of the rate constant and order of reaction between potassium persulphate and potassium iodide and determine the temperature coefficient and energy of activation of the reaction.
10. Study the primary salt effect on the kinetics of ionic reactions and test the Bronsted relationship (iodide ion is oxidized by persulphate ion.

**TEXT BOOKS**

| S. No | Title of the Book | Author | Publishing Company | Year |
|---|---|---|---|---|
| 1. | Advanced Experimental Chemistry, Vol I. | J.N. Gurtu and R.Kapoor | S. Chand & Co. Ltd., New Delhi | 1980 |
| 2. | College Practical Chemistry | V.K. Ahluwalia, Sunitha Dhingra and Adarsh Gulate | Universities Press (India) Pvt Ltd | 2008 |
| 3. | Basic Principles of Practical Chemistry | V. Venkateswaran, R. Veeraswamy, A.R.Kulandaivelu | New Delhi, Sultan Chand & sons, 2nd Edn. | 1997 |

**REFERENCE BOOKS**

| S. No | Title of the Book | Author | Publishing Company | Year |
|---|---|---|---|---|
| 1. | Findlay's Practical Physical Chemistry | B.P. Levitt | Longman, London, 9th Edn. | 1985 |
| 2. | Experimental Physical Chemistry | F. Daniels | McGraw Hill, New York, 7th Edn. | 1970 |
| 3. | Practical Physical Chemistry | A. Findlay | London, Longman,7th Edn. | 1959 |

**SEMESTER - IV**

| CORE COURSE-IX | **M.Sc. Chemistry** | **2019-2020** |
|---|---|---|
| M19PCH09 | **PERICYCLIC REACTION AND NATURAL PRODUCTS** | |
| Credits: 4 | | |

**Objectives**

The aim of this course is to expose the students to understand pericyclic reactions and natural products.

**Course Outcomes**

On the successful completion of the course, students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Know the Conservation of orbital symmetry and Types, principles of Pericyclic reactions | K1 |
| CO2 | Categorize the electrocyclic reactions and sigmatropic rearrangements. | K4 |
| CO3 | Isolate and classify the synthesis of Terpenes | K3 |
| CO4 | Identify the functional groups and analyse the structures of Steroids | K2 |
| CO5 | Sketch out the synthesis of Alkaloids | K3 |

**UNIT I**

Pericyclic Reactions: Molecular orbital symmetry: frontier orbitals of ethylene, 1,3-butadiene, 1,3,5-hexatriene and allyl system; classification of pericyclic reactions. Woodward – Hoffmann correlation diagrams; FMO and transition state aromaticity approach; selection rules.

Cycloaddition reactions: (4+2), (2+2) cycloaddition – selectivity -substituent effect - inverse electron demand Diels-Alder reactions - 1,3-dipolar cycloadditions of ozone, diazomethane and nitrile oxide.

**UNIT II**

Electrocyclic reactions: conrotatory and disrotatory motions; ring opening and ring closing reactions - 4n, 4n+2 and allyl systems.

Sigmatropic rearrangements: (1,3), (1,5), (1,7), (3,3) and (5,5) - carbon migrations, degenerate sigmatropic rearrangements.

**UNIT III**

Terpenoids: Isolation and classification of terpenoids. Structural elucidation and synthesis of Zingiberine, Camphor, Ascorbic acid, Citral, α-pinene,Cadinene & Squalene.

**UNIT IV**

Steroids: Introduction - structural elucidation & synthesis of cholesterol, ergosterol, Bile acid. Male sex hormones - androsterone & testosterone, Female sex hormones - estrone, equilenin, Progesterone.

**UNIT V**

Alkaloids: Introduction - structural elucidation & synthesis of Morphine, Atropine, Piperine, Nicotine, Caffine & Belladine.

**TEXT BOOKS**

| S. No | Title of the Book | Author | Publishing Company | Year |
|---|---|---|---|---|
| 1. | Pericyclic Reactions | S. Sankararaman | Wiley | 2005 |
| 2. | Organic chemistry | Morrion, Boyd, Bhattacharjee | Pearson | 2009 |
| 3. | New Trends in Natural Product Chemistry | Atta-Ur-Rahman andM.I.Choudhary | Gordon & Breach Science Publishers | 1998 |
| 4. | The Natural Pigments | Bentley | Interscience | 1960 |
| 5. | Organic Chemistry Natural Products | O.P. Agarwal | Goel Publishers | 2013 |

**REFERENCE BOOKS**

| S. No | Title of the Book | Author | Publishing Company | Year |
|---|---|---|---|---|
| 1. | Chemistry of Alkaloids | S.W. Pelletier, Van Nostrand | Reinhold | 1970 |
| 2. | Chemistry of Natural Products | V.K. Ahluwalia | Ane Books Pvt. Ltd | 2006 |
| 3. | Chemistry of Natural Products | P.S. Kalsi | Products Kalyani Publisher | 2001 |
| 4. | Natural Products Chemistry Vol. I & II | K. Nakanishi | Academic Press,Inc | 1975 |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | S | S | M | M | M |
| **CO2** | M | S | S | S | M |
| **CO3** | S | M | S | S | M |
| **CO4** | M | M | S | S | S |
| **CO5** | M | S | M | M | S |

**S**- Strong; **M**-Medium.

**SEMESTER - IV**

| CORE COURSE-X | **M.Sc. Chemistry** | **2019-2020** |
|---|---|---|
| M19PCH10 | **SOLID STATE AND NUCLEAR CHEMISTRY** | |
| Credits: 4 | | |

**Objectives**

The aim of this course is to expose the students to understand solid state and nuclear chemistry.

**Course Outcomes**

On the successful completion of the course, students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Study the solid state chemistry of inorganic compounds. | K2 |
| CO2 | Summarize the types and close packing of atoms of solids and important inorganic compounds. | K2 |
| CO3 | Get knowledge about the theories, properties and defect of solid. | K1 |
| CO4 | Device the nuclear structure and radioactive nuclei. | K4 |
| CO5 | Learn the different type of nuclear reactions and their application | K3 |

**UNIT I**

The growth and form of crystals - the crystal systems and Bravais lattices - Miller indices and labelling of planes - symmetry properties - crystallographic point groups and space groups. Fundamentals of X-ray diffraction - powder and rotating crystal methods - systematic absences and determination of lattice types - analysis of X-ray data for cubic system - structure factor and Fourier synthesis. Electron and neutron diffraction and structure determination.

**UNIT II**

Types of solids - close packing of atoms and ions - BCC, FCC and HCP voids - Goldschmidt radius ratio - derivation - its influence on structures. Structures of rock salt - cesium chloride - wurtzite - zinc blende - rutile - fluroite - antifluorite - diamond and graphite - spinel - normal and inverse spinels and perovskite. Lattice energy of ionic crystals - Madelung constant - Born-Haber cycle and its applications.

**UNIT III**

Metallic state - free electron and band theories - electrical properties of solids – conductor, insulators, semiconductors – types and impurity semiconductors (n and P type) and superconductors. Defects in solid: stoichiometry and non-stoichiometry defect - linear defects - dislocations - effects due to dislocations. Elementary study of liquid crystals.

**UNIT IV**

Nucleus: nuclear structure - stability of nuclei - packing fraction - even - odd nature of nucleons - n/p ratio - nuclear potential - binding energy and exchange forces - shell model and liquid drop model. Decay of radio nuclei: rate of decay - determination of half-life period - secular equilibrium and decay series. Modes of decay: alpha, beta, gamma and orbital electron capture - nuclear isomerism - internal conversions - Q value - nuclear cross section - threshold energy and excitation functions. Particle acceleration and counting techniques: linear accelerator - cyclotron and synchrotron - betatron - G. M. counter - proportional and scintillation counters.

**UNIT V**

Different type of nuclear reactions with natural and accelerated particles: transmutation - stripping and pick-up - spallation - fragmentation - fission - characteristics of fission reaction - product distribution and theories of fission - fissile and fertile isotopes - $U^{235}$, $U^{238}$, $Th^{232}$ and $Pu^{239}$ - atom bomb - nuclear fusion - stellar energy. Uses of radioisotopes: agriculture - industry and medicine - mechanism of chemical reactions - radioisotopes in analytical chemistry - isotopic dilution analysis - neutron activation analysis and dating methods.

**TEXT BOOKS**

| S. No | Title of the Book | Author | Publishing Company | Year |
|---|---|---|---|---|
| 1. | Structural principles of Inorganic Chemistry | W.E. Addison | Longman | 1961 |
| 2. | Solid state chemistry | N.B. Hannay | Prentice-Hall | 1967 |
| 3. | Physical chemistry | R.A. Alberty | | 1975 |
| 4. | Essentials of Nuclear chemistry | H.J. Arnikar | Wiley-Blackwell, 2nd Edn. | 1987 |

**REFERENCE BOOKS**

| S. No | Title of the Book | Author | Publishing Company | Year |
|---|---|---|---|---|
| 1. | Physical Chemistry | W.J. Moore | Longmans Green & Co. Ltd. | 1963 |
| 2. | Introduction to solids | L.V. Azroff | Mc Graw Hill, New York | 2009 |
| 3. | Nuclear and Radiochemistry | G. Friedlander, J.W. Kennedy, E.S. Macias, J. M. Miller | Wiley | 1981 |
| 4. | Source book on atomic energy | S. Glasstone | Van Nostrand | 1998 |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | S | S | M | M | M |
| **CO2** | M | S | S | S | M |
| **CO3** | S | M | S | S | M |
| **CO4** | M | M | S | S | S |
| **CO5** | M | S | M | M | S |

**S**- Strong; **M**-Medium.

## SEMESTER IV

| CORE COURSE-XI | **M.Sc. Chemistry** | **2019-2020** |
|---|---|---|
| M19PCH11 | **RESEARCH METHODOLOGY** | |
| Credits: 4 | | |

**Objectives**

On completion of this course student shall know the importance of research, methodology of writing thesis and journal articles and errors involved in chemical analysis.

**Course Outcomes**

On the successful completion of the course, students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Understand the meaning of research. | K2 |
| CO2 | Acquire knowledge about errors involved in chemical analysis. | K1 |
| CO3 | Analyze about sampling techniques. | K2 |
| CO4 | Relate ideas regarding research and thesis writing. | K4 |
| CO5 | Develop knowledge about the use of tools and softwares in research. | K3 |

**UNIT I**

Meaning of Research: The search for knowledge, purpose of research, scientific method, role of theory, characteristics of research. Types of research: fundamental or pure research, applied research, action research, historical research, experimental research.

**UNIT II**

Errors Involved in Chemical Analysis: Classification, minimization of errors, determination of accuracy of results, reliability of results, rounding numbers -Significant figures - Mean standard deviation.

**UNIT III**

Sampling: Introduction - Definitions, theory of sampling - techniques of sampling – Statistical criteria of good sampling & required size - Stratified sampling Vs random sampling.

**UNIT IV**

Nature and purpose, the components of dissertation, overview, title and title page, abstract, preface and table of contents, Introduction, results, discussion, conclusion, experimental section, references and miscellaneous components. Preparation of dissertation.

**UNIT V**

Writing techniques – Introduction, word processing and page layout, hardware and operating systems, word processing and page layout software, writing and formatting with computer, becoming accustomed to your system.

**TEXT BOOKS**

| S. No | Title of the Book | Author | Publishing Company | Year |
|---|---|---|---|---|
| 1. | Research Methodology Methods & Techniques | C.R. Kothari | New AgeInternational Publishers | 2011 |
| 2. | Research Methodology | Y.K. Singh, R. Nath | APH Publishing Corporation | 2005 |
| 3. | Methods in Social Research | W.J. Goode, P.K. Hatt | McGraw-Hill, New York | 1982 |

**REFERENCE BOOKS**

| S. No | Title of the Book | Author | Publishing Company | Year |
|---|---|---|---|---|
| 1. | Basic research methods for librarians | L.S. Connaway & R.R. Powell | Libraries unlimited California. | 2010 |
| 2. | Research methodology in Library and information science | A. Glootenberg | Uxbridge: Koros | 2013 |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | S | S | M | M | M |
| **CO2** | M | S | S | S | M |
| **CO3** | S | M | S | S | M |
| **CO4** | M | M | S | S | S |
| **CO5** | M | S | M | M | S |

**S**- Strong; **M**-Medium.

**SEMESTER - IV**

| CORE PRACTICAL-VII | **M.Sc. Chemistry** | **2019-2020** |
|---|---|---|
| M19PCHP07 | **PRACTICAL-VII - ORGANIC AND INORGANIC PREPARATION** | |
| Credits: 3 | | |

**Course outcomes**

On successful completion of the course students will be able to

1. Develop practical skill in the preparation of organic and inorganic compounds.
2. Understand the preparation methods of organic and inorganic compounds.
3. Execute the idea about recrystalisation.

**A. Organic preparation involving double stage (Minimum 5 Preparations)**

1. p-Bromoacetanilide from Aniline
2. p-Nitroaniline from Acetanilide
3. 1,3,5-Tribromobenzene from Aniline
4. Acetyl salicyclic acid from Methyl salicylate
5. Benzilic acid from Benzoin
6. m-Nitroaniline from Nitrobenzene
7. β-Naphthol from Naphthalene

**B. Preparation of the following Inorganic compounds**

1. Sodium hexanitrocobaltate (III)
2. Sodium Trisoxalatoferrate (III)
3. Bis (acetylacetanato) Copper (II)
4. Hexamminecobalt (III) chloride
5. Hexamminenickel (II) chloride
6. Potassium Tetrachlorocuprate (II)

**TEXT BOOKS**

| S. No | Title of the Book | Author | Publishing Company | Year |
|---|---|---|---|---|
| 1. | Organic Chemistry – Lab manual | N.S. Gnanapragasam and G. Ramamurthy | S.Viswanathan Co. Pvt. Ltd | 1998 |
| 2. | Advanced Experimental Chemistry. | J.N. Gurtu and R. Kapoor | S. Chand and Co. | 1987 |
| 3. | Basic Principles of Practical Chemistry | V. Venkateswaran, R. Veeraswamy, A.R.Kulandaivelu | New Delhi, Sultan Chand & sons, 2nd Edn. | 1997 |

**REFERENCE BOOKS**

| S. No | Title of the Book | Author | Publishing Company | Year |
|---|---|---|---|---|
| 1. | Text book of Practical Organic Chemistry | Vogel | ELBS/Longman, England, 4th Edn. | 1986 |
| 2 | Vogel's Text book of quantitative inorganic analysis | J. Basset, R.C. Denney, G.H. Jeffery and J. Mendham | ELBS/Longman, England, 4th Edn. | 1986 |
| 3 | Experimental Inorganic Chemistry | W.G. Palmer | Van Nostrand Reinhold Co., London | 1972 |
| 4 | An advanced course in practical Inorganic Chemistry | D.N. Grindley | Butterworths | 1964 |

**SEMESTER - IV**

| PROJECT | **M.Sc. Chemistry** | **2019-2020** |
|---|---|---|
| M19PCHPR1 | **PROJECT** | |
| Credits: 3 | | |

**Course Outcomes**

On successful completion of the course students will be able to

1. Learn research methodologies along with literature survey.
2. Get skills on developing new materials through new synthetic routes.
3. Characterize the material using different techniques.

Make the student to understand and present a research finding on a topic in the subject related to Chemistry under the guidance of a department Staff.

**SEMESTER - I**

| ELECTIVE-I | **M.Sc. Chemistry** | **2019-2020** |
|---|---|---|
| M19PCHE01 | **DYE CHEMISTRY** | |
| Credits: 4 | | |

**Objectives**

On completion of this course student could understand theories of colour and constitution, differentiate the types of dyes and know the process and mechanism of dying process.

**Course Outcomes**

On the successful completion of the course, students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Understand basic concepts dye chemistry | K2 |
| CO2 | Classify acid and basic dyes based on structure and mechanism | K3 |
| CO3 | Acquire knowledge about mordant, azo and vat Dyes | K1 |
| CO4 | Examine the synthesis and applications to various types of dyes - azo, di & triphenyl methane, phthalein dyes | K3 |
| CO5 | List out the applications of dyes in different areas | K4 |

**UNIT I**

Colour and constitution: Colour of substances - Complementary colours - theories of colour and constitution - Otto - Witt theory - chromophores, auxochromes, bathochromic shift, hypsochromic shift. Quinonoid theory, modern theories - valence bond theory and molecular orbital theory. Names of commercial dyes; Study of raw materials and dyestuff intermediates; Unit operations - nitration, sulphonation, halogenation, amination, diazotisation and alkali fusion; Colour index and its significance; Classification of dyes based on chemical constitution and method of applications; General properties - linearity, coplanarity and fastness.

**UNIT II**

Direct cotton dyes (substantive dyes) – Classification, properties, structure and mechanism of dyeing, post treatment of dyeing; Acid dyes and Basic dyes – Classification, Characteristics, trade names, Mechanism of dyeing, Nature of affinity on cellulose and protein fibres.

**Unit III**

Mordant dyes – classification, methods of application; Metal complex dyes – types of bond formation between dye and various fibres; Azo dyes – Principles of azo coupling - Mechanism of diazotization - Coupling with amines & phenols. Monoazo & bisazo dyes - Synthesis & applications. Tautomerism in azo dyes. Vat dyes and solubilised vat dyes – classification, methods of application, trade names, principles and application, Stripping agents and correction of faulty dyeing.

**UNIT IV**

Di and Triphenyl Methane Dyes: Synthesis and applications of diphenyl methane dyes – Auramin O, Auramin G. Triphenyl methane dyes - leuco bases - pseudo bases - dye salts; amino triphenyl methane dyes - Malachite Green, Rosaniline & Crystal Violet. Hydroxy triphenyl methane dyes - Aurin, Chrome Violet.

Phthalein Dyes: Phenolphthalein, phenosulpho - phthalein. xanthene dyes, acid xanthene dyes - Fluorescein, Eosin, Erythrocin. Xanthhydrol basic xanthene dyes - Rhodamine - B, Rhodamine - G, pyronine - G

**UNIT V**

Pigments: Requirements of a pigment – Organic / inorganic pigments & their uses in paints. Reactions of dyes with fibre & water. Fluorescent Brightening Agents. Applications of dyes in other areas – Medicine, chemical analysis, cosmetics, colouring agents, foods and beverages.

**TEXT BOOKS**

| S. No | Title of the Book | Author | Publishing Company | Year |
|---|---|---|---|---|
| 1. | Synthetic Dyes | Gurdeep R Chatwal | Himalaya Publishing House (Pvt) | 2016 |
| 2. | A Text Book of Synthetic Dyes | O.D. Thyagi, M. Yadav | Anmol Publication (Pvt) Ltd. | 2002 |
| 3. | The chemistry of synthetic dyes Part I & II | K. Venkataraman | Academic Press, New York | 1952 |

**REFERENCE BOOKS**

| S. No | Title of the Book | Author | Publishing Company | Year |
|---|---|---|---|---|
| 1. | Chemistry of Dyes and Principles of Dyeing Vol.-II | V. A. Shenai | Sevak Prakashan, Mumbai | 1987 |
| 2. | The Dyeing of Synthetic Polymer and Acetate Fibres | D. M. Nunn | Dyers Company, Publication Trust. | 1979 |
| 3. | Dyes and their Intermediates | E.N. Abrahart | Edward Arnold Publishers | 1977 |
| 4. | Synthetic Dyes | Pope Sine | Neha Publishers | 2016 |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | S | S | M | M | M |
| **CO2** | M | S | S | S | M |
| **CO3** | S | M | S | S | M |
| **CO4** | M | M | S | S | S |
| **CO5** | M | S | M | M | S |

**S**- Strong; **M**-Medium.

**SEMESTER - I**

| ELECTIVE-I | **M.Sc. Chemistry** | **2019-2020** |
|---|---|---|
| M19PCHE02 | **POLYMER CHEMISTRY** | |
| Credits: 4 | | |

**Objectives**

At the end of this course student can understand the kinetics of polymerization and know the importance of polymer, technology and the applications of polymers.

**Course Outcomes**

On the successful completion of the course, students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Classify the types of polymers and recognize the basic concepts | K2 |
| CO2 | Illustrate the mechanisms of polymerization | K2 |
| CO3 | Calculate the molecular weight of polymers by various methods | K3 |
| CO4 | Understand the different polymer processing techniques | K2 |
| CO5 | List the commercial polymers in different areas | K3 |

**UNIT I**

Monomers, Plastics, elastomers and fibres. Linear, branched and network Polymers. Degree of polymerization. Polymerization in homogeneous and heterogeneous systems. Condensation Polymerization: Mechanism of stepwise polymerization. Kinetics and statistics of linear stepwise polymerization. Addition polymerization: Free radical, cationic and anionic polymerization. Polymerization conditions.

**UNIT II**

Co-ordination polymerization: Kinetics, mono and bimetallic mechanism of co-ordination polymers. Zeigler Natta catalyst, Co-polymerization: Block and graft co-polymers, kinetics of co-polymerization. Types of co-polymerization. Reactivity ratio.

**UNIT III**

Molecular weight and properties: Polydispersion – average molecular weight- number, weight and viscosity average molecular weights. Measurement of molecular weights - Viscosity, light scattering, osmotic and ultracentrifugation methods. Polymer structure and physical properties – Crystalline melting point (Tm). Glass transition temperature (Tg). Determination of Tg. Relationship between Tm and Tg.

**UNIT IV**

Polymer processing: Processing techniques: Compounding, calendering, die casting, rotational casting, film casting, injection moulding, blow moulding extrusion moulding, thermoforming, foaming, reinforcing and fibre spinning.

**UNIT V**

Commercial polymers: Polyethylene, polyvinyl chloride, polyamides, polyesters, phenolic resins, epoxy resins and silicone polymers. Functional polymers - Fire retarding polymers and Electrically conducting polymers. Biomedical polymers – contact lens, dental polymers, artificial heart, kidney, skin and blood cells.

**TEXT BOOKS**

| S. No | Title of the Book | Author | Publishing Company | Year |
|---|---|---|---|---|
| 1. | Text Book of Polymer Science | F.W. Billmeyer | J.Wiley | 2003 |
| 2. | Polymer Science | Gowariker, N.V. Viswanathan and J. Sreedhar | New Age Int., | 1986 |
| 3. | Introduction to Polymer Chemistry | R. B. Seymour | MC Craw Hill, New York. | 1971 |

**REFERENCE BOOKS**

| S. No | Title of the Book | Author | Publishing Company | Year |
|---|---|---|---|---|
| 1. | Contemporary Polymer Chemistry | H.R. Alcock and F.W. Lamber | Prentice Hall | 1981 |
| 2. | Principles of Polymer Chemistry | P.J. Flory | Cornell University Press, New York | 1953 |
| 3. | Principles of Polymerization | G. Odian | John Wiley & Sons, New York | 1981 |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | S | S | M | S | S |
| **CO2** | M | S | S | S | M |
| **CO3** | S | M | S | M | S |
| **CO4** | M | M | S | M | M |
| **CO5** | M | S | M | S | M |

**S**- Strong; **M**-Medium.

**SEMESTER - I**

| ELECTIVE-I | **M.Sc. Chemistry** | **2019-2020** |
|---|---|---|
| M19PCHE03 | **GREEN CHEMISTRY** | |
| Credits: 4 | | |

**Objectives**

This course can give idea about basic principles and importance of green chemistry and its application.

**Course Outcomes**

On the successful completion of the course, students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Understand basic principles and tools of green chemistry | K2 |
| CO2 | Discuss microwave mediated organic synthesis | K2 |
| CO3 | Analyze the synthetic applications of ionic liquids | K4 |
| CO4 | Relate supported catalysts and bio-catalysts for Green chemistry | K3 |
| CO5 | Acquire knowledge of modified bio catalysts | K1 |

**UNIT I**

Green chemistry: Introduction - relevance and goals, Anastas' twelve principles of green chemistry - Tools of green chemistry: alternative starting materials, reagents, catalysts, solvents and processes with suitable examples.

**UNIT II**

Microwave mediated organic synthesis (MAOS): Microwave activation – advantage of microwave exposure – specific effects of microwave – Neat reactions – solid supports reactions _ Functional group transformations – condensations reactions – oxidations – reductions reactions – multi-component reactions.

**UNIT III**

Ionic liquids: Ionic liquids and PTC Introduction – synthesis of ionic liquids – physical properties – applications in alkylation – hydroformylations – expoxidations – synthesis of ethers – Friedel - craft reactions – Diels-Alder reactions – Knoevengal condensations – Wittig reactions – Phase transfer catalyst - Synthesis – applications.

**UNIT IV**

Supported catalysts and bio-catalysts for Green chemistry Introduction – the concept of atom economy – supported metal catalysts – mesoporous silicas – the use of Biocatalysts for green chemistry.

**UNIT V**

Modified bio catalysts: Fermentations and biotransformations – fine chemicals by microbial fermentations – vitamins and amino acids – Baker's yeast mediated biotransformations – Bio-catalyst mediated Baeyer-Villiger reactions – Microbial polyester synthesis.

**TEXT BOOKS**

| S. No | Title of the Book | Author | Publishing Company | Year |
|---|---|---|---|---|
| 1. | New Trends in Green Chemistry | V.K. Ahluwalia, M.Kidwai | Anamaya Publishers | 2012 |
| 2. | Organic Synthesis - Special Techniques | V.K.Ahluwalia, Renu Aggarwal | Techniques Narosa Publishing House | 2012 |
| 3. | Environmental Chemistry | A. K. De | Wiley Eastern Ltd., New Delhi. | 1989 |

**REFERENCE BOOKS**

| S. No | Title of the Book | Author | Publishing Company | Year |
|---|---|---|---|---|
| 1. | Green Chemistry – Environmentally benign reactions | V. K. Ahluwalia | Ane Books India | 2006 |
| 2. | Green Chemistry – Environment friendly alternatives | Rashmi Sanghi & M. M. Srivastava | Narora Publishing House | 2003 |
| 3. | Green Chemistry – Frontiers in benign chemical synthesis and processes | Paul T. Anastas & Tracy C. Williamson | Oxford University Press | 1998 |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | S | S | M | S | S |
| **CO2** | M | S | S | S | M |
| **CO3** | S | M | S | M | S |
| **CO4** | M | M | S | M | M |
| **CO5** | M | S | M | S | M |

**S**- Strong; **M**-Medium.

**SEMESTER - I**

| ELECTIVE-I | **M.Sc. Chemistry** | **2019-2020** |
|---|---|---|
| M19PCHE04 | **BIOORGANIC & MEDICINAL CHEMISTRY** | |
| Credits: 4 | | |

**Objectives**

After completion of this course student can know the key role of various elements in the living systems and learn about how enzymes and coenzymes work.

**Course Outcomes**

On the successful completion of the course, students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Understand the organic chemistry of biomolecules like amino acids, and protein | K2 |
| CO2 | Acquire basic knowledge about the structure and functions of certain metallo enzymes. | K1 |
| CO3 | Explain the synthesis ofnucleic acids and proteins | K2 |
| CO4 | Contribute insight into the small molecules binding and transport mechanism involving living system | K3 |
| CO5 | Describe the mechanism of binding interactions of metal complexes with biomolecules and metal based drug action. | K3 |

**UNIT I**

Classification, synthesis and properties of amino acids, isoelectric point, biosynthesis of amino acids. Peptides: oligo- and polypepides, geometry of peptide linkage, N-terminal and C-terminal residue analysis, synthesis of peptides-amino and carboxyl protecting groups-solid phase peptide synthesis. Proteins: classification and properties (denaturation, isolelectric point and electrophoresis), primary, secondary, tertiary and quaternary structures of proteins, collagen and triple helix.

**UNIT II**

Mechanism of enzyme catalysis, Factors influencing enzyme action, Examples of typical enzyme mechanisms: chymotrypsin, ribonuclease and lysozyme, Enzyme - catalyzed addition, elimination, condensation, carboxylation and decarboxylation, isomerisation, group transfer and

rearrangement reactions-structure and biological functions of coenzyme A, thiamine pyrophosphate, pyridoxal phosphate, NAD+ , NADP+ , FMN, FAD, lipoic acid and Vitamin B12. Mechanisms of reactions catalysed by the above cofactors.

**UNIT III**

Nucleotides and nucleosides, DNA: primary and secondary structure-replication of DNA, RNA and protein synthesis: Messenger RNA synthesis-transcription, Ribosomes - rRNA, Transfer RNA, genetic code translation. Determination of base sequence of DNA. Polymerase Chain Reaction (PCR). Antisense technology in chemotherapy and other nucleic acid-targeted drugs-intercalaters, sequence specific drugs. A brief account of ribosyme and iRNA.

**UNIT IV**

Designing organic synthesis - disconnection approach - synthons and synthetic equivalents - one group disconnections: alcohol, olefin, ketone, acids-two group disconnections: 1,2, 1,3, 1,4 and 1,5-difunctional compounds - convergent synthesis - functional group interconversions - functional group additions – carbon hetero atom bonds - methods for 3 to 6membered rings.

**UNIT V**

Medicinal Chemistry: Lead and Analogue Synthesis - Combinatorial synthesis in medicinal chemistry: Solid phase techniques - methods of parallel synthesis - mix and split techniques - dynamic combinatorial chemistry - screening and deconvolution -limitations of combinatorial synthesis Assymmetric synthesis: basic principles-stereoselective and stereospecific reactions - methods for determining enantiomeric excess - chiral auxiliary, reagents and catalysts and their applications (wherever applicable) in alkylation, hydrogenation, hydroxylation, epoxidation and hydroboration of alkenes, reduction of ketones - Cram and Felkin - ahn models. Noyori's BINAP – Jacobson catalyst – Evans catalyst.

**TEXT BOOKS**

| S. No | Title of the Book | Author | Publishing Company | Year |
|---|---|---|---|---|
| 1. | Bioorganic Chemistry: A Chemical approach to Enzyme action | Hermann Dugas and C.Penny | Springer-Verlag | 1981 |
| 2. | Designing Organic Synthesis: The Disconnection Approach | Stuart Warren | Wiley | 1984 |
| 3. | Advanced Organic Chemistry: Part-A and Part-B | Francis A. Carey and Richard B. Sundberg | Springer | 2007 |

**REFERENCE BOOKS**

| S. No | Title of the Book | Author | Publishing Company | Year |
|---|---|---|---|---|
| 1. | Fundamentals of Enzymology | N.C. Price and L.Stevens | Oxford University Press. | 2002 |
| 2. | Enzymatic Reaction Mechanisms | C. Walsh, W.H.Freeman | Freeman Inc | 1978 |
| 3. | Introduction to Bio organic Chemistry and Chemical Biology | D.V. Vranken and G.A. Weiss | Garland Science | 2012 |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | S | S | M | S | S |
| **CO2** | M | S | S | S | M |
| **CO3** | S | M | S | M | S |
| **CO4** | M | M | S | M | M |
| **CO5** | M | S | M | S | M |

**S**- Strong; **M**-Medium.

**SEMESTER - II**

| ELECTIVE-II | **M.Sc. Chemistry** | **2019-2020** |
|---|---|---|
| M19PCHE05 | **WATER CHEMISTRY** | |
| Credits: 4 | | |

**Objectives**

Enable the students to have knowledge on physic – chemical properties and the evaluation technique for sewage.

**Course Outcomes**

On the successful completion of the course, students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Understand Physical and chemical characteristics of water | K1 |
| CO2 | Discuss drinking water specification with physical and chemical parameters | K2 |
| CO3 | Identify physical and chemical treatment of waste water. | K3 |
| CO4 | Devise industrial waste water treatment process | K4 |
| CO5 | Develop water treatment plant layouts. | K3 |

**UNIT I**

Water Treatment: Sources of Water; Physical and chemical characteristics of water; Water analysis; Potable water – WTO standard: uses of water.

**UNIT II**

Drinking Water Specification: Physical parameters: Color, taste - odour, Turbidity, suspended solids, Temperature; Chemical parameters: TDS Alkalinity, Hardness, salts, acids and alkalis, chlorides, fluorides, proteins, carbohydrates, organics, fats oil & grease, Hazen units, BOD, COD, DO, TDS, Trace metals, Heavy metals, tests on quality parameters.

**UNIT III**

Waste Water Treatment: Physico - Chemical treatments: Sedimentation, Coagulation-Flocculation, Settling Tanks, Disinfection Systems: Chemicals - Chlorination and other Disinfection methods, UV, Ozonation, Aeration and Gas transfer; Precipitation; Softening; Adsorption and Ion exchange; Reverse Osmosis Technologies Membrane processes, Ultra Filtration.

**UNIT IV**

Industrial waste water treatment: Activated sludge treatment plants – mass balances, with and without recycle plants; Types of plants – single tank, contact stabilization, biosorption plants.

Biofilters: Hydraulic film diffusion, two component diffusion; Types of plants – trickling filters, submerged filters and rotating disc; removal of particulate organic matter

**UNIT V**

Treatment Plants: Plants for nitrification – mass balances, nitrifying plants and types of plants. Treatment plant for denitrification - mass balances, denitrifying plants and types of plants; redox zones in the biomass. Aerobic treatment; Suspended growth aerobic treatment processes; Activated sludge process and its modifications; Attached growth aerobic processes;

Tricking filters and Rotating biological contactors; Anaerobic treatment; suspended growth, attached growth, fluidized bed and sludge blanket systems; nitrification, denitrification; Phosphorus removal.

**TEXT BOOKS**

| S. No | Title of the Book | Author | Publishing Company | Year |
|---|---|---|---|---|
| 1. | Industrial Chemistry (Including Chemical Engineering) | B.K.Sharma | Goel Publishing House, Meerut | 1999 |
| 2. | Outlines of Chemical Technology | M.Gopala Rao & Marshall Sittig | East-West Press Pvt Ltd | 1997 |
| 3. | Environmental Chemistry | A.K. De | Wiley Eastern | 1989 |

**REFERENCE BOOKS**

| S. No | Title of the Book | Author | Publishing Company | Year |
|---|---|---|---|---|
| 1. | Waste Water Engineering | L.Winther | Polyteknisk Forlag, Lyngby | 1978 |
| 2. | Water Chemistry | P.Harremoes | Polyteknisk Forlag, Lyngby | 1989 |
| 3. | Principles of Water treatment | Kerry J. Howe | Wiley | 2012 |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | S | S | M | S | S |
| **CO2** | M | S | S | S | M |
| **CO3** | S | M | S | M | S |
| **CO4** | M | M | S | M | M |
| **CO5** | M | S | M | S | M |

**S**- Strong; **M**-Medium.

**SEMESTER - II**

| ELECTIVE-II | **M.Sc. Chemistry** | **2019-2020** |
|---|---|---|
| M19PCHE06 | **NANO CHEMISTRY** | |
| Credits: 4 | | |

**Objectives**

At the end of the course student learn the synthesis and characterization of nanomaterials and get familiar with nanotechnology and nanodevices.

**Course Outcomes**

On the successful completion of the course, students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Acquire knowledge about nano chemistry. | K1 |
| CO2 | Discuss synthesis of nano materials by using nanofabrication method | K2 |
| CO3 | Discuss on various techniques available for characterizing the nano materials | K2 |
| CO4 | Illustrate carbon clusters and nanostructures | K2 |
| CO5 | Appraise the role of nanotechnology and nano devices | K4 |

**UNIT I**

Introduction to nanoscience and nanotechnology, discussion on various phenomenon at nanoscale, such as size, shape, surface, surface energy, surface stabilization, characteristic length, self-assembly, defects, size quantization, surface plasmon, conductivity, tunneling, magnetism, defects.

**UNIT II**

Basics of nanofabrication method: top-down, bottom-up approaches, gas phase, liquid phase, solid phase synthesis, self-assembly, templated synthesis, sol-gel electrodeposition, fundamentals of nanoparticle formation, thermodynamic approach, super saturation, nucleation, growth, nucleation.

Synthesis of nanoparticles: metallic, semiconducting, quantum dots, oxides, hybrids, micelles and micro emulsion as templates for synthesis. $^{0}D$, $^{1}D$ and $^{2}D$ nanoparticles, core-shell nanoparticles, special nanoparticles, shaped nanoparticles

**UNIT III**

Characterization Techniques for Nanomaterials: Discussion on various techniques available for characterizing the nanomaterials for their size, shape,

morphology, crystalline phase, oxidation states, textural properties (surface area, pore volume, pore size), thermal stability, light absorption and band gap.

Electron Microscopy: Scanning electron microscopy (SEM), Transmission electron microscopy (TEM), Scanning Probe Microscopic Techqnics; Atomic force Microscopy (AFM) and Scanning Tunneling Microscopy. Particle size Analyser (Dynamic light scattering), X-ray Differaction (XRD), Auger Emission Spectroscopy, Electron Spectroscopy for Chemical analysis (ESCA).

**UNIT IV**

Carbon Clusters and Nanostructures: Nature of carbon bond – new carbon structures – carbon clusters – discovery of C60 – alkali doped C60–superconductivity in C60–larger and smaller fullerenes. Carbon nanotubes – synthesis –single walled carbon nanotubes – structure and characterization – mechanism of formation – chemically modified carbon nanotubes – doping – functionalizing nanotubes – applications of carbon nanotubes, and carbon nanowire.

**UNIT V**

Nanotechnology and Nanodevices: DNA as a nanomaterial, DNA – knots and junctions, DNA,nanomechanical device designed by Seeman. Force measurements in simple protein molecules and polymerase – DNA complexes. Molecular recognition and DNA based sensor. Protein nano array, nanopipettes, molecular diodes, self-assembled nano transistors, nanoparticle mediated transfection.

**TEXT BOOKS**

| S. No | Title of the Book | Author | Publishing Company | Year |
|---|---|---|---|---|
| 1. | Nanotechnology | Mark Ratner, Daniel Ratne | Pearson Education | 2008 |
| 2. | Nanotechnology | S .Shanmugam | MJP Publishers | 2011 |
| 3. | Nanomaterials | B. Viswanathan | Narosa Publishing House | 2014 |

**REFERENCE BOOKS**

| S. No | Title of the Book | Author | Publishing Company | Year |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 1. | Nanoscale materials in Chemistry | K. J. Klabunde | Wiley- Interscience, New York | 2001 |
| 2. | Nano Science and Technology – Novel Structures and Phenomena | T. Tang and P. Sheng | Taylor & Francis, New York | 2004 |
| 3. | Introduction to Nanotechnology | C. P. Poole, and Jr. F. J. Owens | Wiley Interscience,New Jersey | 2003 |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | S | S | M | S | S |
| **CO2** | M | S | S | S | M |
| **CO3** | S | M | S | M | S |
| **CO4** | M | M | S | M | M |
| **CO5** | M | S | M | S | M |

**S**- Strong; **M**-Medium.

**SEMESTER - II**

| ELECTIVE-III | **M.Sc. Chemistry** | **2019-2020** |
|---|---|---|
| M19PCHE07 | **APPLIED CATALYSIS** | |
| Credits: 4 | | |

**Objectives**

This course provides knowledge in homogenous and heterogeneous catalysis and the completion of this course helps to learn Surface catalysis and mechanism of surface reactions.

**Course Outcomes**

On the successful completion of the course, students will be able to

| **CO Number** | **CO Statement** | **Knowledge Level** |
|---|---|---|
| CO1 | Understand basic concepts of acid-base catalysis and enzyme catalysis. | K2 |
| CO2 | Analyze the benefits of PTC and industrial processes with PTC | K4 |
| CO3 | Demonstrate Micellar catalysis and effects on thermal and photochemical reactions | K3 |
| CO4 | Identify the electrocatalysis and list out industrial application | K1 |
| CO5 | Explain surface catalysis & surface structures for single crystal surface of metals and solids | K4 |

**UNIT I**

Catalysis phenomenon – mode of action of catalysts – classification of catalysts – Comparison of Homogeneous and Heterogeneous Catalysis. Homogeneous catalysis – general mechanisms; acid - base catalysis – catalytic activity, mechanisms and salt effects. Enzyme catalysis – influence of substrate concentration, pH, temperature, and enzyme mechanisms. Kinetics of inhibition – chain reaction, enzyme catalyzed reactions.

**UNIT II**

Catalysis in molecular-scale cavities – structure of crystalline solids – zeolites – families of zeolites; adsorption and diffusion in zeolites – catalysis by zeolites containing metal complexes and clusters; non-zeolite molecular sieves – clays and other layered materials. Catalysis – catalysts for PTC – mechanism and benefits of PTC – PTC reactions – selected industrial processes with PTC.

**UNIT III**

Micellar catalysis: effects of micelles on chemical reactions, characteristics of enzymatic reactions, micelle-catalyzed reactions, inhibition in micellar solutions; reverse micelles and microemulsions – catalysis in thermal and photochemical reactions.

**UNIT IV**

Electrocatalysis – introduction to electrocatalysis and fuel cells – industrial application of catalysis – petroleum refining – distillation, cracking, reforming, hydrotreating, Alkylation and isomerization, ethylene-based processes – ethylene oxide and ethylene glycol, polyethylene, vinyl chloride and PVC; Propylene-based processes – acrylic acid and acrylonitrile, Ziegler-Natta chemistry; C-based processes – butadiene, isobutylene.

**UNIT V**

Surface catalysis – introduction – mechanism of surface reactions: Langmuir Hinshel wood &-Rideal mechanisms; surface structures – single crystal surface of metals, high-surface area amorphous solids; adsorption; functionalized surfaces; catalysis on functionalized surfaces: connection to molecular catalysis; catalysis on metal surfaces, metal oxide surfaces, mixed metal oxides, metal sulfides.

**TEXT BOOKS**

| S. No | Title of the Book | Author | Publishing Company | Year |
|---|---|---|---|---|
| 1. | Catalytic Chemistry | B. C. Gates | John Wiley & Sons, Inc., | 1992 |
| 2. | Catalysis | J. C. Kuriacose | Macmillan India Ltd., New Delhi | 1991 |
| 3. | Kinetics and Catalysis in Micro heterogeneous Systems | M. Gratzel, K. Kalyana sundaram | Marcel Dekker, New York | 1991 |

**REFERENCE BOOKS**

| S. No | Title of the Book | Author | Publishing Company | Year |
|---|---|---|---|---|
| 1. | Chemical Kinetics | K. J. Laidler | Pearson Education Pvt Ltd. | 2005 |
| 2. | Catalysis, Vol. I and II | P. H. Emmett | Reinhold Corp., New York | 1954 |
| 3. | Industrial Catalysis: A Practical Approach | J. Hagen | Wiley-VCH, 2nd Edn | 2006 |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | S | S | M | M | M |
| **CO2** | M | S | S | S | M |
| **CO3** | S | M | S | S | M |
| **CO4** | M | M | S | S | S |
| **CO5** | M | S | M | M | S |

**S**- Strong; **M**-Medium.

**SEMESTER - II**

| ELECTIVE-II | **M.Sc. Chemistry** | **2019-2020** |
|---|---|---|
| M19PCHE08 | **COMPUTATIONAL QUANTUM CHEMISTRY** | |
| Credits: 4 | | |

**Objectives**

On accomplishment of this course students can understand the quantum mechanics necessary for the description of atoms and molecules and their chemical reaction.

**Course Outcomes**

On the successful completion of the course, students will be able to

| **CO Number** | **CO Statement** | **Knowledge Level** |
|---|---|---|
| CO1 | Acquire knowledge about computational chemistry principles and tools. | K1 |
| CO2 | State molecular mechanics and its application | K3 |
| CO3 | Understand semi empirical methods and abinitro methods and property calculations. | K2 |
| CO4 | Discuss basics sets of computational chemistry | K2 |
| CO5 | Simplify intrinsic property calculations using computational methods | K3 |

**UNIT I**

Computational chemistry: Introduction- scope of computational chemistry - methods- Molecular Mechanics - Semi Empirical Methods - *ab initio* Method - Density Functional Theory Method - Molecular Dynamics. Computational chemistry software tools – introduction - MOPAC - ORCA - GAUSSIAN - ADF - CHARM, INSIGHT Different input formats- Cartesian coordinates - internal coordinates. Applications of computational chemistry.

**UNIT II**

Molecular Mechanics: Postulates of molecular mechanics - introduction to molecular mechanics, popular force fields, performance of molecular mechanics - the Born - Oppenheimer approximation, potential energy surfaces, local and global minima, transition states and Hessian matrix - Eigen vectors and Eigen values , the Schroedinger equation, orbitals and variational and Perturbational methods. Applications, Examples.

**UNIT III**

Semiempirical Methods and Optimisation Techniques: Semi empirical Methods – Different methods (MNDO, AMI, PM3) - Geometry optimisation - Transition state location - Frequency calculation-Applications – Examples - Hartree - Fock equations, Hartree - Fock energy expressions for arbitrary spin orbital configurations, spin integration, restricted and unrestricted configuration, Self-Consistent-Field (SCF) procedure - Vibrational frequency analysis - Symmetry analysis, harmonic vs fundamental frequencies, Zero Point Vibrational Energies (ZPVE's), Hessian index, distinguish minima from transition States. Intrinsic reaction co-ordinate (IRC) analysis,

**UNIT IV**

Computational Methods: *Ab initio* and DFT methods – basics - different methods – TD-DFT- CCSD, Mp(n), G(n), MC-SCF - introduction about basic sets Slater and Gaussian functions, contractions, polarizations and diffuse functions, split valance sets, correlation consistent sets, core valence sets, general contractions, EMSL basis set exchange functional - applications-examples.

**UNIT V**

Molecular Dynamics and Property Calculations: Molecular dynamics and its applications of modelling biomolecules, Intrinsic property calculations using computational methods. NMR, EPR, IR, UV excited state calculations.

**REFERENCE BOOKS**

| S. No | Title of the Book | Author | Publishing Company | Year |
|---|---|---|---|---|
| 1. | Molecular Quantum Mechanics | P.W. Atkins and R.S. Friedman, | Oxford University Press, New York | 1997 |
| 2. | Introduction of Computational chemistry | F. Jensen | John Wily & Sons Ltd | 2007 |
| 3. | Quantum Chemistry | D.A Quarrie | University Science Book Mill Valley | 1983 |

**TEXT BOOKS**

| S. No | Title of the Book | Author | Publishing Company | Year |
|---|---|---|---|---|
| 1. | Quantum Chemistry | J.P. Lowe | Academic Press, New York | 1978 |
| 2. | Quantum Chemistry | N. Livine | Prentice Hall, Englewood, Cliffs. | 1991 |
| 3. | Hand book of Computational Chemistry | Jerzy Leszcznski | Springer | 2012 |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | S | S | M | S | S |
| **CO2** | M | S | S | S | M |
| **CO3** | S | M | S | M | S |
| **CO4** | M | M | S | M | M |
| **CO5** | M | S | M | S | M |

**S**- Strong; **M**-Medium.

**SEMESTER - III**

| ELECTIVE-III | **M.Sc. Chemistry** | **2019-2020** |
|---|---|---|
| M19PCHE09 | **TEXTILE CHEMISTRY** | |
| Credits: 4 | | |

**Objectives**

This course provides knowledge in Fibre, chemical structure, production, properties and uses of the synthetic fibres and Dyeing of wool and silk.

**Course Outcomes**

On the successful completion of the course, students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Understand basic concepts of Fibre in textile. | K1 |
| CO2 | Analyze the synthetic fibres. | K3 |
| CO3 | Validate of Impurities in raw materials of textile. | K3 |
| CO4 | Classify dyes and their importance in textiles. | K2 |
| CO5 | Explain the concepts of Dyeing of fibres | K4 |

**UNIT I**

Fibre theory – polymers and polymerization-Morphology of fibres – Molecular arrangements in fibres. General classification of fibres - chemical structure, production, properties and uses of the following natural fibres (a)natural cellulosic fibres (cotton and jute) (b) natural protein fibre (wool and silk).

**UNIT II**

Chemical structure, production, properties and uses of the following synthetic fibres.(i) Man made cellulosic fibres (Rayon, modified cellulosic fibres) (ii) Man made protein fibres (Azions) (iii) Poly amide fibres (different types of nylons) (iv) Poly ester fibres (v) Acrylic fibres and (vi) Olefin fibres

**UNIT III**

Impurities in raw cotton and grey cloth, wool and silk- general principles of the removal – Scouring – bleaching – Desizing – Kierboiling- Chemicking Chemical and machinery use- Degumming and Bleaching of silk Scouring and Bleaching of wool..

**UNIT IV**

Dyeing – Classification of dyes and their properties- applications – direct, basic, sulphur and azoic dyes on cotton. Application of Vat and solubilised vat dyes on cotton and viscose. Mordant mineral colours and black. Application of vegetable and other colour to cotton.

**UNIT V**

Dyeing of wool and silk – Fastnerss properties of dyed materials – dyeing of nylon, terylene and other synthetics. Finishes given to fabrics - Mechanical finishes on cotton, wool and silk, method used process of mercerizing – Anti-crease and Anti-shrink finishes – Water proofing.

**TEXT BOOKS**

| S. No | Title of the Book | Author | Publishing Company | Year |
|---|---|---|---|---|
| 1. | Chemical Technology of fibrous Materials | F. Sadov, M.Horchagin and A.Matetshy | Mir Publishers | 1973 |
| 2. | The Identification of Textile Fibres | M M Houck | Woohead Publishing | 2009 |
| 3. | Text Book of Applied Chemistry | K. Kapur | Macmillan Publisher | 2006 |
| 4. | A Students Text Book of Textile Science | A. J. Hall | Allman Publisher | 1963 |
| 5. | Chemistry of dyes & Principles of Dyeing | V. A. Shenai | Sevak Publications | 1973 |

**REFERENCE BOOKS**

| S. No | Title of the Book | Author | Publishing Company | Year |
|---|---|---|---|---|
| 1. | Textile Chemistry –Vol.II | R.H. Peters | Elserier, Avesterdam | 1967 |
| 2. | Dyeing and chemical Technology of Textile fibres | E.R. Trotman | Charles Griffin & Co Ltd., 5th Edn. | 1970 |
| 3. | Textile Scouring and Bleaching | E.R. Trotman | Charles Griffin & Co Ltd | 1968 |
| 4. | Industrial Chemistry | B. K. Sharma | Krishna Prakasan | 2014 |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | S | S | M | M | M |
| **CO2** | M | S | S | S | M |
| **CO3** | S | M | S | S | M |
| **CO4** | M | M | S | S | S |
| **CO5** | M | S | M | M | S |

**S**- Strong; **M**-Medium.

**SEMESTER - III**

| ELECTIVE-III | **M.Sc. Chemistry** | **2019-2020** |
|---|---|---|
| M19PCHE10 | **MATERIAL SCIENCE** | |
| Credits: 4 | | |

**Objectives**

This course gives an insight into the fascinating area of advanced material tools and characterization techniques for smart materials.

**Course Outcomes**

On the successful completion of the course, students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Acquire knowledge about smart materials and nano materials. | K1 |
| CO2 | Discuss different techniques for characterization of materials. | K2 |
| CO3 | Demonstrate mechanical and thermal properties of metallic, ceramic and polymeric materials | K3 |
| CO4 | Understand the concept of energy band diagram for materials | K1 |
| CO5 | Illustrate optical and magnetic properties of metallic and ceramic materials | K4 |

**UNIT I**

Advanced Materials and Tools: Smart materials, exhibiting ferroelectric, piezoelectric, optoelectric, semiconducting behavior, lasers and optical fibers, photoconductivity and superconductivity, nanomaterials, synthesis, properties and applications, biomaterials, super alloys, shape memory alloys.

**UNIT II**

Materials Characterization Techniques: Scanning electron microscopy, transmission electron microscopy, atomic force microscopy, scanning tunneling microscopy, atomic absorption spectroscopy, differential scanning calorimetry.

**UNIT III**

Stress-strain diagrams of metallic, ceramic and polymeric materials, modulus of elasticity, yield strength, tensile strength, toughness, elongation, plastic deformation, viscoelasticity, hardness, impact strength, creep, fatigue,

ductile and brittle fracture. Thermal Properties: Heat capacity, thermal conductivity, thermal expansion of materials.

**UNIT IV**

Electronic Properties: Concept of energy band diagram for materials - conductors, semiconductors and insulators, electrical conductivity effect of temperature on conductivity, intrinsic and extrinsic semiconductors, dielectric properties.

**UNIT V**

Optical Properties: Reflection, refraction, absorption and transmission of electromagnetic radiation in solids. Magnetic Properties: Origin of magnetism in metallic and ceramic materials, paramagnetism, diamagnetism, anti-ferromagnetism, ferromagnetism, ferrimagnetism, magnetic hysterisis.

**TEXT BOOKS**

| S. No | Title of the Book | Author | Publishing Company | Year |
|---|---|---|---|---|
| 1. | The Chemistry of Nano materials | C.N.R. Rao, A. Muller, A.K. Cheetam | Wiley – VCH, Weinheim | 2004 |
| 2. | Introduction to Nanotechnology | C.P. Poole, F.J. Owens | Wiley Interscience, New Jersey | 2003 |
| 3. | An Introduction to Nanomaterials & Nano Science | Asimk Das, Mahua Das | CBS Publishers | 2017 |

**REFERENCE BOOKS**

| S. No | Title of the Book | Author | Publishing Company | Year |
|---|---|---|---|---|
| 1. | Nanoscale materials in Chemistry | Kenneth J. Klabunde | Wiley - Interscience, New York | 2001 |
| 2. | The Essentials in understanding nanoscience and nanotechnology | T. Pradeep | Tata McGraw Hill, New Delhi | 2007 |
| 3. | Nanotechnology | Thomas Varghese, K. M. Balakrishna | Atlantic Publishers | 2017 |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | S | S | M | S | S |
| **CO2** | M | S | S | S | M |
| **CO3** | S | M | S | M | S |
| **CO4** | M | M | S | M | M |
| **CO5** | M | S | M | S | M |

**S**- Strong; **M**-Medium.

**SEMESTER - III**

| ELECTIVE-III | **M.Sc. Chemistry** | **2019-2020** |
|---|---|---|
| M19PCHE11 | **NUCLEAR CHEMISTRY** | |
| Credits: 4 | | |

**Objectives**

This course makes the student is knowledgeable in nuclear chemistry and familiarize the students with nuclear and radioisotopes techniques.

**Course Outcomes**

On the successful completion of the course, students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Understand basic concept of nuclear chemistry | K2 |
| CO2 | Acquire knowledge about nuclear reaction and nuclear theory | K1 |
| CO3 | Describe the components of nuclear reactors | K2 |
| CO4 | Develop knowledge about chemical effects induced in matter by absorption of ionizing radiations | K3 |
| CO5 | Discuss the application of radio isotopes in various fields. | K2 |

**UNIT I**

Discovery and types of decay – decay kinetics – half - life period, mean life, parent daughter decay – growth relationship – secular and transient equilibrium; Units of radioactivity; alpha, beta and gamma decay; Theory of decay, energies and properties – artificial radioactivity. Detectors: ionization chamber, electron pulse counter, scintillation detectors.

**UNIT II**

Bathe's notation – types of nuclear reactions: The compound nucleus theory – reaction cross section, transmutation reactions, elastic and inelastic scattering, spallation, fragmentation, stripping and pick-up; fission, fusion, photonuclear reactions and thermonuclear reactions.

**UNIT III**

The fission energy – reproduction factor; Classification of reactors based on moderators, coolants, phase of fuel and generation. Principle of thermal

nuclear reactors: The four factor formula, reactor power, critical size of a thermal reactor, excess reactivity and control. Breeder reactor India's nuclear energy programmes – reprocessing of spent fuels.

**UNIT IV**

Radiation chemistry – passage of radiation through matter – units for measuring radiation absorption – radiation dosimetry – radiolysis of water – free radicals in water radiolysis – chemical dosimetry: Radiolysis of Fricke Dosimeter solution – Radiation induced colour centres in crystals – Effects of radiation with matter. Radiolysis of inorganic gases, organic gases, organic compounds, solids and polymers – Annealing of radiation damage.

**UNIT V**

Application of radioisotopes: probing by isotopes, reactions involved in the preparation of radioisotopes. The Szilard-Chalmers' reaction – Radiochemical principles in the use of Tracers – Applications of radioisotopes as tracers – chemical investigations, analytical applications, agricultural and industrial applications – Neutron activation analysis – Carbon and rock dating.

**REFERENCE BOOKS**


| S. No | Title of the Book | Author | Publishing Company | Year |
|---|---|---|---|---|
| 1. | Nuclear and Radiochemistry | M.G. Friedlander, J.M. Kennedy, E.S. Macian and J.M. Miller | John Wiley & Sons | 1981 |
| 2. | Nuclear Chemistry | M.G. Arora and M. Singh | Anmol Publications | 1994 |
| 3. | Fundamental concepts of Inorganic Chemistry | E.S.Gilreath | McGraw Hill | 1986 |
| 4. | Basis of nuclear Chemistry | Ram Naresh Malsaling | Anmol pub | 2009 |

**TEXT BOOKS**

| S. No | Title of the Book | Author | Publishing Company | Year |
|---|---|---|---|---|
| 1. | Source book on atomic energy | S. Glasstone | East West press | 1967 |
| 2. | Essentials of Nuclear Chemistry | H.J. Arniker | New Age International | 2009 |
| 3 | Nuclear chemistry | Seema singh | Sonali publications | 2012 |
| 4. | Nuclear & Radiation chemical approaches to fullerene science | Tiber Braun & Harold kroto | Kluwer academic publisher | 2010 |
| 5. | Nuclear & Radiochemistry | Jonsef Konya Noemi M.Nagy | Elsevier science | 2018 |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | S | S | M | S | S |
| **CO2** | M | S | S | S | M |
| **CO3** | S | M | S | M | S |
| **CO4** | M | M | S | M | M |
| **CO5** | M | S | M | S | M |

**S**- Strong; **M**-Medium.

**SEMESTER - III**

| ELECTIVE-III | **M.Sc. Chemistry** | **2019-2020** |
|---|---|---|
| M19PCHE12 | **CHEMISTRY OF INDUSTRIAL PRODUCTS** | |
| Credits: 4 | | |

**Objectives**

This course gives idea in industrial products like Cement, Glass, Pigments, Dyes, Plastic, Fibres and Cosmetics.

**Course Outcomes**

On the successful completion of the course, students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Extract Industrial products like cement and glass and their manufacturing processes and their properties. | K2 |
| CO2 | Learn about dyes, pigments and paints and their preparation and uses. | K4 |
| CO3 | Understand the types and processing of plastics and fibres and their utility. | K3 |
| CO4 | Describe the preparation and uses of fertilizers in the agricultural sector. | K1 |
| CO5 | Correlate the chemistry of cosmetics used on day today life. | K4 |

**UNIT I**

Cement and Glass Cement - Composition, types - Portland cement - Composition, types, manufacture (Wet and Dry process), uses - Setting of cement, Glass - Composition, Types, methods of manufacturing - Melting, Blowing, Pressing, Annealing and finishing- chemical and physical properties of glass.

**UNIT II**

Pigments, Dyes and Paints Pigments - Classification, Manufacture and uses; Dyes - Classification, preparation, Dyeing processes; Paints - Composition, Types, Manufacture and testing of Paints.

**UNIT III**

Fibres, Plastics and Rubber – definition-difference between Natural and synthetic fibres-properties of synthetic fibres - Artificial silk, rayon, nylon and Terylene Plastics - composition, Classification, manufacture, properties and

uses recycling of plastics Rubber: types of rubber - synthetic rubber - natural rubber - Vulcanizations of Rubber - properties and uses.

**UNIT IV**

Sugar Industry: Manufacture of sugar from molasses and beetroot. Fermentation: Manufacture of spirits and wines. Distillation: Manufacture of vinegar and ethyl alcohol.

Match Industry: Manufacture – Chemistry of lighting and pyrotechnique

**UNIT V**

Cosmetics – Shampoo- composition and its preparation, lipstick - preparation, Face cream and face powder - composition and their preparation. Hair dyes – chemical and herbal dyes. Perfumes and Deodorants.

**TEXT BOOKS**

| S. No | Title of the Book | Author | Publishing Company | Year |
|---|---|---|---|---|
| 1 | Industrial Chemistry | B.N. Charkarabarthy | Oxford and IBH Publishing Co., New Delhi, 1st Edition. | 1981 |
| 2 | Industrial chemistry | Anthony Benvenuto | Degoruyter | 2013 |
| 3 | An Introduction to Industrial Chemistry | Alan heaton | Academic & professional | 1996 |

**REFERENCE BOOKS**

| S. No | Title of the Book | Author | Publishing Company | Year |
|---|---|---|---|---|
| 1 | Encyclopedia of Chemical Technology | Kirk Othmer | John Wiley &Sons, New York | 1999 |
| 2 | Industrial Chemistry | B.K. Sharma | Goel Publishing House, 1st Edition, Meerut | 2014 |
| 3 | Engineering chemistry fundamentals & applications | Shikha Agarwal | Cambridge University Press | 2016 |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | S | S | M | M | M |
| **CO2** | M | S | S | S | M |
| **CO3** | S | M | S | S | M |
| **CO4** | M | M | S | S | S |
| **CO5** | M | S | M | M | S |

**S**- Strong; **M**-Medium.

**SEMESTER - II**

| EDC | **M.Sc. Chemistry** | **2019-2020** |
|---|---|---|
| M19ECH01 | **HEALTH CHEMISTRY** | |
| Credits: 4 | | |

**Objectives**

This course provides knowledge in Food, Carbohydrates, Protein and vitamins, blood, enzymes, hormones and Toxicants in food and common diseases.

**Course Outcomes**

On the successful completion of the course, students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Sketch the importance of basic nutrients and maintenance of good health and classification of carbohydrates, proteins and vitamins | K2 |
| CO2 | Relate knowledge on drugs and their mode of action | K4 |
| CO3 | Compare the functions of body fluids and blood | K2 |
| CO4 | Describe the enzymes and hormones | K2 |
| CO5 | Recognize the various Toxicants in food and common diseases. | K1 |

**UNIT I**

Definition: Food, Food Pyramid – Health – Hygiene - mal, under and over nutrition - causes and remedies, sanitation, Carbohydrates: Classification, Biological functions, Protein: Classification, Biological functions, vitamins: Classification, Biological functions.

**UNIT II**

Drugs - Types of drugs – anti depressants, anticonvulsant, narcotics, antipyretics, antibiotics, antiseptics, analgesics, muscle relaxants and cardiovascular and vasodepressants, Steroids.

**UNIT III**

Blood volume, groups, coagulation, blood pressure, anemia, blood sugar, hemoglobin - chemistry of respiration – urine-electrolyte balance.

**UNIT IV**

Types of enzymes and enzyme action, Characters of hormones action, examples of essential hormones - digestion in mouth, stomach, intestine and pancreas - mineral metabolism.

**UNIT V**

Toxicants in food- cancer-types and causes- common diseases-Jaundice, vomiting, fever, rickets, scurvy, beriberi, pellagra, night blindness, ulcer, gout, goiter, diabetes, anemia and their causes.

**TEXT BOOKS**

| S. No | Title of the Book | Author | Publishing Company | Year |
|---|---|---|---|---|
| 1. | A Text book of Pharmaceutical Chemistry | Jayashree Ghosh | S. Chand and Co.Ltd | 1999 |
| 2. | Food Chemistry | Alex V Ramani | MJP Publishers, Chennai | 2009 |
| 3. | Fundamentals of Biochemistry | A.C. Deb | New Central Book Agency, Calcutta | 1994 |
| 4. | Chemistry for Health Science | M Satake and Y Mido | Discovery Publishing House, New Delhi | 2003 |

**REFERENCE BOOKS**

| S. No | Title of the Book | Author | Publishing Company | Year |
|---|---|---|---|---|
| 1. | Medicinal Chemistry | Ashutosh Kar | Wiley Easterns Limited, New Delhi | 1993 |
| 2. | Food chemistry | Lillian Hoagland meyer | New York, Reinhold | 1960 |
| 3. | Drug design & Medicinal chemistry | Erica Helmer | Callisto publisher | 2015 |
| 4. | Enzyme chemistry & molecular biology of Amylases and related enzymes | Takehiko yamamoto | CRC press | 1994 |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | S | S | M | M | M |
| **CO2** | M | S | S | S | M |
| **CO3** | S | M | S | S | M |
| **CO4** | M | M | S | S | S |
| **CO5** | M | S | M | M | S |

**S**- Strong; **M**-Medium.

**SEMESTER - II**

| EDC | **M.Sc. Chemistry** | **2019-2020** |
|---|---|---|
| M19ECH02 | **DRUG DISCOVERY** | |
| Credits: 4 | | |

**Objectives**

This course gives knowledge in drug discovery, drugs derived from Natural Products, Prodrug Design and source of drugs.

**Course Outcomes**

On the successful completion of the course, students will be able to

| **CO Number** | **CO Statement** | **Knowledge Level** |
|---|---|---|
| CO1 | Understand basic concepts of drug discovery and Structural effects on drug action. | K2 |
| CO2 | Analyze drug design approaches. | K4 |
| CO3 | Discover enzymes as Targets of Drug design and Rational Design of Enzyme Inhibitors. | K3 |
| CO4 | Correlate the Receptor Theory, Receptor Complexes and allosteric Modulators for Receptors as Targets of Drug Design. | K4 |
| CO5 | Explain Prodrug Design and list its application. | K4 |

**UNIT I**

Introduction - Drug Discovery/Development-Drug Discovery - Drug Development - Source of Drugs - Structural effects on drug action - Approaches to New Drug Discovery.

**UNIT II**

Drugs Derived from Natural Products - Existing Drugs as a Source for New Drug Discovery - Using Disease Models as Screens for New Drug Leads - Physiological Mechanisms: the Modern “Rational Approach” to Drug Design - Approaches to Lead Optimization.

**UNIT III**

Bioisosteric replacement - Conformation restriction - Increase selectivity - Increase affinity - Enzymes as Targets of Drug Design - - Approaches to the Rational Design of Enzyme Inhibitors.

**UNIT IV**

Receptor Theory - Receptor Complexes and Allosteric Modulators - Second and Third Messenger Systems -Molecular Biology of Receptors - Receptor Models and Nomenclature - Receptor Binding Assays - Receptor agonists and antagonists - Prodrug Design - Definition - Applications.

**UNIT V**

Prodrug Design Considerations - Prodrug Forms of Various Functional Groups - Ester prodrugs of compounds containing –COOH - Prodrugs of Amines - Drug release and activation mechanisms - Simple one-step activation - Cascade release/activation systems. Prodrugs and intellectual property rights.

**TEXT BOOKS**

| S. No | Title of the Book | Author | Publishing Company | Year |
|---|---|---|---|---|
| 1 | Drug-Like Properties: Concepts, Structure Design and Methods: from ADME to Toxicity Optimization | Kerns E.H. | Academic Press, Oxford | 2008 |
| 2 | Medicinal Chemistry and Drug Discovery, Vol. 1. Principles and Practice | M. E. Wolff | John Wiley & Sons: New York | 2003 |
| 3 | Medicinal chemistry | Ashutosh Kar | Anshan pub | 2006 |
| 4 | Text book of medicinal chemistry | V. Alagar swamy | CBS Pub | 2005 |

**REFERENCE BOOKS**

| S. No | Title of the Book | Author | Publishing Company | Year |
|---|---|---|---|---|
| 1 | Medicinal Chemistry | F.F.Blicke and R.H.Cox, | John Wiley & Sons, New York | 1959 |
| 2 | Organic Chemistry of drug synthesis | D.Lednicer and L.A.Mitscher | John Wiley & Sons, New York | 1959 |
| 3 | Chemiinformatics Theory practice & products | Barry A. Bunin, Brian siesel | Springer | 2007 |
| 4 | Organic chemistry of Drug design and drug action | Silverman | Elsevier | 2014 |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | S | S | M | M | M |
| **CO2** | M | S | S | S | M |
| **CO3** | S | M | S | S | M |
| **CO4** | M | M | S | S | S |
| **CO5** | M | S | M | M | S |

**S**- Strong; **M**-Medium.

**SEMESTER - II**

| EDC | **M.Sc. Chemistry** | **2019-2020** |
|---|---|---|
| M19ECH03 | **CHEMICAL INSTRUMENTATION** | |
| Credits: 4 | | |

**Objectives**

This course provides knowledge in signal measurement, operational amplifiers, digital electronics and optical absorption spectrometry and concept of Signal-to-Noise Optimization

**Course Outcomes**

On the successful completion of the course, students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Describe the nature and choice of measurement methods | K2 |
| CO2 | Illustrate the Variables that control the measurements | K4 |
| CO3 | Sketch the limits of detection and amplification | K3 |
| CO4 | Recognize the concept of operational amplifiers | K1 |
| CO5 | Explain the control of spectrometers instrumentation. | K2 |

**UNIT I**

Measurement and Instrumentation: Introduction – Nature of a measurement – choice of a method of measurement – control of variables – basic design patterns – general properties of modules – propagation of uncertainity – single channel design – limit of detection and amplification – automatic operation and computer control.

**UNIT II**

Operational Amplifiers: The operational amplifier – limitations on amplifier performance – mathematical operations – differentiation – integration – measurement of current and voltage – precise control of current and voltage.

**UNIT III**

Signal-to-Noise Optimization [ONLINE]: Sensitivity and detection limits – noise – minimizing noise in a system – signal averaging – modulation: chopping – demodulation: phase sensitive detection – other methods of optimizing signal-to-noise ratio.

**UNIT IV**

Digital Electronics: Binary logic concepts – logic gates – multivibrators – counters – wave shaping – analog to digital converters – instruments and digital computers.

**UNIT V**

Instrumentation for Optical Absorption Spectrometry: Visual photometers (colorimeter) – filter photometer – the spectrophotometer – double beam spectrophotometer – recording spectrophotometers – optimal values of adjustable parameters – multiple internal reflection assembly – rapid scanning spectrometer – non-dispersive photometers – photometric titration equipment – Fourier transform spectrometers.

**TEXT BOOKS**

| S. No | Title of the Book | Author | Publishing Company | Year |
|---|---|---|---|---|
| 1 | Chemical Instrumentation A systematic approach to Instrumental Analysis | H.A Strobel | Addison-Wesley Publishing Company Inc, Philippines, 2nd Edn. | 1973 |
| 2 | Instrumental methods of chemical Analysis | H.Kaur | Pragati Prakashan | 2010 |
| 3 | A text book of instrumental method of Analysis | Poonam A Salunke | S.Vikas | 2018 |

**REFERENCE BOOKS**

| S. No | Title of the Book | Author | Publishing Company | Year |
|---|---|---|---|---|
| 1 | Vogel's Textbook of Quantitative Chemical Analysis | G.H. Jeffery, J. Bassett, J. Mendham and R.C. Denney | Longman Scientific & Technical, Essex, 5th Edn. | 1989 |
| 2. | Principles of Instrumental Analysis | D.A. Skoog, F.J. Holler and S.R. Crouch | Thompson Brooks/Cole, Belmont CA, 6th Edn. | 2007 |
| 3 | Instrumentation Reference book | H. Walt boyes | Elsevier | 2003 |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | S | S | M | M | M |
| **CO2** | M | S | S | S | M |
| **CO3** | S | M | S | S | M |
| **CO4** | M | M | S | S | S |
| **CO5** | M | S | M | M | S |

**S**- Strong; **M**-Medium.

# ENHANCEMENT COMPULSORY COURSE

**SEMESTER - II**

| ECC | **M.Sc. Chemistry** | **2019-2020** |
|---|---|---|
| M19PHR01 | **HUMAN RIGHTS** | |
| Credits: 2 | | |

**Objectives**

This course provides knowledge on the different aspects of human rights and can learn the rights for the duties to be carried out in the days to come.

**Course Outcomes**

On the successful completion of the course, students will be able to

| CO | Statement | Knowledge Level |
|---|---|---|
| CO1 | Remember the need and types of Human rights | K1 |
| CO2 | Understand the Classification of Human Rights | K2 |
| CO3 | Apply the Rights of Women and Children | K4 |
| CO4 | Aware on the Rights of Labour | K2 |
| CO5 | Analyze the National and State level human Rights Commissions and their policies | K3 |

**UNIT I**

Introduction to Human Rights: Human Rights: Meaning – Definitions – Origin and Growth of Human Rights in the World – Need and types of Human Rights – UNHRC (United nations Human Rights) – Human Rights in India.

**UNIT II**

Classification of Human Rights: Right to Liberty – Right to Life – Right to Equality – Right to dignity – Right to against Exploitation – Educational Rights – Cultural Rights – Economic Rights – political Rights – Social Rights.

**UNIT III**

Rights of Women and Children: Rights of Women – Female feticide and Infanticide and selective abortion – Physical assault and sexual harassment – Domestic Violence – Violence at work place – Remedial Measures. Rights of Children – Protection rights, survival rights – Participation rights – Development rights – Role of UN on convention on rights of children.

**UNIT IV**

Multi-Dimensional aspects of Human Rights: Labour rights – Bodend Labour – Child Labour – Contract Labour – Migrant Labour – Domestic Women Labour – Gender Equity – Rights of Ethnic refugees – Problems and remedies – Role of trade union in protecting the unorganized labourers.

**UNIT V**

Grievance and Redressal Mechanism: Redressal Mechanism at national level – Structure and functions of National and State level human Rights Commission – constitutional remedies and directive principles of state policy.

## REFERENCE BOOKS


| S. No | Title of the Book | Author | Publishing Company | Year |
|---|---|---|---|---|
| 1. | Teaching of Human Rights | Barat Sergio and Swaronjali Ghosh | Dominant Publishers and distributors, New Delhi | 2009 |
| 2. | Human Rights Achievements and Challenges | A.N. Roy | Vista International Publishing House, Delhi | 2005 |
| 3. | Human Rights in India | Asish Kumar das and Prasant Kumar Monaty | Sarup and Sons, New Delhi | 2007 |
| 4. | Human Rights Social justice and political change | Bani Bargohain | Kanishka publishers and distributors, New Delhi | 2007 |
| 5. | Human Rights and Development Issues | G. Velan | Ambala Cantt | 2008 |
| 6. | Human rights Theory and Practice | P. K. Meena | Murali lal and Sons, New Delhi | 2008 |
| 7. | Human Rights Development and Environmental Law | Bhavani Prasad Panda | Academic Excellence, Delhi. | 2007 |
| 8. | Human Rights – Twenty first Century Challenges | V. N. Vishvanathan | Kalpaz Publications, New Delhi. | 2008 |

| | | | | |
|---|---|---|---|---|
| 9. | Protecting Human Rights | M. R. Ansari | Max Ford Books, New Delhi. | 2006 |
| 10. | Social Movements in Indi – Social Movements and Social Transformation in India | M. S. A Rao | Vol 1& 2: Manohar Publications, New Delhi. | 1978 |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | M | S | M | S | M |
| **CO2** | M | M | S | M | M |
| **CO3** | S | S | M | S | S |
| **CO4** | M | M | S | M | S |
| **CO5** | S | M | S | S | M |

**S**- Strong; **M**-Medium.

# MAHENDRA ARTS & SCIENCE COLLEGE
## (Autonomous)

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Kalippatti – 637 501, Namakkal (Dt), Tamil Nadu.

## DEPARTMENT OF CHEMISTRY

**List of Courses Focusing on Employability/ Entrepreneurship/ Skill Development (Regulations – 2016)**

**Programme: M.Sc. Chemistry**

| S. No. | Course Name | Course Code | Employability | Entrepreneurship | Skill development |
|---|---|---|---|---|---|
| 1 | Elective-I-Polymer Chemistry | M16PCHE01 | ✓ | - | - |
| 2 | Practical-I-Organic Chemistry - I | M16PCHP01 | - | - | ✓ |
| 3 | Practical-II-Inorganic Chemistry - I | M16PCHP02 | - | - | ✓ |
| 4 | Practical-III-Physical Chemistry - I | M16PCHP03 | - | - | ✓ |
| 5 | Practical-IV-Organic Chemistry - II | M16PCHP04 | - | - | ✓ |
| 6 | Practical-V-Inorganic Chemistry - II | M16PCHP05 | - | - | ✓ |
| 7 | Practical-VI-Physical Chemistry - II | M16PCHP06 | - | - | ✓ |

**Head of the Department**

HOD, Department of Chemistry
MAHENDRA ARTS & SCIENCE COLLEGE
Kalippatti (PO.), Namakkal (Dt.)

**Principal**

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## DEPARTMENT OF CHEMISTRY

**List of Courses Focusing on Employability/ Entrepreneurship/ Skill Development (Regulations – 2016)**

**Programme: M.Sc. Chemistry**

| S. No. | Name of the Course | Course Code | Employability/ Entrepreneurship/ Skill development | Year of introduction (during the last five years) |
|---|---|---|---|---|
| 1. | Elective-I-Polymer Chemistry | M16PCHE01 | Employability | 2016 - 2017 |
| 2. | Practical-I-Organic Chemistry - I | M16PCHP01 | Skill development | 2016 - 2017 |
| 3. | Practical-II-Inorganic Chemistry - I | M16PCHP02 | Skill development | 2016 - 2017 |
| 4. | Practical-III-Physical Chemistry - I | M16PCHP03 | Skill development | 2016 - 2017 |
| 5. | Practical-IV-Organic Chemistry - II | M16PCHP04 | Skill development | 2017 - 2018 |
| 6. | Practical-V-Inorganic Chemistry - II | M16PCHP05 | Skill development | 2017 - 2018 |
| 7. | Practical-VI-Physical Chemistry - II | M16PCHP06 | Skill development | 2017 - 2018 |

Head of the Department

HOD, Department of Chemistry
MAHENDRA ARTS & SCIENCE COLLEGE
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**Kalippatti – 637 501, Namakkal (Dt), Tamil Nadu.**

## MASTER OF CHEMISTRY

## CHOICE BASED CREDIT SYSTEM

## SYLLABUS FOR M.Sc. CHEMISTRY

**For the students admitted from the Academic Year 2016-2017 onwards**

PRINCIPAL
MAHENDRA ARTS & SCIENCE COLLEGE
(Autonomous)
Kalippatti (PO) - 637 501, Namakkal (DT)

**MAHENDRA ARTS & SCIENCE COLLEGE (AUTONOMOUS), KALLIPATTI**
**M.Sc., CHEMISTRY Course structure for CBCS (2016-2017 onwards)**

| SEM | Course Title | Sub Code | Hrs/ Week | Credit | Ex Hr | Marks | | Total |
|---|---|---|---|---|---|---|---|---|
| | | | | | | IA | EA | |
| I | Organic Chemistry-I | M16PCH01 | 5 | 4 | 3 | 25 | 75 | 100 |
| | Inorganic Chemistry-I | M16PCH02 | 5 | 4 | 3 | 25 | 75 | 100 |
| | Physical Chemistry-I | M16PCH03 | 5 | 4 | 3 | 25 | 75 | 100 |
| | Elective – I - Polymer Chemistry | M16PCHE01 | 6 | 4 | 3 | 25 | 75 | 100 |
| | Value added - General Trends in Applied Chemistry (Seminar & Report) | M16PCHVA01 | 1 | - | - | - | 100 | 100 |
| | Practical – I - Organic Chemistry - I | M16PCHP01 | 3 | - | - | - | - | - |
| | Practical – II - Inorganic Chemistry - I | M16PCHP02 | 3 | - | - | - | - | - |
| | Practical – III - Physical Chemistry – I | M16PCHP03 | 3 | - | - | - | - | - |
| II | Organic Chemistry-II | M16PCH04 | 5 | 4 | 3 | 25 | 75 | 100 |
| | Physical Chemistry-II | M16PCH05 | 5 | 4 | 3 | 25 | 75 | 100 |
| | Elective – II - Coordination Chemistry | M16PCHE07 | 5 | 4 | 3 | 25 | 75 | 100 |
| | Value added - General Trends in Applied Chemistry (Seminar & Report) | M16PCHVA01 | 2 | 2 | - | - | 100 | 100 |
| | Practical – I - Organic Chemistry - I | M16PCHP01 | 3 | 4 | 6 | 40 | 60 | 100 |
| | Practical – II - Inorganic Chemistry - I | M16PCHP02 | 3 | 4 | 6 | 40 | 60 | 100 |
| | Practical – III - Physical Chemistry – I | M16PCHP03 | 3 | 4 | 6 | 40 | 60 | 100 |
| | EDC – Fundamentals of computers and Communications | M16PCSED1 | 4 | - | 3 | 25 | 75 | 100 |
| | Human Rights | M16PHR01 | - | 2 | 3 | - | 100 | 100 |
| III | Organic Chemistry-III | M16PCH06 | 5 | 5 | 3 | 25 | 75 | 100 |
| | Inorganic Chemistry-II | M16PCH07 | 5 | 5 | 3 | 25 | 75 | 100 |
| | Physical Chemistry-III | M16PCH08 | 5 | 5 | 3 | 25 | 75 | 100 |
| | Elective – III - Electrochemistry, Spectroscopy and Analytical Techniques | M16PCHE09 | 5 | 4 | - | - | - | 100 |
| | Practical – IV - Organic Chemistry – II | M16PCHP04 | 3 | - | - | - | - | - |
| | Practical – V- Inorganic Chemistry - II | M16PCHP05 | 3 | - | - | - | - | - |
| | Practical – VI - Physical Chemistry - II | M16PCHP06 | 3 | - | - | - | - | - |
| IV | Organic Chemistry - IV | M16PCH09 | 6 | 5 | 3 | 25 | 75 | 100 |
| | Inorganic Chemistry-III | M16PCH10 | 6 | 5 | 3 | 25 | 75 | 100 |
| | Practical – IV - Organic Chemistry – II | M16PCHP04 | 3 | 3 | 6 | 40 | 60 | 100 |
| | Practical – V- Inorganic Chemistry - II | M16PCHP05 | 3 | 3 | 6 | 40 | 60 | 100 |
| | Practical – VI - Physical Chemistry - II | M16PCHP06 | 3 | 3 | 6 | 40 | 60 | 100 |
| | Project Report | M16PCHPR01 | 6 | 4 | 3 | 50 | 150 | 200 |
| | **Grand total** | | **120** | **90** | | | | |

| MAJOR | M.Sc. Chemistry | 2016-2017 |
|---|---|---|
| M16PCH01 | ORGANIC CHEMISTRY-I | |
| Credits: 4 | | |

**UNIT-I: STRUCTURE, REACTIVITY AND INTERMEDIATES**

1.1 Resonance, field effects, hyperconjugation, steric effects, steric inhibition of resonance. Quantitative treatment of field and resonance effects – Hammett and Taft treatments-Acidity of carboxylic acids and phenols, basicity of aliphatic and aromatic bases.

1.2 Study and description of organic reaction mechanisms.

1.2.1 Non – kinetic methods – Energy profile diagrams, intermediate versus ttransition state, identification of products, Cross – over experiments, Stereochemical studies – uses of isotopes.

1.2.2 Kinetic methods: kinetic isotopic effects, salt effects, solvent effect, solvent isotopic effects, kinetic and thermodynamic controlled productd. Hammond postulates. Curtin – Hammett principle.

1.3 Reactive intermediates: Generation, detection, stability and reactivity of Carbocations, carbanions, carbenes, arynes, nitrenes and free radicals, anions and cations.

**UNIT-II: STEREOCHEMISTRY**

2.1 Interconversion of perspective, Fischer, sawhorse and Newman structures. Cram's and Prelog's rules; D, L, R, S-notations; Cahn-Ingold-Prelog rules, absolute and relative configurations; configurations of allenes, spiranes, biphenyls, cyclooctene, and helicene.

2.2 Conformation and reactivity in cyclohexane - Conformational analysis of disubstituted cyclohexanes and their stereochemical features - Conformation and reactivity of cyclohexanols (oxidation and acylation), cyclohexanones (reduction) and cyclohexane carboxylic acid derivatives (esterification and hydrolysis). Conformation and stereochemistry of cis and trans decalins.

2.3 Geometrical and optical isomerism of disubstituted cyclopropane, cyclobutane and cyclopentanes. Identification of enantiotropic, homotropic, diastereotropic hydrogens and prochiral carbons – Stereospecific and stereoselective synthesis

**UNIT-III: AROMATIC ELECTROPHILIC AND NUCLEOPHILIC SUBSTITUTION**

3.1 Aromaticity of non – benzenoid and hetrocyclic compounds – Aromatic electrophilic substitutions: Mechanism, orientation and reactivity – Quantitative treatment of reactivity in the substrate and reactivity of the electrophiles.

3.2 Electrophilic substitution: Mechanistic interpretations of second substitution, orientation and reactivity – the ortho/para ratio- ipso attack, third substitution, orientation and reactivity of other ring systems like polycyclic aromatic hydrocarbons, diazonium coupling, Vilsmeir reaction, Gattermann – Koch reaction.

3.3 Reactions involving a) Nitrogen electrophiles: nitration, nitrosation and diazonium coupling b) Sulphur electrophiles: sulphonation c) Halogen electrophiles: chlorination and bromination d) Carbon electrophiles: Friedel-Crafts alkylation, acylation and arylation reactions.

3.4 Nucleophilic substitution: $S_NAr$, $S_N1$, benzyne and $SR_N1$ mechanisms-Reactivity – effect of substrate structure, leaving group and nucleophile. The Von Richter and Smiles rearrangements.

**Self study**: orientation and reactivities of 5 and 6 membered rings containing one and two hetero atoms in electrophilic substitutions and Nucleophilic substitutions.

**UNIT–IV: ALIPHATIC NUCLEOPHILIC SUBSTITUTION AND ELIMINATION REACTIONS**

4.1 Substitution at $sp^3$ carbon atom –$S_N1$ and $S_N2$ mechanisms, ion pair in $S_N1$. Factors influencing $S_N1$ and $S_N2$ reactions – substrate, leaving group, nucleophile and solvent effects, ambident substrates and nucleophiles – regioselectivity. Border line cases: intermediate mechanism, Mixed $S_N1$ and $S_N2$ mechanisms. Neighboring group participation, non-classical carbocations. $S_Ni$ mechanism, Allylic rearrangements.

4.2 Substitution at a trigonal carbon atom – the tetrahedral mechanism, formation of acid derivatives, cleavage of esters and N-acylation reactions. Substitution at vinyl carbon – tetrahedral and addition – elimination mechanisms.

4.3 Aliphatic substitution Mechanisms: $S_E1$, $S_E2$ and $S_Ei$; Substitution by double bond shifts; other mechanism: addition – elimination and cyclic mechanism. Electrophilic substitution via enolization, Stork – enamine reaction.

**UNIT –V: ADDITION REACTIONS**

5.1 Elimination Reactions: E1, E2 and E1cB mechanisms, competition between elimination and substitution, orientation of product formation, stereochemistry of E2 reactions, intermolecular pyrolytic eliminations, the Chugaev reaction, Cope elimination.

5.2 Addition reactions: Electrophilic addition to alkenes, mechanism, effect of structure, isotope effects, orientation and stereochemistry, the nature of the intermediates, Ozonolysis, hydroboration, additions to dienes, alkynes (halogenation and hydrogenation) and allenes, Diels-Alder reaction, 1,3 dipolar additions.

5.3 Nucleophilic addition to multiple bonds, Mannich reactions-Aldol and related reactions, Stobbe, Cannizzaro reaction, Darzens, Thorpe and Wittig reaction, benzoin condensation.

**TEXT BOOKS**


1. Advanced Organic Chemistry, Part A: Structure and Mechanisms, F. A. Carey and R. A. Sundberg, Fifth edition, Springer, New York, 2007.
2. Stereochemistry of Organic Compounds. Principles and Applications, D. Nasipuri, Second Edition, Wiley Eastern Limited, New Delhi, 1994. Ch.2-6 and 9-12.
3. J. March and M Smith, Advanced Organic Chemistry, 5th ed., John-Wiley and sons, 2001.
4. P. S. Kalsi, Stereochemistry of carbon compounds, 3rdedn, New Age International Publishers, 1995.


**REFERENCE BOOKS**


1. E. L. Eliel, Stereochemistry of Carbon Compounds, Tata-McGraw Hill, 2000.
2. D. Nasipuri, Stereochemistry of Organic Compounds, 2nded,, New Age Publishers, 2005.
3. I. L. Finar, Organic Chemistry. Vol-2, 5th ed., Pearson Education Asia, 1975.
4. I. L. Finar, Organic chemistry, Vol-1, 6th ed., Pearson Education Asia, 2004.

| MAJOR | M.Sc. Chemistry | 2016-2017 |
|---|---|---|
| M16PCH02 | INORGANIC CHEMISTRY-I | |
| Credits: 4 | | |

## UNIT – I: ATOMIC STRUCTURE AND BONDING

Atomic Structure and Periodic Table: Atom as nucleus with orbital electrons, concept of wave-functions, quantum numbers and spin, shape of s, p and d orbitals and their radial distribution functions, electronic configuration of atoms, Aufbau principle, Pauli Exclusion Principle, and Hund's rule; arrangement of elements in Groups in the Periodic Table, s-block, p-block, d-block and f-block elements; periodic properties, ionic radii, ionization potential, electron affinity, electronegativity (Pauling, Mulliken and Aflred-Rochnow scales); atomic states and term symbols.

Bonding and structure: Types of bonds, ionic, covalent, coordinate, double and triple bonds; orbital symmetry and overlaps, concept of MO and VB theory, concept of hybridization, the extent of d orbital participation in molecular bonding; bond energy and covalent radii, concept of resonance, bond moment and molecular dipole moment; polarizing power and polarizability, Fajan's rules.

## UNIT – II: SOLID STATE AND NUCLEAR CHEMISTRY

Inorganic Solids and Nuclear Chemistry: Types of solids, covalent, ionic, molecular and metallic solids, lattice energy, cohesive energy and Medulong constants, Van der Waals forces, hydrogen bonding, unit cell, crystal lattices, structure of simple ionic compounds, z radius ratio and closed packed structures. Imperfections in crystals (point defects and F centers).

Nuclear chemistry: nuclear reactions, Q value, cross sections, types of reactions, chemical effects of nuclear transformations; fission and fusion, fission products and fission yields; radioactive decay and equilibrium, radioactive techniques, tracer technique, neutron activation analysis, counting techniques such as G. M. ionisation and proportional counter.

## UNIT – III: COMPOUNDS OF BORON AND SILICON

Synthesis, properties and structures of Boron and Silicon compounds: Boron hydrides (small boranes and their anions, B1−B4), boron nitride, borazines, carboranes, metalloboranes, metallocarboranes; silicates, silicones, diamond, graphite, zeolites.

## UNIT – IV: COMPOUNDS OF SULFUR, NITROGEN, PHOSPHOROUS AND NOBEL GAS

Nitrogen, Phosphorous, Sulphur and noble gas compounds: Hydrides, oxides and oxy acids of Nitrogen, Phosphorous, Sulphur and halogens; phosphazines, sulphur-nitrogen compounds, inter halogen compounds, pseudo halogens, noble gas compounds.

## UNIT – V: POLYANIONS AND CLATHRATES

Poly anions and isopoly anions of Phosphorous, Vanadium, Chromium, Molybdenum and Tungsten, heteropoly anions of Molybdenum and Tungsten; clathrates (noble gases, phosphazines) hydrogen bonding in clathrates, Phosphorous and Oxygen cage compounds.

## RECOMMENDED BOOKS:


1. J. E. Huheey, Inorganic Chemistry, Principles, Structure and Reactivity, Harper and Row, 3rd Edn, 1983.
2. D. F. Shriver, P.W. Atkins, C.H. Langford, Inorganic Chemistry, 2nd Edn, ELBS, 1994.
3. F. A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry, A comprehensive Text, John Wiley, 5th Edn, 1987.
4. H. J. Arnikar, Essentials of Nuclear Chemistry, Wiley Eastern, 2nd Edn, 1988.
5. C. N. R. Rao and J.Gopalakrishnan, New Directions in Solid State Chemistry.
6. B. Douglas, D. McDaniel, J. Alexander, Concepts and Models of Inorganic Chemistry, 3rd Edn., John Wiley, 2001.
7. J. D. Lee, A New Concise Inorganic Chemistry, 3rd Edn., ELBS, 1987.

| MAJOR | M.Sc. Chemistry | 2016-2017 |
|---|---|---|
| M16PCH03 | PHYSICAL CHEMISTRY-I | |
| Credits: 4 | | |

**UNIT – I: CLASSICAL THERMODYNAMICS – I**

Maxwell's relations and thermodynamic equations of state – applications in the evaluation of Cp – Cv for solids and for vanderwaals gases, Cp – Cv in terms of coefficient of expansion and coefficient of compressibility – Relation between Cp and Cv – Partial molar properties – Gibbs – Duhem equation – Partial molar free energy (Chemical Potential) – Determination of chemical potential [Direct Method and Method of Intercepts] and partial molar volume – variation of chemical potential with Temperature and Pressure

**UNIT – II: CHEMICAL KINETICS – I**

Theories of Reaction rates – Arrhenius theory – effect of temperature on reaction rate – Hard – Sphere collision theory of reaction rates – molecular beams – Reaction cross section – effectiveness of collisions – Probability factor.

Transition state theory of reaction rates – Potential energy surface – Partition functions and activated complex – Eyring equation – Comparison of collision theory and activated complex theory – Estimation of free energy, enthalpy and entropy of activation and their significance.

**UNIT – III: QUANTUM CHEMISTRY – I**

Black body Radiation – Experimental results of Black body radiation – Photoelectric effect – De – Broglie equation – Heisenberg uncertainty principle – Compton effect – operators and commutation relations – quantum mechanical postulates – Schrodinger equation and its solution to the problem of a particle in one and three dimensional boxes – the harmonic oscillator.

**UNIT – IV: GROUP THEORY – I**

Symmetry elements and symmetry operations – Point groups – identification and representation of groups – comparison of Molecular symmetry with Crystallographic symmetry – Reducible and irreducible representation – Direct product representation – Great orthogonality theorem and its consequences – Character Table and their uses.

**UNIT – V: SPECTROSCOPY – I**

Interaction of matter with radiation– Rotation spectroscopy – Rigid Rotor – Intensity of spectral lines – Molecular parameters from rotation spectra - Effect of isotopic substitution on the rotation spectra. Vibrational spectroscopy – harmonic oscillator – anharmonic oscillator – Hot bands – selection rules – Vibrational spectra of polyatomic molecules – Overtones and combination frequencies – Fermi Resonance.

Raman spectroscopy – Raman effect – Rotational and vibrational Raman Spectra – Mutual Exclusion Rule. Electronic spectroscopy – Electronic spectra of diatomic molecules – vibrational coarse structure – Franck – Condon Principle.

**TEXT BOOKS:**


1. S.Glasstone, Thermodynamics for chemists, Affiliated East West press, New Delhi, 1960.
2. J. Rajaram and J.C. Kuriacose, Thermodynamics for students of chemistry, Lal Nagin Chand, New Delhi, 1986.
3. J. Rajaram and J.C. Kuriacose, Kinetics and mechanism of chemical transformation Macmillan India Ltd., 1993.
4. K.J.Laidlar, Chemical Kinetics, Harper and Row Newyork, 1987.
5. D.A. Mcquarrie, Quantum chemistry, University science books, Mill Valley, California (1983)
6. .K. Prasad, Quantum Chemistry, Wiley Eastern, New Delhi, 1992.
7. V.Ramakrishnan and M.S.Gopinathan, Group theory in chemistry, Vishal Publications, 1988.
8. V.Raman, Group theory and its application to chemistry, Tata McGraw Hill Publishing Co., 1990.
9. Raymond chang, Basic principles of Spectroscopy, McGraw Hill Ltd., New York, 1971.
10. C.N. Banwell, Fundamentals of Molecular Spectroscopy, Mc Graw Hill, Newyork 1966.


**REFERENCE BOOKS:**


1. W.J. Moore, Physical Chemistry, Orient Longman, London, 1972.
2. K.G. Den beigh, Thermodynamics of Steady state, Meklien and Co., London, 1951.
3. L. K. Nash, Elements of Chemical Thermodynamics, Addison Wesley, 1962.
4. R. G.Frost and Pearson, Kinetics and Mechanism, Wiley, Newyork, 1961.
5. W. Moore and R.G. Pearson, Kinetics and Mechanism, 1981.
6. C.Capellos and B.H.J. Bielski, Kinetic systems, Willey interscience, Newyork, 1968.
7. G. M.Harris, Chemical Kinetics, D.C. Heath and Co., 1966.
8. I. N.Levine, Quantum chemistry, Allyn and Bacon, Boston, 1983.
9. J. Goodman, Contemporary Quantum Chemistry, An Introduction, Plenum Press, Newyork, 1977.
10. F.J.Bockhoff, Elements of Quantum theory, Addision Wesley, Reading, Mass, 1976.
11. P.W.Atkins, Physical Chemistry, Oxford University Press, Oxford., 1990.
12. P.W.Atkins, Molecular Quantum Mechanics, Oxford University Press, Oxford., 1983.
13. H.Eyring, J.Walter and G. Kimball, Quantum chemistry, John wiley and sons, Newyork, 1944.
14. L.S.Pauling and E.B.Wilsob, Introduction to Quantum Mechanics, Mc Graw Hill book Co., Newyork, 1935.
15. F.A. Cotton, Chemical Application of Group Theory, John wiley and Sons Inc., Newyork, 1971.

16. N. Tinkham, Group Theory and Quantum Mechanics, McGraw Hill Book Company, Newyork, 1964.
17. Alan Vincent, Molecular Symmetry and Group theory – Programmed Introduction to chemical applications, Wiley, Newyork, 1977.
18. G.M. Barrow, Introduction to Molecular Spectroscopy, Mc Grawhill, Newyork, 1962.
19. G.W.King, Spectroscopy and Molecular Structure, Holt, Rienehart and Winston, 1964.
20. E.B.Wilson, J.C. Decius and D.C.Cross, Molecular Vibrations, Mc Graw Hill Book Co., 1955.
21. B.P. Straughan and S.Walker, Spectroscopy Vol-I, Vol-II and Vol-III, Chapmann and Hall, 1976.

| ELECTIVE-I | M.Sc. Chemistry | 2016-2017 |
|---|---|---|
| M16PCHE01 | **POLYMER CHEMISTRY** | |
| Credits: 4 | | |

**UNIT – I: BASIC CONCEPTS**

Monomers, repeat units, degree of polymerization, Linear, branched and network Polymers. Condensation Polymerization : Mechanism of stepwise polymerization. Kinetics and statistics of linear stepwise polymerization. Addition polymerization : Free radical, cationic and anionic polymerization. Polymerization conditions. Polymerization in homogeneous and heterogeneous systems.

**UNIT – II: CO-ORDINATION POLYMERIZATION**

Kinetics, mono and bimetallic mechanism of co-ordination polymers. Zeigler Natta catalyst, co-polymerization: Block and graft co-polymers, kinetics of copolymerization. Types of co-polymerization. Reactivity ratio.

**UNIT – III: MOLECULAR WEIGHT AND PROPERTIES**

Polydispersion – average molecular weight concept, number, weight and viscosity average molecular weights. Measurement of molecular weights. Viscosity, light scattering, osmotic and ultracentrifugation methods. Polymer structure and physical properties – crystalline melting point Tm. The glass transition temperature. Determination of Tg. Relationship between Tm and Tg.

**UNIT – IV: POLYMER PROCESSING**

Plastics, elastomers and fibres. Compounding, processing techniques: calendering, die casting, rotational casting, film casting, injection moulding, blow moulding extrusion, moulding, thermoforming, foaming, reinforcing and fibre spinning.

**UNIT – V: PROPERTIES OF COMMERCIAL POLYMERS**

Polyethylene, polyvinyl chloride, polyamides, polyesters, phenolic resins, epoxy resins and silicone polymers. Functional polymers, Fire retarding polymers and electrically conducting polymers. Biomedical polymers – contact lens, dental polymers, artificial heart, kidney, skin and blood cells.

**Text Books**


1. F.W. Billmeyer, TextBook of Polymer Science, 3rd Edition, J.Wiley, 2003.
2. Gowariker, N.V. Viswanathan and J. Sreedhar, Polymer Science, New Age Int., 1986.


**Reference Books**


1. H.R. Alcock and F.W. Lamber, Contemporary Polymer Chemistry, Prentice Hall, 1981.
2. P.J. Flory, Principles of Polymer Chemistry, Cornell University press, New York, 1953.
3. G. Odian, Principles of Polymerization, 2nd Edition, John Wiley & Sons, New York, 1981

| ELECTIVE-I | M.Sc. Chemistry | 2016-2017 |
|---|---|---|
| M16PCHE02 | APPLIED ELECTROCHEMISTRY | |
| Credits: 4 | | |

**UNIT – I: INTRODUCTION**

Overview of electrochemical concepts and methods; the electrochemical experiment; electrochemical methods; sign conventions; the three-electrode cell, the potentiostat, electrochemical window, types of electrodes.

**UNIT –II: THERMODYNAMICS**

Redox reactions; cell notation; standard potentials, free energy & equilibrium constants; the SHE; the Nernst equation; activity and formal potentials; reference electrodes, etc.

**UNIT –III**: **THE ELECTRIFIED INTERFACE**

Electric double layer; Helmholtz and Gouy-Chapman models; the dropping mercury electrode; surface tension; double-layer capacitance; specific and non-specific adsorption; Debye-Hückel theory, etc.

**UNIT –IV: ELECTRON TRANSFER KINETICS**

Standard rate constant; transfer coefficient; Tafel equation; Marcus theory; Butler-Volmer equation; Tafel plots; irreversible & quasi-reversible voltammetry, etc.

**UNIT –V: POTENTIOMETRY**

Two types; general methods and calibration; redox and ion-selective electrodes, etc.

**REFERENCE BOOKS**


1. Encyclopedia of Applied Electrochemistry ISBN: 978-1-4419-6995-8.
2. Electro analysis theory and applications in aqueous and non-aqueous media and in automated chemical control, E.A.M. F. Dahmen,1986.

| ELECTIVE-I | **M.Sc. Chemistry** | **2016-2017** |
|---|---|---|
| M16PCHE03 | **GREEN CHEMISTRY** | |
| Credits: 4 | | |

**UNIT-I: GREEN CHEMISTRY**

Introduction to green chemistry: Green chemistry-relevance and goals, Anastas' twelve principles of green chemistry - Tools of green chemistry: alternative starting materials, reagents, catalysts, solvents and processes with suitable examples.

**UNIT-II: MICROWAVE MEDIATED ORGANIC SYNTHESIS (MAOS)**

Microwave activation – advantage of microwave exposure – specific effects of microwave – Neat reactions – solid supports reactions _ Functional group transformations – condensations reactions – oxidations – reductions reactions – multi-component reactions.

**UNIT-III: IONIC LIQUIDS**

Ionic liquids and PTC Introduction – synthesis of ionic liquids – physical properties – applications in alkylation – hydroformylations – expoxidations – synthesis of ethers – Friedel-craft reactions – Diels-Alder reactions – Knoevengal condensations – Wittig reactions – Phase transfer catalyst - Synthesis – applications.

**UNIT-IV: BIO-CATALYSTS**

Supported catalysts and bio-catalysts for Green chemistry Introduction – the concept of atom ecomomy – supported metal catalysts – mesoporous silicas – the use of Biocatalysts for green chemistry.

**UNIT-V: MODIFIED BIO CATALYSTS**

Fermentations and biotransformations – fine chemicals by microbial fermentations – vitamins and amino acids – Baker's yeast mediated biotransformations – Bio-catalyst mediated Baeyer-Villiger reactions – Microbial polyester synthesis.

**REFERENCE BOOKS**


1. Green Chemistry – Environmentally benign reactions – V. K. Ahluwalia. Ane Books India (Publisher). (2006). Green Chemistry – Designing Chemistry for the Environment – edited by Paul T. Anastas & Tracy C. Williamson. Second Edition, (1998).
2. Green Chemistry – Frontiers in benign chemical synthesis and processes- edited by Paul T. Anastas & Tracy C. Williamson. Oxford University Press, (1998).
3. Green Chemistry – Environment friendly alternatives- edited by Rashmi Sanghi & M. M. Srivastava, Narora Publishing House, (2003).

| ELECTIVE-I | **M.Sc. Chemistry** | **2016-2017** |
|---|---|---|
| M16PCHE04 | **MATERIAL SCIENCE** | |
| Credits: 4 | | |

**UNIT-I**: **ADVANCED MATERIALS AND TOOLS**

Smart materials, exhibiting ferroelectric, piezoelectric, optoelectric, semiconducting behavior, lasers and optical fibers, photoconductivity and superconductivity, nanomaterials, synthesis, properties and applications, biomaterials, superalloys, shape memory alloys.

**UNIT-II: MATERIALS CHARACTERIZATION TECHNIQUES**

Scanning electron microscopy, transmission electron microscopy, atomic force microscopy, scanning tunneling microscopy, atomic absorption spectroscopy, differential scanning calorimetry.

**UNIT-III: MECHANICAL PROPERTIES**

Stress-strain diagrams of metallic, ceramic and polymeric materials, modulus of elasticity, yield strength, tensile strength, toughness, elongation, plastic deformation, viscoelasticity, hardness, impact strength, creep, fatigue, ductile and brittle fracture.

**UNIT-IV: THERMAL PROPERTIES**

Heat capacity, thermal conductivity, thermal expansion of materials. Electronic Properties: Concept of energy band diagram for materials - conductors, semiconductors and insulators, electrical conductivity effect of temperature on conductivity, intrinsic and extrinsic semiconductors, dielectric properties.

**UNIT-V: OPTICAL PROPERTIES**

Reflection, refraction, absorption and transmission of electromagnetic radiation in solids. Magnetic Properties: Origin of magnetism in metallic and ceramic materials, paramagnetism, diamagnetism, antiferro magnetism, ferromagnetism, ferrimagnetism, magnetic hysterisis.

**REFERENCE BOOKS**


1. C.N.R. Rao, A. Muller, A.K. Cheetam (Eds), The Chemistry of Nanomaterials, Vol.1, 2, Wiley – VCH, Weinheim, 2004.
2. C.P. Poole, Jr: F.J. Owens, Introduction to Nanotechnology Wiley Interscience, New Jersey, 2003 Kenneth J. Klabunde (Ed), Nanoscale materials in Chemistry, Wiley-Interscience, New York, 2001. T. Pradeep, Nano: The Essentials in understanding nanoscience and nanotechnology, Tata McGraw Hill, New Delhi, 2007.

| MAJOR | M.Sc. Chemistry | 2016-2017 |
|---|---|---|
| M16PCH04 | ORGANIC CHEMISTRY-II | |
| Credits: 4 | | |

## UNIT–I: UV AND VISIBLE SPECTROSCOPY AND IR

Terminology, classification of electronic transitions. Effect of substituent and conjugation on the spectra of alkenes. Woodward – Fieser rules for polyenes. Electronic spectra of carbonyl compounds. Effect of solvent on $\pi - \pi^*$ and $n - \pi^*$ transitions. Woodward's rules for enones. Electronic spectra of benzene and its derivatives.

### IR spectroscopy

Theory and principle, Characteristic vibrational frequencies of alkanes, alkenes, alkynes, aromatic compounds, alcohols, ethers, phenols and amines. Detailed study of vibrational frequencies of carbonyl compounds (ketones, aldehydes, esters, amides, acids, anhydrides). Effect of solvent and hydrogen bonding on the vibrational frequencies in alcohols.

## UNIT-II: NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY

Introduction- Nuclear spin and nuclear parameters-NMR nuclei-Nuclear spin states. The mechanism of absorption( resonance condition).Calculation of resonance frequency. Population densities of nuclear spin states. Relaxation processes.

The chemical shift and shielding. Chemical environment and chemical shift. Factors affecting chemical shift. Magnetic anisotropy. Continuous wave and pulsed Fourier methods of recording NMR spectra. Spin – spin coupling and splitting of NMR signals. Spin – spin interactions – AX, $AX_2$, $AX_3$, AMX and AB types. The coupling constant. Intensities of multiplets – Pascal's triangle

Geminal and vicinal coupling. Karplus equation and Karplus curve. First and second order coupling of AB systems. Spin decoupling methods. Double resonance. Applications in structural elucidation.

## UNIT-III: CARBON–13 NMR SPECTROSCOPY

The carbon – 13 nucleus, carbon – 13 chemical shift. Proton coupled and proton decoupled carbon – 13 spectra. Nuclear overhauser effect. Problems with integration in carbon - 13 spectra. Off resonance decoupling. Applications. Introduction to $^{19}F$, $^{31}P$ NMR spectra

## UNIT-IV: ADVANCED NMR TECHNIQUES AND PROBLEMS

Pulse sequences, spins and magnetization vectors. The DEPT experiment. Determining the number of attached hydrogens. Introduction to two – dimensional spectroscopic methods. The COSY technique. An overview of the COSY Experiment.

Problem solving excercises involving UV, IR NMR & MS data

**UNIT-V: MASS SPECTROSCOPY**

Introduction, principle and instrumentation. Ion production – electron impact, chemical ionization, field desorption and fast atom bombardment techniques. High resolution mass spectrometry – base -, molecular ion -, parent ion -, fragmentation ion -, metastable – and isotopic peaks. Factors affecting fragmentation, ion analysis and ion abundance. Mass spectral fragmentation of organic compounds (hydrocarbons, aromatic compounds, alcohols, carbonyl compounds, acids and esters). McLafferty rearrangement. Determination of molecular weight and molecular formula.

**REFERENCE BOOKS**


1. Physical methods in Inorganic chemistry, R.S. Drago, Affiliated East-West Press Pvt. Ltd., New Delhi (1965).
2. Infrared Spectra of Inorganic and co-ordination Compounds, K. Nakamoto, Wiley-Interscience, New York, (1970).
3. Vibrational spectroscopy: theory and Applications, D.N.Sathyanarayana, New-Age International Publishers, New Delhi (2000).
4. Electronic Absorption Spectroscopy and related techniques, D.N.Sathyanarayana, Universities Press, Bangalore, (2001).
5. Applications of absorption Spectroscopy to Organic Compounds, J.R. Dyer, Prentice – Hall, New Delhi, (1969).
6. Organic Spectroscopy, W. Kemp, ELBS London, (1975).
7. Spectrometric Identification of Organic Compounds, R.M. Silverstein and W.P. Webster, Wiley & Sons, (1999).
8. Organic Mass Spectroscopy, K.R. Dass and E.P. James, IBH New Delhi, (1976).
9. Principles of Instrumental Analysis, D.A. Skoog, S.J. Holler, T.A. Nilman, 5th Edition, Saunders College Publishing, London, (1998).
10. Introduction To Spectroscopy, 2nd Edition, Donald L. Pavia, Gary M. Lampman and George S. Keiz, Harcourt Brace College Publishers, (1996).
11. Physical Methods for Chemists, R.S. Drago, 2nd Edition, Saunders College Publishing New York, (1992).
12. Mass Spectrometry – Analytical Chemistry By Open Learning -, R. Davies, M. Frearson and E. Prichard, John Wiley and Sons, New York, (1987).

| MAJOR | M.Sc. Chemistry | 2016-2017 |
|---|---|---|
| M16PCH05 | PHYSICAL CHEMISTRY-II | |
| Credits: 4 | | |

**UNIT – I: CLASSICAL THERMODYNAMICS – II**

Thermodynamics of ideal and real gases, gas mixtures – Fugacity – definition – Methods of determination of fugacity – Variation of fugacity with temperature and pressure.

Standard states for gases, liquids, solids and components of solutions –determination of activities and activity coefficient from Vapour pressure, Freezing point, Boiling point and EMF – measurements.

Solution of Electrolytes – mean ionic activity, mean ionic molality and mean ionic activity coefficients – determination of activity coefficient from Freezing Point, EMF and Solubility measurements – Concept of ionic strength.

**UNIT – II: CHEMICAL KINETICS – II**

Reactions in solutions – comparison between gas phase and solution reactions – the influence of solvent, ionic strength, dielectric constant and pressure on reaction in solution – Kinetic isotope effects – Linear free energy relationship – Hammett and Taft equations.

**UNIT – III: QUANTUM CHEMISTRY –II**

Schrödinger equation for the rigid rotator and Hydrogen atom – arriving solution for energy and wave function – the origin of quantum numbers and their physical significance – Probability distribution of electrons.

Approximation methods – Perturbation and Variation methods – application of Variation method to Hydrogen and Helium atom – Spin - orbit interaction – LS coupling and JJ coupling – Term symbols and spectroscopic states. Ground state term symbols for simple atoms.

**UNIT – IV: GROUP THEORY – II**

Symmetry selection rules for vibrational, Electronic and Raman Spectra – determination of representation of vibrational modes in non-linear molecules such as H2O, CH4 , XeF4, SF6 and NH3 – symmetry of Hybrid orbitals in non-linear molecule (BF3, CH4, XeF4, PCl5 and SF6) – Electronic spectra of formaldehyde.

**UNIT – V: SURFACE CHEMISTRY AND CATALYSIS**

Kinetics of surface reactions: Physical and chemical adsorption – adsorption isotherms – types of adsorption isotherms – Langmuir adsorption isotherm – B.E.T theory for multilayer adsorption – measurement of surface area – Mechanism of heterogeneous catalytic reactions – the adsorption coefficient and its significance.

Acid – Base catalysis – mechanism – Bronsted catalysis Law – catalysis by enzymes – rate of enzyme catalysed reactions – effect of substrate concentration, pH and temperature on enzyme catalysed reactions –Michael – Menton's equation.

**TEXT BOOKS:**


1. S.Glasstone, Thermodynamics for chemists, Affiliated East West press, New Delhi, 1960.
2. J. Rajaram and J.C. Kuriacose, Thermodynamics for students of chemistry, Lal Nagin Chand, New Delhi, 1986.
3. J. Rajaram and J.C. Kuriacose, Kinetics and mechanism of chemical transformation, Macmillan India Ltd., 1993.
4. K.J.Laidlar, Chemical Kinetics, Harper and Row, Newyork, 1987.
5. R.K. Prasad, Quantum Chemistry, Wiley Eastern, New Delhi, 1992.
6. M.W. Hanna, Quantum mechanics in chemistry, W.A. Benjamin INC, London (1965)
7. V.Ramakrishnan and M.S.Gopinathan, Group theory in chemistry, Vishal Publications, 1988.
8. K.V.Raman, Group theory and its application to chemistry, Tata McGraw Hill Publishing Co., 1990.
9. Gurudeep raj, Advanced Physical Chemistry, Goel Publishing House, Meerut.


**REFERENCE BOOKS:**


1. W.J. Moore, Physical Chemistry, Orient Longman, London, 1972.
2. K.G. Den beigh, Thermodynamics of Steady state, Meklien and Co., London, 1951.
3. L.K. Nash, Elements of Chemical Thermodynamics, Addison Wesley, 1962.
4. R.G.Frost and Pearson, Kinetics and Mechanism, Wiley, Newyork, 1961.
5. J.W. Moore and R.G. Pearson, Kinetics and Mechanism, 1981.
6. C.Capellos and B.H.J. Bielski, Kinetic systems, Willey interscience, Newyork, 1968.
7. G.M.Harris, Chemical Kinetics, D.C. Heath and Co., 1966.
8. A.K. Chandra, Introductory Quantum Chemistry, Tata Mc Graw Hill.
9. D.A. Mc Quarrie, Quantum Chemistry, University science books, Mill Valley, California (1983).
10. P.W.Atkins, Molecular Quantum Mechanics, Oxford University Press, Oxford., 1983.
11. I.N.Levine, Quantum chemistry, Allyn and Bacon, Boston, 1983.
12. F.J.Bockhoff, Elements of Quantum theory, Addision Wesley, Reading, Mass, 1976.
13. H.Eyring, J.Walter and G. Kimball, Quantum chemistry, John wiley and sons, Newyork, 1944.
14. L.S.Pauling and E.B.Wilsob, Introduction to Quantum Mechanics, Mc Graw Hill book Co., Newyork, 1935.
15. F.A. Cotton, Chemical Application of Group Theory, John wiley and Sons Inc., Newyork, 1971.
16. N. Tinkham, Group Theory and Quantum Mechanics, McGraw Hill Book Company, Newyork, 1964.
17. Alan Vincent, Molecular Symmetry and Group theory – Programmed Introduction to chemical applications, Wiley, Newyork, 1977.

| ELECTIVE-II | M.Sc. Chemistry | 2016-2017 |
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| M16PCHE05 | PHYSICAL ORGANIC CHEMISTRY | |
| Credits: 4 | | |

**UNIT- I: MODERN THEORY OF ORGANIC STRUCTURES AND BONDING**

Modern theory of organic structures and bonding. Symmetry-adapted orbitals. Perturbation theory and orbital mixing rules. Buildup approach to large molecular structures. Bonding and structure of reactive intermediates: Carbocations, carbanions, and carbenes. Relation between structure and energetics.

**UNIT-II: SOLUTIONS**

Solutions and forces of molecular recognition. Bronsted acid-base chemistry. Lewis acids/bases, electrophiles and nucleophiles. Reactivity, kinetics, and mechanisms. Energy surfaces and transition states. Hammond Postulate.

**UNIT-III: ISOTOPE EFFECTS**

Isotope effects. Hammet plot. Steric and polar effects. Empirical scales of solvent effect. pH and Bronsted relationship.

**UNIT-IV: MECHANISM AND CATALYSIS**

Mechanism and catalysis of proton transfer. General principles of catalysis. Enzyme-catalytic effect and concept of transition-state stabilization.

**UNIT-V: PHYSICAL ORGANIC APPROACH**

Investigation of organic reaction mechanisms by physical organic approach. Examples illustrating application to investigation of electrophilic/nucleophilic reactions, and enzyme-catalyzed reactions.

**REFERENCE BOOKS:**


1. E. V. Anslyn and D. A. Dougherty, Modern Organic Chemistry, University Science, 2005. A. Pross, Theory and Physical Principles of Organic Reactivity, John Wiley, 1995.
2. A. Rauk, Orbital Interaction Theory of Organic Chemistry, John Wiley, 1994. T. H.Lowry and K. H.Richardson, Mechanisms and Theory in Organic Chemistry, Harper and Row, 1976.

## UNIT-I: AMINO ACIDS AND PROTEINS STRUCTURE

Classification, synthesis and properties of amino acids, isoelectric point, biosynthesis of amino acids. Peptides: oligo- and polypepides, geometry of peptide linkage, N-terminal and C-terminal residue analysis, synthesis of peptides-amino and carboxyl protecting groups-solid phase peptide synthesis. Proteins: classification and properties (denaturation, isolelectric point and electrophoresis), primary, secondary, tertiary and quaternary structures of proteins, collagen and triple helix.

## UNIT-II: ENZYMES AND COFACTORS

Mechanism of enzyme catalysis, Factors influencing enzyme action, Examples of typical enzyme mechanisms: chymotrypsin, ribonuclease and lysozyme, Enzyme-catalyzed addition, elimination, condensation, carboxylation and decarboxylation, isomerisation, group transfer and rearrangement reactions-structure and biological functions of coenzyme A, thiamine pyrophosphate, pyridoxal phosphate, NAD+ , NADP+ , FMN, FAD, lipoic acid and Vitamin B12. Mechanisms of reactions catalysed by the above cofactors.

## UNIT-III: NUCLEIC ACIDS AND PROTEIN SYNTHESIS

Nucleotides and nucleosides, DNA: primary and secondary structure-replication of DNA. RNA and protein synthesis: Messenger RNA synthesis-transcription, Ribosomes-rRNA, Transfer RNA, genetic codetranslation. Determination of base sequence of DNA. Polymerase Chain Reaction (PCR). Antisense technology in chemotherapy and other nucleic acid-targeted drugs-intercalaters, sequence specific drugs. A brief account of ribosyme and iRNA.

## UNIT-IV: LEAD AND ANALOGUE SYNTHESIS

Designing organic synthesis-disconnection approach-synthons and synthetic equivalents-one group disconnections: alcohol, olefin, ketone, acids-two group disconnections:1,2-, 1,3-, 1,4- and 1,5-difunctional compounds-convergent synthesis-functional group interconversions-functional group additions-carbonheteroatom bonds-methods for 3- to 6-membered rings. 17

## UNIT-V: MEDICINAL CHEMISTRY

Lead and Analogue Synthesis-2 Combinatorial synthesis in medicinal chemistry: Solid phase techniques-methods of parallel synthesis-mix and split techniques-dynamic combinatorial chemistry-screening and deconvolution-limitations of combinatorial synthesis Assymmetric synthesis: basic principles-stereoselective and stereospecific reactions- methods for determining enantiomeric excess-chiral auxiliary, reagents and catalysts and their applications (wherever applicable) in alkylation, hydrogenation, hydroxylation, epoxidation and hydroboration of

alkenes, reduction of ketones-Cram and Felkin-ahn models. Noyori's BINAP – Jacobson catalyst – Evans catalyst.

**REFERENCE BOOKS:**


1. Bioorganic Chemistry: A Chemical approach to Enzyme action, Hermann Dugas and C.Penny, Springer-Verlag.
2. Fundamentals of Enzymology,N.C. Price and L.Stevens, Oxford University Press.
3. Enzymatic Reaction Mechanisms, C. Walsh, W.H.Freeman.
4. Designing Organic Synthesis: The Disconnection Approach by Stuart Warren, Wiley, 2nd edition, 1984.
5. Asymmetric Synthesis by H. B. Kagan, Thieme Medical Publishers, 2003.
6. Advanced Organic Chemistry: Part-A and Part-B by Francis A. Carey and Richard B. Sundberg, Springer, 5th edition, 2007.

| ELECTIVE-II | M.Sc. Chemistry | 2016-2017 |
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| M16PCHE07 | COORDINATION CHEMISTRY | |
| Credits: 4 | | |

**UNIT – I: Introduction to Transition Metal Complexes:**

Brief review of the general characteristics of transition elements, types of ligands, nomenclature of coordination complexes, chelates, chelate effect, geometry and isomerism, formation of complexes, stability constants, Werner, Sidzwick and VSEPR theory.

**UNIT – II: Electronic Structure of Transition Metal Complexes 1:**

Crystal field theory, crystal field splitting, application of d-orbital splittings to explain magnetic properties, low spin and high spin complexes, crystal field stabilization energy, spectrochemical series, weak and strong field complexes, thermodynamic and related aspects of crystal fields, ionic radii, heats of ligation, lattice energies, site preference energies.

**UNIT – III: Electronic Structure of Transition Metal Complexes 2:**

VB and MO theory of complexes (quantitative principles involved in complexes with no pi and with pi bonding) and ligand filed theories and molecular symmetry, angular overlap model, Jahn Teller effect, electronic spectra of transition metal complexes, Term states of $d^n$ ions, orgal and Tanabe-Sugano diagrams, charge transfer and d-d transitions, nephelauxetic series.

**UNIT – IV: Inorganic Reaction Mechanisms**

Inorganic reaction mechanisms: inert and labile compounds, substitution reactions of octahedral complexes, dissociative, associative, anation, aquation, conjugate base mechanism; substitution reactions of square planar complexes, trans effect, trans effect series, theories of trans effect; electron transfer reactions.

**UNIT – V: Inorganic Clusters**

Inorganic chains - rings - cages and clusters - catenation - heterocatenation - intercalation chemistry - one dimensional conductor - isopolyanions - heteropolyanions - borazines - phosphazenes - phosphazene polymers - ring compounds of sulphur and nitrogen - homocyclic inorganic systems - cages - boron cage compounds - metal clusters - dinuclear clusters - trinuclear clusters - tetranuclear clusters - hexanuclear clusters - structural prediction of organometallic clusters.

**RECOMMENDED BOOKS:**


1. F. A. Cotton, G. Wilkinson, Advanced Inorganic Chemistry, 5th Edn., John Wiley.
2. J. E. Huheey, Inorganic Chemistry, 3rd Edn., Harper International, 1983.
3. B. Douglas, D. McDaniel, J. Alexander, Concepts and Models of Inorganic Chemistry, 3rd Edn., John Wiley, 2001.
4. D. F. Shriver, P. W. Atkins, C. H. Langford, Inorganic Chemistry, ELBS. 1990.
5. N. N. Greenwood, A. Earnshaw, Chemistry of the Elements, 2nd Edn., BH, 1997.
6. W. L. Jolly, Modern Inorganic Chemistry, 2nd Edn., McGraw-Hill, 1991.
7. J. D. Lee, A New Concise Inorganic Chemistry, 3rd Edn., ELBS, 1987.

| ELECTIVE-II | M.Sc. Chemistry | 2016-2017 |
|---|---|---|
| M16PCHE08 | SCIENTIFIC RESEARCH METHODOLOGY | |
| Credits: 4 | | |

**UNIT – I: INTRODUCTION**

Introduction to Research Methodology Research Problem and Research Design Formulation of Hypotheses.

**UNIT – II: RESEARCH METHODS**

Types of Research Methods: Quantitative and Qualitative Research Techniques and Tools.

**UNIT – III: RECORDS**

Questionnaire, Interview, Observation, Schedule, Check-list, Library Records and Reports. Metric Studies in LIS

**UNIT – IV: DATA ANALYSIS**

Data Analysis and Interpretation Data Analysis: Statistical Methods Data Analysis : Computer Processing Interpretation and Presentation of Results

**UNIT –V: REPORTS**

Report Writing Research- Report Writing Style Manuals IPR and Plagiarism.

**REFERENCE BOOKS:**


1. Connaway (L S) & Powell (R R). Basic research methods for librarians (Ed.5), (2010) Libraries unlimited. California.
2. Glootenberg (A). Research methodology in Library and information science, (2013) Uxbridge: Koros.
3. Goode (WJ) and Hatt (PK): Methods in social research. McGraw-Hill, (1982) New York.
4. Kothari (C R). Research methodology: Methods & Techniques (Rev. Ed.), (2006) New Age International. New Delhi.
5. Roig (M). Avoiding plagiarism, self-plagiarism, and other questionable writing practices: A guide to ethical writing, (2006).

| PRACTICAL-I | M.Sc. Chemistry | 2016-2017 |
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| M16PCHP01 | ORGANIC CHEMISTRY - I | |
| Credits: 4 | | |

**PART-I**

1. Separation and analysis of two component organic mixtures by chemical methods.

**PART-II**

2. Preparations involving single stage.
   (i) Benzoic acid from ethyl benzoate
   (ii) Acetanilide from aniline
   (iii) Acetylsalicyclic acid from salicyclic acid
   (iv) 2,4,6-Tribromoaniline from aniline
   (v) p-Bromoacetanilide from acetanilide
   (vi) m-Dinitro benzene from nirobenzene
   (vii) Picric acid from phenol
   (viii) 2-Naphthylbenzoate from 2-naphthol.

**TEXT BOOKS**


1. N.S. Gnanapragasam and G. Ramamurthy, Organic Chemistry – Lab manual, S.Viswanathan Co. Pvt. Ltd, 1998.
2. J.N. Gurtu and R. Kapoor, Advanced Experimental Chemistry, S. Chand and Co., 1987


**REFERENCE**


1. Vogel's Text book of Practical Organic Chemistry, 4th Ed, ELBS/Longman, England, 1984.


**Distribution of marks for practical –I**

| | |
|---|---|
| Qualitative organic analysis | : 30 marks |
| Preparation | : 15 marks |
| Viva-voce in practical | : 10 marks |
| Record | : 5 marks |
| Total | : 60 marks |
| Duration | : 6 hour |

| PRACTICAL-II | M.Sc. Chemistry | 2016-2017 |
|---|---|---|
| M16PCHP02 | INORGANIC CHEMISTRY - I | |
| Credits: 4 | | |

**PART –I**

Semimicro qualitative analysis of mixtures containing two common and two rare cations. The following are the rare to be included: W, Tl, Mo, Te, Se, Ce, Th, Be, Zr, V, U and Li.

**PART – II**

a) Colorimetric analysis: Visual and photometric; determination of iron, nickel, manganese and copper.
b) Preparation of the following :

i)Potassium trioxalatoaluminate (III) trihydrate
ii)Tristhioureacopper (I) chloride
iii)Potassium trioxalatochromate (III) trihydrate
iv)Sodium bis (thiosulphato) cuprate (I)
v)Tetramminecopper (II) sulphate
vi)Potassium Tetrachlorocuprate (II)

**Reference Books**


1. G. Svehla, Vogel's qualitative Inorganic analysis, VI Edition, Orient Longman, 1987.
2. V.V. Ramanujam, Inorganic Semimicro Qualitative analysis. National Publishing Co., 1971.


**Distribution of Marks for Practical –I**

| | | |
|---|---|---|
| Qualitative analysis | : | 20 marks |
| Colorimetric analysis | : | 15 marks |
| Preparation | : | 10 marks |
| Viva – voce in practical | : | 10 marks |
| Record | : | 5 marks |
| Total | : | 60 marks |
| Duration | : | 6 hours |

Experiments in chemical kinetics, phase rule, Chemical equilibrium and Conductivity measurements:

**DETAILED LIST OF EXPERIMENTS**

Typical list of possible experiments are given. Experiments of similar nature and other experiments may also be given. The list given is only a guideline. A minimum of 15 experiments have to be performed in a year.

1. Study the kinetics of acid hydrolysis of an ester, determination of the temperature coefficient of the reaction and determination of the activation energy of the hydrolysis of ethylacetate.

2. Study the kinetics of the reaction between acetone and iodine in acidic medium by half life method and determine the order with respect to iodine and acetone.

3. Study of the saponification of ethylacetate by sodium hydroxide conductometrically and determine the order of the reaction.

4. Determination of association factor of benzoic acid in benzene by distribution method.

5. Study the phase diagram for m-toluidine and glycerine system.

6. Construction of phase diagram for a simple binary system (naphthalene – phenanthrene and benzophenone – diphenylamine)

7. Construction of the phase diagram of the three component of partially immiscible liquid systems (DMSO – Water – Benzene; Water-Benzene –Acetic acid; Ethyl alcohol – Benzene – Water; Acetone-Chloroform – Water; Chloroform – Acetic acid-Water).

8. Determination of equivalent conductance of a weak acid at different concentrations and verify Ostwald's dilution law and calculation of the dissociation constant of the acid.

9. Determination of equivalent conductivity of a strong electrolyte at different concentrations and examine the validity of the Onsager's theory as limiting law at high dilutions.

10. Conductometric titrations of a mixture of HCl and CH3COOH against Sodium hydroxide.

11. Compare the relative strength of acetic acid and monochloroacetic acid by conductivity method.

**REFERENCE BOOKS**


1. B.P. Levitt (Ed.). Findlay's Practical Physical Chemistry, 9th Edn., Longman, London, 1985.
2. J.N. Gurtu and R.Kapoor, Advanced Experimental Chemistry, Vol I. S. Chand & Co. Ltd., New Delhi, 1980.


**Distribution of Marks for Practical –I**

| | | |
|---|---|---|
| Experiment | : | 45 marks |
| Viva-voce in practica | : | 10 marks |
| Record | : | 5 marks |
| Total | : | 60 marks |
| Duration | : | 6 hours |

| VALULE ADDED | M.Sc. Chemistry | 2016-2017 |
|---|---|---|
| M16PCHVA01 | GENERALTRENDS IN APPLIED CHEMISTRY | |
| Credits: 2 | | |

**Objectives:**

To make the student to understand publications in journals and present a research topic, under the guidance of a professor, in the subject related to Applied Chemistry and his/her broad field of project work in the class room.

**Testing:**

Each student, during, semester-I or II, will give a one hour seminar on a Title of recent trends in applied chemistry taken from current publications in reputed journals.

The student will be tested both in subject matter and mode of presentation of the seminar as follows:

**Subject matter - 50 Marks**

Standard of subject and plan
Preparation and mastery
Originality and logical development
Answers to questions
Summary and references

**Mode of presentation - 50 Marks**

Economy of time
Voice as a tool of communication
Blackboard use and teaching aids
Language and diction
Relating to the audience

| MAJOR | M.Sc. Chemistry | 2016-2017 |
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| M16PCH06 | ORGANIC CHEMISTRY-III | |
| Credits: 5 | | |

## UNIT-I: HETEROCYCLIC CHEMISTRY AND ADDITION TO CARBON-HETERO ATOM MULTIPLE BONDS

Synthesis and reactions of indole, imidazole, thiazole, pyridines, pyrimidine, pyridazine, pyrazine, chromans, chromons, coumarins, carbazoles, uracil, uric acid and xanthines.

Addition to carbon-hetero atom multiple bonds: Mechanisms of metal hydride reduction of carbonyl compounds, acids, esters and nitriles; addition of Grignard reagents and organolithium reagents to carbonyl compounds; mechanisms of formation of hydrates, acetals, oximes and hydrazones on carbonyl compounds, Wittig reaction.

## UNIT-II: FORMATION OF CARBON-CARBON SINGLE BONDS AND C-C $\pi$ BONDS

Formation of carbon- carbon single bonds using organometallic reagents: organolithium, organomegnesium, organocopper, organozinc, organoboron, organosilicon and palladium catalysed coupling reactions. Formation of carbon-carbon $\pi$ bonds: Wittig olefination- Horner-Wadsworth-Emmons reactions-Peterson olefination- Julia olefination- The Shapiro reaction-Gilbert's reagent.

## UNIT-III: MODERN SYNTHETIC REACTIONS

**Oxidation Reactions:** Chromium and manganese reagents (CrO3, K2Cr2O7, PCC, PDC, Sarret reagent, Jones reagent, MnO2, KMnO4), Oxygen (singlet and triplet), ozone, peroxides and peracids, lead tetraacetate, periodic acid. OsO4, SeO2, NBS, chloramine-T, Sommelet oxidation, Oppenauer oxidation, Fenton's reagent, Sharpless epoxidation.

**Reductions**: Catalytic hydrogenation (homogeneous and heterogeneous) catalysts (Pt, Pd, Rh-C, Ni, Ru), Wilkinson catalyst, LiAlH4, NaBH4, DIBAL-H, Sodium cyanoborohydride, dissolving metal reactions (Birch reduction). Leukart reaction (reductive amination) Diborane as reducing agent, Meerwein-Ponndorf-Verley reduction, Wolff-Kishner reduction, Clemensen reduction, tributyl tinhydride, stannous chloride, Bakers yeast. Suzuki coupling, Heck reaction, Negishi reaction.

## UNIT-IV: REARRAENGEMENTS

Types of rearrangements: Nucleophilic; free radical and electrophilic reactions. Mechanisms: Nature of migration; migratory ability and memory effects, ring enlargement and ring contraction rearrangements Reactions: Wagner-Meerwin and related reactions, Benzil-benzilic acid, Favorskii, Hoffmann and related rearrangements, Beckmann, Neber, Baeyer-Villiger, Stevens, Claisen rearrangements, boron-carbon migration, Non-1,2-rearrangements, Fischer-indole synthesis, Arndt-Eistert synthesis-expansion and contraction of rings.

**UNIT-V: ORGANIC SYNTHESIS BY DISCONNECTION APPROACH**

Introduction - Basic Principles of Synthesis of Aromatic Compounds - Disconnection Approach - Functional Group Inter conversions - Synthons - Aromatic Electrophilic and Nucleophilic Substitutions - Strategy I (The order of Events - Some Guidelines) - One-Group CX Disconnections - Strategy II (Chemoselectivity, some Guidelines) - Two-Group Disconnections- Strategy III (Polarity Reversal, Cyclization) - Amine Synthesis (Salbutamol, Fenfluramine) -Protecting the Functional Groups - synthesis of a sweetening agent (Asp-Phe-OMe) - General Strategy of Choosing a Dsiconnection - Stereoselectivity - Regioselectivity - Alkene synthesis -Use of Acetylenes - Group C-C Disconnections (Alcohols, Carboxylic acids, Carbonyl compounds)

**REFERENCE BOOKS**


1. T. L. Gilchrist, Heterocyclic Chemistry, Longman Press, 1989.
2. J. A. Joule and K. Mills, Heterocyclic Chemistry, 4thed., John-Wiley, 2010
3. Carruthers, Modern Methods in Organic Synthesis, Academic Presistry, Vol. 1 and 2 (2002)
4. Stuart Warren, Organic Synthesis: The Disconnection Approach, Wiley-India, New Delhi (2007)
5. J. March and M Smith, Advanced Organic Chemistry, 5thed., John-Wiley and sons, 2001.
6. F. A. Carey and R. Sundberg, Advanced Organic Chemistry, Vol. 1 and 2 (2002)

| MAJOR | M.Sc. Chemistry | 2016-2017 |
|---|---|---|
| M16PCH07 | INORGANIC CHEMISTRY-III | |
| Credits: 5 | | |

**UNIT-I**

Definition of organometallic compound - 18 electron rule - effective atomic number rule - classification of organometallic compounds - the metal carbon bond types - ionic bond – sigma covalent bond - electron deficient bond - delocalised bond - dative bond - metal carbonyl complexes - synthesis - structure and reactions of metal carbonyls - the nature of M- CO bonding-binding mode of CO and IR spectra of metal carbonyls - metal carbonyls- metal carbonyl anions - metal carbonyl hydrides - metal carbonyl halides - metal carbonyl clusters - Wades rule and isolobal relationship - metal nitrosyls - dinitrogen complexes - dioxygen complexes.

**UNIT - II**

Metal alkyl complexes - stability and structure - synthesis by alkylation of metal halides - by oxidative addition - by nucleophilic attack on coordinated ligands - metal alkyl and 18 electron rule - reactivity of metal alkyls - M-C bond cleavage reactions - insertion of CO to M-C bonds - double carbonylation - insertions of alkenes and alkynes - insertions of metals with C-H bonds - alkylidene and alkylidyne complexes - synthesis of alkylidene complexes in low oxidation states and in high oxidation states - bonding in alkylidene complexes - synthesis and bonding in alkylidyne complexes - reactivity of alkylidene and alkylidyne complexes.

**UNIT - III**

Alkene complexes - synthesis of alkene complexes by ligand substitution - by reduction and by metal atom synthesis - bonding of alkenes to transition metals - bonding in diene complexes - reactivity of alkene complexes - ligand substitution - reactions with nucleophiles - olefin hydrogenation - hydrosilation - Wacker process - C-H activation of alkenes - alkyne complexes - bonding in alkyne complexes - reactivity of alkynes - alkyne complexes in synthesis - cobalt catalysed alkyne cycloaddition.

**UNIT - IV**

Cyclopentadienyl complexes - metallocenes - synthesis of metallocenes - bonding in metallocenes - reactions of metallocenes - Cp2Fe/Cp2Fe+ couples in biosensors - bent sandwich complexes - bonding in bent sandwich complexes - metallocene halides and hydrides - metallocene and stereospecific polymerisation of 1-alkenes - cyclopentadiene as a non-spectator ligand - monocyclopentadienyl (half-sandwich) complexes - synthesis and structures of allyl complexes - arene complexes - synthesis - structure and reactivity of arene complexes - multidecker complexes.

**UNIT - V**

Organometallic compounds in homogeneous catalytic reactions - coordinative unsaturation - acid-base behaviour reaction - migration of atoms or groups from metal to ligand - insertion reaction - reactions of coordinated ligands - catalytic reactions of alkenes - isomerisation of alkenes - hydrogenation - hydroformylation and hydrosilation of alkenes - alkene polymerisation and oligomerisation - fluxional molecules - The Nobel Prize in Chemistry 2001- Assymetric synthesis, 2005- Olefins metathesis in organic synthesis and 2010 – Palladium catalysed cross coupling reactions in organic synthesis.

**REFERENCE BOOKS**


1. Organometallics 1, complexes with transition metal-carbon -bonds, Bockmann, Oxford science publications, Oxford, 1996.
2. Organometallics 2, complexes with transition metal-carbon -bonds, Bockmann, Oxford science publications, Oxford, 1996.
3. Basic organometallic chemistry, J. Haiduc and J. J. Zuckerman, Walter de Gruyter, Brelin, 1985.
4. Inorganic Chemistry - Priciples of structure and reactivity, J. E. Huheey Harper International Edition, Harper and Rone New York, 1978.
5. Advanced Inorganic Chemistry, F. A. Cotton and G. Wilkinson, Fourth Edition.

| MAJOR | M.Sc. Chemistry | 2016-2017 |
|---|---|---|
| M16PCH08 | PHYSICAL CHEMISTRY-II | |
| Credits: 5 | | |

**UNIT – I: STATISTICAL THERMODYNAMICS**

Objectives of Statistical thermodynamics – concept of thermodynamical and mathematical probabilities – Distribution of distinguishable and non – distinguishable particles.

Maxwell –Boltzmann, Bose-Einstein and Fermi-Dirac statistics - comparisions

Partition Functions – evaluation of Translational, Vibrational, Rotational and Electronic partition Function – Thermodynamic Functions in terms of partition Function – Application of partition Function to monoatomic and diatomic gases – Statistical expression for equilibrium constant – Calculation of Equilibrium Constant from Partition Function – (isotopic exchange equilibria and dissociation of diatomic molecules) – Heat capacities of Monoatomic crystals – Einstein and Debye theory of heat capacities.

**UNIT – II: IRREVERSIBLE THERMODYNAMICS**

Postulates of Local equilibrium – Entropy production – Entropy Production in Heat flow – Entropy production in matter flow – Progogine's principle of minimum entropy production – Forces and Fluxes – Linear force – flux relation – phenomenological equation – microscopic reversibility and Onsager's reciprocity relations.

Electrokinetic phenomena – diffusion – Non – equilibrium stationary states.

**UNIT – III: CHEMICAL KINETICS – III**

Kinetics of complex reactions – reversible reactions, consecutive reactions – Parallel reactions and Chain reactions – General treatment of chain reaction – Chain length – Rice Herzfeld mechanism – explosion limits.

Study of Fast reactions: Luminescence and energy transfer process – Study of kinetics by relaxation methods-temperature and pressure jump methods - Stopped flow technique, flash photolysis and Crossed molecular beam method.

**UNIT – IV: QUANTUM CHEMISTRY – III**

Theory of chemical bonding – Born – Oppenheimer approximation – LCAO – MO approximation for hydrogen molecule ion and Hydrogen – Valence Bond theory of Hydrogen molecule – Concept of Hybridisation – sp, sp2 and sp3 hybridisation – Huckel Molecular orbital (HMO) theory for conjugated π- system – applications to simple systems – (Ethylene, butadiene and benzene) – Physical Significance of HMO coefficients – Self consistant field approximation – Hartree's and Hartree – Fock Self Consistant field theory – Slater type orbitals – Slater rules.

**UNIT – V: SPECTROSCOPY – II**

NMR spectroscopy – theory – nuclear zeeman effect- chemical shift – Spin-spin coupling – NMR of simple AX and AMX type molecules – Calculation of coupling constants -13C-NMR – a brief discussion of Fourier Transformation.

ESR Spectroscopy – Theory – hyperfine interactions – Spin densities – Mcconnel relationship – selection rules in ESR – 'g' value and coupling constants.

**TEXT BOOKS:**


1. Gurudeep raj, Advanced Physical Chemistry, Goel Publishing House, Meerut.
2. M.C. Gupta, Statistical Thermodynamics, Wiley Eastern, New Delhi, 1990.
3. R. Hasse, Thermodynamics of Irreversible Process, Addison Wesley, Reading,Mass 1969.
4. I. Progogine, Introduction to Thermodynamics of Irreversible Process, InterScience, New York, 1961.
5. J. Rajaram and J.C. Kuriakose, Kinetics and Mechanism of ChemicalTransformations, Macmillan India Ltd., 1993.
6. K.J. Laidlar, Chemical Kinetics, Harper and row, New york. 1987.
7. R.K. Prasad, Quantum Chemistry, Wiley Eastern, NewDelhi, 1992.
8. M.W. Hanna, Quantum Mechanics in Chemistry, W.A. Benjamin Inc,London 1965.
9. C.N. Banwell, Fundamentals of Molecular Spectroscopy, Mc Graw Hill, Newyork, 1966.
10. A. Carrington and A.D. McLachlan, Introduction to Magnetic Resonance,Harper and Row, New york (1967)


**REFERENCE BOOKS**


1. M. Dole, Statistical Thermodynamics, Prentice Hall, New York, 1954.
2. B.J. Mccleland, Statistical Thermodynamics, Chapman and Hall, London 1973.
3. N.O. Smith, Elementary, Statistical Thermodynamics, a Problem approach,Pleunum Press, New York, 1980.
4. R.G. Frost and Pearson, Kinetics and Mechanism, Wiley New York, 1961.
5. J.W. Moore, and R.G. Pearson, Kinetics and Mechanism, 1981.
6. C. Capellos and B.H.J. Bielski, Kinetics Systems, Wiley inter science, New York, 1972.
7. I. Amdur and C.G. Hammes, Chemical Kinetics, Principle and Selected Topics, McGraw Hill, New York, 1968.
8. G.M. Harris, Chemical Kinetics, D.C. Heath and Co, 1966.
9. A.K. Chandra, Introductory Quantum Chemistry, Tata McGraw Hill.
10. D.A. McQuarrie, Quantum Chemistry, University Science Books, Mill Valley, California (1983).

11. P.W. Atkins, Molecular Quantum Mechanics, Oxford University Press, Oxford, 1983.
12. J.N. Murrell, S.F.A. Kettle and J.M. Tedder, The Chemical Bond, Wiley.
13. Raymond chang, Basic Principle of Spectroscopy, McGraw Hill Ltd., New York (1971).
14. G.M. Barrow, Introduction to Molecular Spectroscopy, McGraw Hill, New York, 1962.
15. W. Kemp, NMR in Chemistry, Mac Millan Ltd., (1986).
16. K.P. McLauchlan, Magnetic Resonance, Oxford Chemistry series, Oxford, (1972).
17. F.A. Rushworth and D.P. Tunstall, Nuclear Magnetic Resonance, Gordon and Breach Science Publishing, New York, (1973).
18. J.K.M. Sanders and B.K. Hunther, Modern NMR Spectroscopy, A guide for chemists, Oxford University press, Oxford, (1987).

| ELECTIVE-III | M.Sc. Chemistry | 2016-2017 |
|---|---|---|
| M16PCHE09 | ELECTROCHEMISTRY, SPECTROSCOPY AND ANALYTICAL TECHNIQUES | |
| Credits: 4 | | |

**UNIT – I: ELECTROCHEMISTRY – I**

Ions in solutions – Debye – Huckel theory of strong electrolytes – Debye – Huckel – Onsager equation – verification and limitation – Debye – Huckel limiting law and its extension. Electrode – Electrolyte interface - adsorption at electrified interface – electrical double layers – Electro capillary phenomena – Lippmann capillary equation – structure of double layers – Helmholtz Perrin, Gouychapman and Stern models of electrical double layers – electro kinetic Phenomena – Tiselius method of separation of proteins – Membrane potential.

**UNIT – II: ELECTROCHEMISTRY – II**

Mechanism of electrode reactions – Polarisation and Over Potential – the Butler Volmer equation for one step and multi step electron transfer reactions – significance of equilibrium exchange current density and symmetry factor – transfer coefficient and its significance – Theory and applications of dropping mercury electrode – Polarography, Amperometry and Cyclic voltametry – Principles and applications – mechanism of Hydrogen and Oxygen evolution reactions.

**UNIT – III: ELECTROCHEMISTRY – III**

Electrochemical inorganic and organic reactions of technological interest (at least one example in each) – Corrosion and Passivation of metals – construction of Pourbaix and Evans diagrams – Prevention of Corrosion.

Electrochemical energy systems – Primary and Secondary batteries – (dry cells, lead acid - storage batteries, silver zinc cell, nickel cadmium battery, mercury cell) –Fuel cells – Electrodeposition – Principles and applications.

**UNIT – IV: EPR SPECTROSCOPY AND MOSSBAUER SPECTROSCOPY**

Theory : EPR spectra of VO (II), Mn (II), Co (II), Ni (II) and Cu (II) complexes; covalency of metal – ligand bonding by EPR; John-teller distortions in Cu(II) complexes.

Mossbauer Spectroscopy – Doppler effect; isomer effect; electron – neutron hyperfine interactions; Quadrupole interactions and magnetic interactions; simple applications to Iron and Tin compounds.

**UNIT-V: ANALYTICAL TECHNIQUES**

Chromatography – Gas liquid chromatography – Principle, retention volumes; instrumentation; carrier gas; columns preparations; stationary phase; detectors – thermal conductivity, flame ionization, electron capture; applications of GLC.

High Performance liquid chromatography – scope; column efficiency; instrumentation; pumping systems; columns; column packing; detectors; applications.

**REFERENCE BOOKS**


1. S. Glasstone, Introduction to Electro Chemistry, Affiliated East West Press, NewDelhi, 1960.
2. D.R. Craw, Principles and applications of Electro chemistry, Chapman andHall, 1991.
3. J. Robbins, Ions in solution – An Introduction to Electro chemistry, ClarendonPress, Oxford (1972).
4. D.A. Skoog and D.M. West, Fundamentals of Analytical Chemistry, Holt Rinehart and Winston Publications, IV Edn, 1982.
5. D.A. Skoog, Principles of Instrumental Analysis, Saunders College Pub. Co, III Edn., 1985.
6. R.S. Drago, Physical Methods in Chemistry, Reinhold, New York, 1968.

| ELECTIVE-III | **M.Sc. Chemistry** | **2016-2017** |
|---|---|---|
| M16PCHE10 | ADVANCED INDUSTRIAL INORGANIC COMPOUNDS | |
| Credits: 4 | | |

**Unit- I**

Ceramics – classification, optical waveguides (optical fiber), sol-gel formation for low temperature ceramic formation. Non-oxide ceramics – general aspects, silicon carbide, silicon nitride and boron nitride ceramics. Fabrication of ceramic materials and its challenges.

**Unit -II**

Carbon fibers: introduction, manufacture, applications and economic importance. SiC-coated carbon fibers. Aluminium oxide coated fibers; their manufacture and applications. Zeolites: Natural and synthetic zeolites, manufacture of synthetic zeolites from different sources, pelletization, dehydration and applications.

**Unit -III**

Inorganic pigments: white pigments: $TiO_2$ pigment, its manufacture, post-treatment and applications; ZnO white, lithopone and ZnS pigments. Coloured pigments: iron oxide pigments – manufacture, oxidation processes and applications.

**Unit -IV**

Silicon: metallurgical grade, ferrosilicon and electronic grade silicon, manufacture and applications. Silicones & poly(organo siloxanes) (POS): manufacture, linear and branched POS, high molecular weight POS; silicone oil, emulsion, rubbers and resins.

**Unit V**

General characteristics, degree of polymerization, catenation and heterocatenation, SN chain one dimensional conductor, isopoly and heteropoly acids (polyoxometallates) and their characteristics and applications (introductory level), phosphazene polymers; Metal clusters: dinuclear, trinuclear, tetranuclear and hexanuclear clusters and their synthesis and properties.

**REFERENCE BOOKS**

1. H.R. Allcock, Introduction to Materials Chemistry, Wiley, 2008.

2. S.K. Agarwala, Keemti Lal, Advanced Inorganic Chemistry, Pragati Prakashan, 10th edn., 2011.

3. A.R. West, Solid State Chemistry and its applications, Wiley, 2004.

4. M.G. Arora, M. Singh, Industrial Chemistry, Anmol Publications, Reprint 2004.

5. Harish Kumar, Industrial Chemistry, Sarup & Sons Reprint 2002.

6. J.E. Huheey, E.A. Keiter, R.L. Keiter, Inorganic Chemistry, Pearson Education Asia, Reprint 2001.

7. F.A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry, John Wiley & Sons, 5th Edn., 1988.

8. B.E. Douglas, D.H. McDaniel and J.J. Alexander, Concepts and Models of Inorganic Chemistry, John Wiley & Sons, 2 Edn. 1983.

9. I. V. Kozhevnikov, Catalysis by Heteropoly Acids and Multicomponent Polyoxometalates in Liquid-Phase Reactions, Chem. Rev. 1998, 98, 171-198.

10. D. E. Katsoulis, A Survey of Applications of Polyoxometalates, Chem. Rev. 1998, 98, 359-387.

| ELECTIVE-III | **M.Sc. Chemistry** | **2016-2017** |
|---|---|---|
| M16PCHE11 | **NUCLEAR CHEMISTRY** | |
| Credits: 4 | | |

**Unit I**

Discovery – types of decay – decay kinetics – half-life period, mean life, parentdaughter decay – growth relationship – secular and transient equilibrium; Units of radioactivity; alpha, beta and gamma decay; Theory of decay, energies and properties – artificial radioactivity. Detectors: ionization chamber, electron pulse counter, scintillation detectors.

**Unit II**

Bathe's notation – types of nuclear reactions: The compound nucleus theory – reaction cross section, transmutation reactions, elastic and inelastic scattering, spallation, fragmentation, stripping and pick-up; fission, fusion, photonuclear reactions and thermonuclear reactions.

**Unit III**

The fission energy – reproduction factor; Classification of reactors based on moderators, coolants, phase of fuel and generation. Principle of thermal nuclear reactors: The four factor formula, reactor power, critical size of a thermal reactor, excess reactivity and control. Breeder reactor India's nuclear energy programmes – reprocessing of spent fuels.

**Unit IV**

Radiation chemistry – passage of radiation through matter – units for measuring radiation absorption – radiation dosimetry – radiolysis of water – free radicals in water radiolysis – chemical dosimetry: Radiolysis of Fricke Dosimeter solution – Radiation induced colour centres in crystals – Effects of radiation with matter. Radiolysis of inorganic gases, organic gases, organic compounds, solids and polymers – Annealing of radiation damage.

**Unit V**

Application of radioisotopes: probing by isotopes, reactions involved in the preparation of radioisotopes. The Szilard-Chalmers' reaction – Radiochemical principles in the use of Tracers – Applications of radioisotopes as tracers – chemical investigations, analytical applications, agricultural and industrial applications – Neutron activation analysis – Carbon and rock dating .

**REFERENCE BOOKS**


1. S. Glasstone, Source book on atomic energy, East West press, 3rd Edn. 1967.
2. H.J. Arniker, Essentials of Nuclear Chemistry, New Age International, Reprint 2009.
3. M.G. Friedlander, J.M. Kennedy, E.S. Macian and J.M. Miller, Nuclear and Radiochemistry, 3rd Edn. John Wiley & Sons, 1981.
4. M.G. Arora and M. Singh, Nuclear Chemistry, Anmol Publications, 1994.
5. E.S.Gilreath, Fundamental concepts of Inorganic Chemistry, McGraw Hill 17th print 1982.

| ELECTIVE-III | **M.Sc. Chemistry** | **2016-2017** |
|---|---|---|
| M16PCHE12 | **CATALYSIS** | |
| Credits: 4 | | |

**Unit-I**

Catalysis phenomenon – mode of action of catalysts – classification of catalysts – Comparison of Homogeneous and Heterogeneous Catalysis. Homogeneous catalysis – general mechanisms; acid-base catalysis – catalytic activity, mechanisms and salt effects. Enzyme catalysis – influence of substrate concentration, pH, temperature, and enzyme mechanisms. Kinetics of inhibition –chain reaction, enzyme catalyzed reactions.

**Unit-II**

Catalysis in molecular-scale cavities – structure of crystalline solids – zeolites – families of zeolites; adsorption and diffusion in zeolites – catalysis by zeolites containing metal complexes and clusters; non-zeolite molecular sieves – clays and other layered materials. Catalysis – catalysts for PTC – mechanism and benefits of PTC – PTC reactions – selected industrial processes with PTC.

**Unit-III**

Micellar catalysis: effects of micelles on chemical reactions, characteristics of enzymatic reactions, micelle-catalyzed reactions, inhibition in micellar solutions; reverse micelles and microemulsions – catalysis in thermal and photochemical reactions.

**Unit-IV**

Electrocatalysis – introduction to electrocatalysis and fuel cells – industrial application of catalysis – petroleum refining – distillation, cracking, reforming, hydrotreating, Alkylation and isomerization, ethylene-based processes – ethylene oxide and ethylene glycol, polyethylene, vinyl chloride and PVC; Propylene-based processes – acrylic acid and acrylonitrile, Ziegler-Natta chemistry; C$-based processes – butadiene, isobutylene.

**Unit-V**

Surface catalysis – introduction – mechanism of surface reactions: Langmuir Hinshel wood & -Rideal mechanisms; surface structures – single crystal surface of metals, high-surface area amorphous solids; adsorption; functionalized surfaces; catalysis on functionalized surfaces: connection to molecular catalysis; catalysis on metal surfaces, metal oxide surfaces, mixed metal oxides, metal sulfides.

**REFERENCE BOOKS**

1. B. C. Gates, Catalytic Chemistry, John Wiley & Sons, Inc., 1992.

2. J. C. Kuriacose, Catalysis, Macmillan India Ltd., New Delhi, 1991.

3. M. Gratzel, K. Kalyanasundaram, Eds., Kinetics and Catalysis in Microheterogeneous Systems, Marcel Dekker, New York, 1991.

4. K. Kalyanasundaram, Photochemistry in Microheterogeneous Systems, Academic Press, Orlando, 1987.

5. K. J. Laidler, Chemical Kinetics, 3rd Edition, Pearson Education Pte., Ltd., 2005.

6. P. H. Emmett, Catalysis, Vol. I and II, Reinhold Corp., New York, 1954.

7. J. M. Smith, Chemical Engineering Kinetics, McGraw Hill, 1971.

8. J. Hagen, Industrial Catalysis: A Practical Approach, 2nd Edition, Wiley-VCH, 2006.

| MAJOR | M.Sc. Chemistry | 2016-2017 |
|---|---|---|
| M16PCH09 | ORGANIC CHEMISTRY-IV | |
| Credits: 5 | | |

**UNIT-I: PERICYCLIC REACTIONS**

Molecular orbital symmetry; frontier orbitals of ethylene, 1,3-butadiene, 1,3,5-hexatriene and allyl system; classification of pericyclic reactions. Woodward – Hoffmann correlation diagrams; FMO and transition state aromaticity approach; selection rules.

Cyclo addition reactions-(4+2), (2+2) cyclo addition -selectivity-substituent effect-inverse electron demand Diels-Alder reactions-1,3-dipolar cycloadditions of ozone, diazomethane and nitrile oxide and chelotropic reactions.

**UNIT-II: ELECTROCYCLIC REACTIONS AND SIGMATROPIC REARRANGEMENTS**

Electro cyclic reactions: conrotatory and disrotatory motions; ring opening and ring closing reactions- 4n, 4n+2 and allyl systems.

Sigmatropic rearrangements: (1,3), (1,5), (1,7), (3,3) and (5,5)-carbon migrations, degenerate sigmatropic rearrangements.

**UNIT-III**

Problems on the applications of cycloaddition , electrocyclic and sigmatropic reaction to be discussed and assigned home works.

**UNIT-IV: LAWS OF PHOTOCHEMISTRY AND PHOTOPRIMARY PROCESSES**

Interaction of Electromagnetic radiation with Matter-Types of excitations – Laws of Photochemistry – Grothus and Draper law – Lambert and Beer‟s law – Einstein law – Quantum yield – Photo primary processes ,fate of the Excited molecule – State energy diagrams – Fluorescence – Fluorescence life times – phosphorescence life times – Quenching – Sterm – Volmer equation – Inter molecular processes – Photosensitisation – Predissociation – Fluorescence and structure – Triplet state and phosphorescence emission.

**UNIT-V: PHOTOCHEMICAL REACTIONS**

Light absorption – Experimental techniques – Electronic transitions – Frank – Codon principle – Jablonski diagrams – Intersystem crossing – Energy transfer – Molecular orbital view of excitation – The Geometry of excited states – Reactivity of Electronically excited ketones –α - cleavage - γ - hydrogen transfer Norrish Type I, Type II, Type III reactions – Photoreduction – Oxetate formation – Reactivity of π, π* excited ketones – Photochemistry of α, β - unsaturated ketones – Optical pumping – Dienone phenol rearrangement.

**REFFERENCE BOOKS:**


1. Fundamentals of Photochemistry – K.K.Rohatgi – Mukherjee (Revised Edition) New age International publications, Reprint 2002.
2. Physical Chemistry – Robert A.Alberty (Sixth edition) – Wiley Eastern Limited Reprint 1987.
3. F. A. Carey and R. Sundberg, Advanced Organic Chemistry, Vol. 1 & Vol.2 and 2 (2002).
4. J. March and M Smith, Advanced Organic Chemistry, 5thed., John-Wiley and sons, 2001.
5. Principles of Organic synthesis, R.O.C. Norman, J.M. Coxon, 3rd Edition., Chapman & Hall, (1993).

| MAJOR | M.Sc. Chemistry | 2016-2017 |
|---|---|---|
| M16PCH10 | INORGANIC CHEMISTRY-III | |
| Credits: 5 | | |

**UNIT - I**

The growth and form of crystals - the crystal systems and Bravais lattices - Miller indices and labelling of planes - symmetry properties - crystallographic point groups and space groups - fundamentals of X-ray diffraction - powder and rotating crystal methods - systematic absences and determination of lattice types - analysis of X-ray data for cubic system - structure factor and Fourier synthesis - electron and neutron diffraction and structure determination.

**UNIT - II**

Types of solids - close packing of atoms and ions - bcc , fcc and hcp voids - Goldschmidt radius ratio - derivation - its influence on structures - structures of rock salt - cesium chloride - wurtzite - zinc blende - rutile - fluroite - antifluorite - diamond and graphite - spinel - normal and inverse spinels and perovskite - lattice energy of ionic crystals - Madelung constant - Born-Haber cycle and its applications.

**UNIT - III**

Metallic state - free electron and band theories - non - stochiometry - point defects in solids - Schottky and Frenkel defects - linear defects - dislocations - effects due to dislocations - electrical properties of solids - insulators - intrinsic semiconductors - impurity semiconductors (n and P type) and superconductors - elementary study of liquid crystals.

**UNIT - IV**

Nucleus: nuclear structure - stability of nuclei - packing fraction - even - odd nature of nucleons - n/p ratio - nuclear potential - binding energy and exchange forces - shell model and liquid drop model. Decay of radionuclei: rate of decay - determination of half-life period - secular equilibrium and decay series. Modes of decay: alpha, beta, gamma and orbital electron capture - nuclear isomerism - internal conversions - Q value - nuclear cross section - threshold energy and excitation functions. Particle acceleration and counting techniques: linear accelerator - cyclotron and synchrotron - betatron - G. M. counter - proportional and scintillation counters.

**UNIT - V**

Different type of nuclear reactions with natural and accelerated particles - transmutation - stripping and pick-up - spallation - fragmentation, etc. - fission - characteristics of fission reaction - product distribution and theories of fission - fissile and fertile isotopes - U235, U238, Th232 and Pu239 - atom bomb - nuclear fusion - stellar energy - synthesis of new elements - principles underlying the usage of radioisotopes in analysis - agriculture - industry and medicine - mechanism of chemical reactions - uses of radioisotopes in analytical chemistry - isotopic dilution analysis - neutron activation analysis and dating methods.

**REFERENCES**


1. W.J.Moore – Physical Chemistry
2. L.V.Azroff – Introduction to solids
3. W.E.Addision – structural principles of Inorganic Chemistry
4. N.B.Hannay – Solid state chemistry
5. R.A.Alberty – Physical chemistry
6. S.Glasstone – Source book on atomic energy
7. G.Friedlander, J.W.Kennedy, - Nuclear and Radiochemistry
8. H.J.Arnikar – Essentials of Nuclear chemistry.

| PRACTICAL – IV | M.Sc. Chemistry | 2016-2017 |
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| M16PCHP04 | ORGANIC CHEMISTRY – II | |
| Credits: 3 | | |

**PART-I**

**1. Estimations**

a) Phenol and aniline
b) Ketones (ethyl methyl ketone)
c) Sugars (Glucose)
d) Ascorbic acid (Vitamin-C tablets)
e) Amino groups (aniline)
f) Nitro groups (aromatic nitro compounds)
g) Amino acids (Glycine)

**PART-II**

A. Two stage preparations

a) p-Bromoacetanilide from Aniline
b) p-Nitroaniline from Acetanilide
c) 1,3,5-Tribromobenzene from Aniline
d) Acetyl salicyclic acid from Methyl salicylate
e) Benzilic acid from Benzoin
f) m-Nitroaniline from Nitrobenzene
g) β-Naphthol from Naphthalene

**TEXT BOOKS**


1. N.S. Gnanapragasam and G. Ramamurthy, Organic Chemistry – Lab manual, S. Viswanathan Co. Pvt. Ltd, 1998.
2. J.N. Gurtu and R. Kapoor, Advanced Experimental Chemistry, S. Chand and Co., 1987


**REFERENCE**


1. Vogel's Text book of Practical Organic Chemistry, 4thEdn, ELBS/Longman, England, 1984.

| PRACTICAL – V | **M.Sc. Chemistry** | **2016-2017** |
|---|---|---|
| M16PCHP05 | **INORGANIC CHEMISTRY – II** | |
| Credits: 3 | | |

**PART-I: Quantitative analysis**

Quantitative analysis of the following mixture

1. Iron and magnesium
2. Iron and nickel
3. Copper and nickel
4. Copper and Zinc

**PART-II**

Preparations of the following:

1. Sodium hexanitrocobaltate (III)
2. Sodium Trisoxalatoferrate (III)
3. Prussian blue Fe4[Fe(CN)6]3
4. Bis (acetylacetanato) Copper (II)
5. Hexamminecobalt (III) chloride
6. Hexamminenickel (II) chloride

**REFERENCE BOOKS:**


1. G. Svehla, Vogel's qualitative Inorganic analysis, VI Edition, Orient Longman,1987.
2. V.V. Ramanujam, Inorganic Semimicro Qualitative analysis. National PublishingCo., Chennai.1971.
3. J. Basset, R.C. Denney, G.H. Jeffery and J.Mendham Vogel's Text book of quantitative inorganic analysis, IV Edition, ELBS, 1985.
4. W.G. Palmer, Experimental Inorganic Chemistry, Van Nostrand Reinhold Co., London, 1972.
5. D.N. Grindley, An advanced course in practical Inorganic Chemistry, Butterworths, 1964.

**Experiments in Electrochemistry, Polarography and Cheimcal Kinetics.**

**EMF Measurements**

1. Determination of standard potentials (Cu and Ag)
2. Determination of thermodynamic quantities from EMF measurements
3. Potentiometric titrations.
4. Determination of pH and calculation of pKa.
5. Determination of stability constant of complex.
6. Determination of solubility product of a sparingly soluble salt, Redox titrations.
7. Precipitation titration of mixture of halides by emf measurements.

**DETAILED LIST OF EXPERIMENTS**

Typical list of possible experiments are given. Experiments of similar nature and other experiments may also be given. The list given is only a guideline. A minimum of 15 experiments have to be performed.

1. Determination of the activity coefficient of an electrolyte at different molalities by emf measurements.
2. Determination of the dissociation constant of acetic acid by titrating it with sodium hydroxide using quinhydrone as an indicator electrode and calomel as a reference electrode.
3. Determination of the strength of a given solution of KCl using differential potentiometric titration technique.
4. Determination of the pH of the given solutions with the help of the indicators using buffer solutions and by colorimetric method.
5. Determination of the pH of a given solution by emf method using hydrogen electrode and quinhydrone electrode.
6. Determination of the composition and instability constant of a complex by mole ratio method.
7. Calculation of the thermodynamic parameters for the reaction
   $Zn + H_2SO_4$ -------> $ZnSO_4 + H_2$ by emf method.
8. Determination of the formation constant of silver ammonia complex and stoichiometry of the complex potentiometrically.
9. Solubility and solubility products by emf method.
10. Determination of the activity coefficient of Zinc ions in the solution of 0.002 M Zinc sulphate using Debye - Huckel Limiting law.
11. Determination of solubility product of Silver bromide and calculate its solubility in water and 0.1 M and 0.01 M $KBrO_3$ using Debye- Huckel limiting law.

12. Determination of the electrode potentials of Zn and Ag electrodes in 0.1 M and 0.001M solutions at 298 K and find the standard potentials for these electrodes and test the validity of Nernst equations.
13. Study the inversion of cane sugar in presence of acid using polarimeter.
14. Determination of the rate constant and order of reaction between potassium persulphate and potassium iodide and determine the temperature coefficient and energy of activation of the reaction.
15. Study the primary salt effect on the kinetics of ionic reactions and test the Bronsted relationship (iodide ion is oxidized by persulphate ion.)
16. Determination of the viscosities of mixtures of different compositions of liquids and find the composition of a given mixture.
17. Determination of the partial molar volume of glycine/methanol/formic acid/ sulphuric acid by graphical method and by determining the densities of the solutions of different compositions.
18. Study the surface tension – concentration relationship of solutions (Gibb's equation)

**REFERENCE BOOKS**


1. B.P. Levitt (Ed.). Findlay's Practical Physical Chemistry, 9th Edn., Longman, London, 1985.
2. J.N. Gurtu and R.Kapoor, Advanced Experimental Chemistry, Vol I. S. Chand & Co. Ltd., New Delhi, 1980.

| PROJECT | **M.Sc. Chemistry** | **2016-2017** |
|---|---|---|
| M16PCHPR1 | **PROJECT** | |
| Credits: 4 | | |

**Objectives:**

To make the student to understand and present a research finding on a topic in the subject related to Chemistry under the guidance of a Department Staff.

**Testing:**

The student will be tested both in subject matter of the report and the mode of presentation in the viva-voce examination.

The viva-voce examination, on the project work done, will be conducted by two examiners (Project guide & an external examiner appointed by the Controller of examination)

**Project report:** 150 Marks

Standard of subject and plan
Preparation and mastery
Originality and logical development
Summary and references

**Viva-voce**: 50 Marks

Economy of time
Communication
Blackboard use and teaching aids
Language and diction
Answer to questions

| EDC | M.Sc. Chemistry | 2016-2017 |
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| M16PCHED01 | GREEN MANUFACTURING TECHNOLOGY | |
| Credits: 4 | | |

**UNIT-I**

Introduction to green chemistry: Green chemistry-relevance and goals, Anastas' twelve principles of green chemistry - Tools of green chemistry: alternative starting materials, reagents, catalysts, solvents and processes with suitable examples.

**UNIT-II**

Microwave activation – advantage of microwave exposure – specific effects of microwave – Neat reactions – solid supports reactions _ Functional group transformations – condensations reactions – oxidations – reductions reactions – multi-component reactions.

**UNIT-III**

Ionic liquids and PTC Introduction – synthesis of ionic liquids – physical properties – applications in alkylation – hydroformylations – expoxidations – synthesis of ethers – Friedel-craft reactions – Diels-Alder reactions – Knoevengal condensations – Wittig reactions – Phase transfer catalyst - Synthesis – applications.

**UNIT-IV**

Supported catalysts and bio-catalysts for Green chemistry Introduction – the concept of atom ecomomy – supported metal catalysts – mesoporous silicas – the use of Biocatalysts for green chemistry.

**UNIT-V**

Fermentations and biotransformations – fine chemicals by microbial fermentations – vitamins and amino acids – Baker's yeast mediated biotransformations – Bio-catalyst mediated Baeyer-Villiger reactions – Microbial polyester synthesis.

**REFERENCE BOOKS**


1. Green Chemistry – Environmentally benign reactions – V. K. Ahluwalia. Ane Books India (Publisher). (2006). Green Chemistry – Designing Chemistry for the Environment – edited by Paul T. Anastas & Tracy C. Williamson. Second Edition, (1998).
2. Green Chemistry – Frontiers in benign chemical synthesis and processes- edited by Paul T. Anastas & Tracy C. Williamson. Oxford University Press, (1998).
3. Green Chemistry – Environment friendly alternatives- edited by Rashmi Sanghi & M. M. Srivastava, Narora Publishing House, (2003).

| EDC | M.Sc. Chemistry | 2016-2017 |
|---|---|---|
| M16PCHED02 | NANO TECHNOLOGY IN CHEMICAL INDUSTRY | |
| Credits: 4 | | |

**UNIT – I**

Nanoscale, nanometerials –definition. Types of nanometerials – quantum wells, quantum wires, quantum dot. Different types of nano structures – nanoclusters, nanocrystals, nanowires and nanotubes, definition of nanotechnology, nanoscience and nanochemistry. Significance of the nanoscale. Factors responsible for the special properties of nanometerials. Nanotechnology and health issues - risks from nanoparticles and nanosafety. Nanotechnology and environmental issues.

**UNIT – II**

A few important methods of synthesis of nanometerials – Laser Ablation, Sonication, phase – transfer methods and sol – gel method. Application of nanotechnology – medicine diagnostics, drug delivery, food and drinks, cosmetics, textiles, sports / outdoor, filtration chemical industry, catalysis, electronic, displays.

**UNIT III**

Sol gel processing-Solvothermal, hydrothermal, precipitation, Spray pyrolysis, Electro spraying and spin coating routes, Self-assembly, self-assembled monolayers (SAMs). Langmuir-Blodgett (LB) films, micro emulsion polymerization- templated synthesis, pulsed electrochemical deposition.

**UNIT IV**

Vapor deposition and different types of epitaxial growth techniques (CVD,MOCVD, MBE,ALD)- pulsed laser deposition, Magnetron sputtering - lithography :Photo/UV/EB/FIB techniques, Dip pen nanolithography, Etching process :Dry and Wet etching, micro contact printing.

**UNIT V**

Zeolites, mesoporous materials, nanomembranes - Carbon nanotubes and graphene - Core shell and hybrid nanocomposites. Overview of nanomaterials properties and their applications, Molecular Electronics and Nanoelectronics – Nanobots- Biological Applications – Quantum Devices – Nanomechanics - Photonics- Nano structures as single electron transistor –principle and design.

**REFERENCE BOOKS**


1. Kenneth J.Klabunde, *Nanoscale materials chemistry*, A. John wiley and Sons lnc. Publications.
2. S.P. Gaponenko, Optical Properties of semiconductor nanocrystals, Cambridge University Press, 1980.
3. W.Gaddand, D.Brenner, S.Lysherski and G.J.Infrate(Eds.), Handbook of NanoScience, Engg. and Technology, CRC Press, 2002.

4. K. Barriham, D.D. Vvedensky, Low dimensional semiconductor structures: fundamental and device applications, Cambridge University Press, 2001.
5. G. Cao, Nanostructures & Nanomaterials: Synthesis, Properties &Applications , Imperial College Press, 2004.
6. J.George, Preparation of Thin Films, Marcel Dekker, Inc., New York. 2005.