NOTIFICATION

Sub: Restructuring the Curriculum of Chemistry (PG) programme.

Ref: 1. Proceedings of Faculty of Science & Technology Meeting held on 14-02-2014.

The Board of Studies in Chemistry (PG) at its meeting held on 02-12-2013 has resolved to restructuring the existing syllabus of Chemistry (PG) to be effective from the academic year 2014-15 onwards.

The Faculty of Science and Technology and the Academic Council at their meetings held on 14-02-2014 and 29-03-2014 respectively approved the above proposals and the same is hereby notified.

The copy of restructuring the existing syllabus of Chemistry (PG) is annexed herewith.

To

1. The Registrar (Evaluation), University of Mysore, Mysore.
2. The Chairperson, BOS/DOS in Chemistry, MGM.
3. The Dean, Faculty of Science & Technology, DOS in Zoology, MGM.
4. The Principals of the Affiliated Science Colleges.
5. The Deputy/Assistant Registrar (Evaluation), University of Mysore, Mysore.
7. The Supdt AC.1 & AC.2, A.B., Academic Section / PMEB, UOM., Mysore.
8. The P.A. to the Vice-Chancellor/Registrar/Registrar (Evaluation), UOM., Mysore.
9. The Case Worker, AC.7, Academic Section, University of Mysore, Mysore.
10. The Section Guard File(Supdt.AC.2), A.B., A.C., UOM.
11. The Schedule File.
GENERAL REQUIREMENTS

Scheme of Instructions
1. A Masters Degree programme is of 4 semesters-two years duration. A candidate can avail a maximum of 8 semesters – 4 years (in one stretch) to complete Masters degree (including blank semesters, if any). Whenever a candidate opts for blank semesters, he/she has to study the prevailing courses offered by the department when he/she continues his/her studies.
2. A candidate has to earn a minimum of 76 credits, for successful completion of a Master Degree. The 76 credits shall be earned by the candidate by studying Hardcore, Soft Core and Open Elective.
3. **Minimum for Pass:** In case a candidate secures less than 30% in C₁ and C₂ put together, the candidate is said to have DROPPED the course, and such a candidate is not allowed to appear for C₃.
4. In case a candidate secures less than 30% in C₃, or secures more than 30% in C₃ but less than 50% in C₁, C₂ and C₃ put together, the candidate is said to have not completed the course and he/she may either opt to DROP the course or to utilize PENDING option.
5. **Credits (Minimum) Matrix:** A candidate has to study a minimum of 20 credits in Soft Core (sum total of 4 semesters) and 04 credits in Open Elective (III Semester) for the successful completion of the Masters degree programme.
6. All other rules and regulations hold good which are governed by the University from time to time.

Definitions
1. In the Choice Based Credit System – Continuous Assessment Grading Pattern (CBCS-CAGP), programme means a course and a course means a paper.
2. Composite course means which includes both Theory and Practical.
3. HC: Hard Core; SC: Soft Core; OE: Open Elective
## GENERAL SCHEME WITH RESPECT TO ASSESSMENT OF CREDITS

<table>
<thead>
<tr>
<th>Semester</th>
<th>Hard Core</th>
<th>Soft Core</th>
<th>Open Elective</th>
</tr>
</thead>
<tbody>
<tr>
<td>I Semester</td>
<td>2 + 0 + 2 = 4</td>
<td>A 2 + 0 + 2 = 4&lt;sup&gt;a&lt;/sup&gt;</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>2 + 0 + 2 = 4</td>
<td>I 2 + 0 + 0 = 2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2 + 0 + 2 = 4</td>
<td>O 2 + 0 + 0 = 2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3 + 0 + 0 = 3</td>
<td>P 2 + 0 + 0 = 2</td>
<td></td>
</tr>
<tr>
<td>II Semester</td>
<td>2 + 0 + 2 = 4</td>
<td>A 2 + 0 + 2 = 4&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3 + 1 + 0 = 4&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>2 + 0 + 2 = 4</td>
<td>I 2 + 0 + 0 = 2</td>
<td>(General Chemistry)</td>
</tr>
<tr>
<td></td>
<td>2 + 0 + 2 = 4</td>
<td>O 2 + 0 + 0 = 2</td>
<td>3 + 1 + 0 = 4&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>3 + 0 + 0 = 3</td>
<td>P 2 + 0 + 0 = 2</td>
<td>(Chemistry)</td>
</tr>
<tr>
<td>III Semester</td>
<td>3 + 0 + 0 = 3</td>
<td>A&lt;sup&gt;c&lt;/sup&gt; 2 + 0 + 2 = 4&lt;sup&gt;a&lt;/sup&gt;; 2 + 0 + 0 = 2</td>
<td>3 + 1 + 0 = 4&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>3 + 0 + 0 = 3</td>
<td>T&lt;sup&gt;c&lt;/sup&gt; 2 + 0 + 2 = 4&lt;sup&gt;d&lt;/sup&gt;; 2 + 0 + 0 = 2&lt;sup&gt;d&lt;/sup&gt;</td>
<td>(General Chemistry)</td>
</tr>
<tr>
<td></td>
<td>3 + 0 + 0 = 3</td>
<td>O&lt;sup&gt;c&lt;/sup&gt; 2 + 0 + 2 = 4&lt;sup&gt;d&lt;/sup&gt;; 2 + 0 + 0 = 2&lt;sup&gt;d&lt;/sup&gt;</td>
<td>3 + 1 + 0 = 4&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>--</td>
<td>P&lt;sup&gt;c&lt;/sup&gt; 2 + 0 + 2 = 4&lt;sup&gt;d&lt;/sup&gt;; 2 + 0 + 0 = 2&lt;sup&gt;d&lt;/sup&gt;</td>
<td>(Chemistry)</td>
</tr>
<tr>
<td>IV Semester</td>
<td>3 + 0 + 0 = 3</td>
<td>A&lt;sup&gt;c&lt;/sup&gt; 2 + 0 + 2 = 4&lt;sup&gt;a&lt;/sup&gt;; 2 + 0 + 0 = 2</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>3 + 0 + 0 = 3</td>
<td>T&lt;sup&gt;c&lt;/sup&gt; 2 + 0 + 2 = 4&lt;sup&gt;d&lt;/sup&gt;; 2 + 0 + 0 = 2&lt;sup&gt;d&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3 + 0 + 0 = 3</td>
<td>O&lt;sup&gt;c&lt;/sup&gt; 2 + 0 + 2 = 4&lt;sup&gt;d&lt;/sup&gt;; 2 + 0 + 0 = 2&lt;sup&gt;d&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4 + 0 + 0 = 4</td>
<td>P&lt;sup&gt;c&lt;/sup&gt; 2 + 0 + 2 = 4&lt;sup&gt;d&lt;/sup&gt;; 2 + 0 + 0 = 2&lt;sup&gt;d&lt;/sup&gt;</td>
<td></td>
</tr>
</tbody>
</table>

### Total Credits

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>I Semester</td>
<td>52</td>
<td>20 (46)</td>
<td>04 (08)</td>
</tr>
</tbody>
</table>

**Note:**

A – Analytical; I – Inorganic; O – Organic; P – Physical; G - General Chemistry; Diss. – Dissertation/Project work

e.g., X + Y + Z: Theory + Tutorial + Practical

<sup>a</sup> All students have to opt composite paper (Theory + Practical) in Soft Core compulsorily in both I and II Semesters

<sup>b</sup> Courses are common for both II and III Semesters and it is only for non-chemistry students

<sup>c</sup> Among the strength in class, each 25% is allowed to opt one composite paper (Theory + Practical) in both III and IV Semesters since it is very difficult to accommodate all the students in any one branch

<sup>d</sup> Courses are common for both III and IV Semesters
## SCHEME OF STUDY AND EXAMINATION
### FIRST SEMESTER

### HARD CORE

<table>
<thead>
<tr>
<th>Courses</th>
<th>Title</th>
<th>Contact Hours/week</th>
<th>Credit</th>
<th>Max. Marks</th>
<th>Internal Assessment Marks</th>
<th>Semester End Exams (C₃)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHI HCT: 1.1.</td>
<td>Concepts and Models of Inorganic Chemistry + Inorganic Chemistry</td>
<td>02+04</td>
<td>04</td>
<td>100</td>
<td>15 15</td>
<td>03 70</td>
</tr>
<tr>
<td>CHO HCT: 1.2.</td>
<td>Reaction Mechanism + Organic Chemistry</td>
<td>02+04</td>
<td>04</td>
<td>100</td>
<td>15 15</td>
<td>03 70</td>
</tr>
<tr>
<td>CHP HCT: 1.3.</td>
<td>Physical Chemistry-I + Physical Chemistry</td>
<td>02+04</td>
<td>04</td>
<td>100</td>
<td>15 15</td>
<td>03 70</td>
</tr>
<tr>
<td>CHG HCT: 1.4.</td>
<td>Symmetry, Group Theory and Chemical Spectroscopy</td>
<td>03 03</td>
<td>100</td>
<td>15 15</td>
<td>03 70</td>
<td></td>
</tr>
</tbody>
</table>

**Note:** For all Composite Courses, Theory will be evaluated for 100 marks and Practical for 100 marks separately and the average will be taken for the result declaration.

### SOFT CORE

<table>
<thead>
<tr>
<th>Courses</th>
<th>Title</th>
<th>Contact Hours/week</th>
<th>Credit</th>
<th>Max. Marks</th>
<th>Internal Assessment Marks</th>
<th>Semester End Exams (C₃)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHA SCT: 1.51.</td>
<td>Fundamentals of Chemical Analysis + Analytical Chemistry Practicals-I</td>
<td>02+04</td>
<td>04</td>
<td>100</td>
<td>15 15</td>
<td>03 70</td>
</tr>
<tr>
<td>CHI SCT: 1.52.</td>
<td>Chemistry of Selected Elements</td>
<td>02 02</td>
<td>100</td>
<td>15 15</td>
<td>03 70</td>
<td></td>
</tr>
<tr>
<td>CHO SCT: 1.53.</td>
<td>Vitamins and Medicinal Chemistry</td>
<td>02 02</td>
<td>100</td>
<td>15 15</td>
<td>03 70</td>
<td></td>
</tr>
<tr>
<td>CHP SCT: 1.54.</td>
<td>Biophysical Chemistry and Pharmacokinetics</td>
<td>02 02</td>
<td>100</td>
<td>15 15</td>
<td>03 70</td>
<td></td>
</tr>
</tbody>
</table>
## SECOND SEMESTER
### HARD CORE

<table>
<thead>
<tr>
<th>Courses</th>
<th>Title</th>
<th>Contact Hours/week</th>
<th>Credit</th>
<th>Max. Marks</th>
<th>Internal Assessment Marks</th>
<th>Semester End Exams (C₃)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHI HCT: 2.1.</td>
<td>Coordination Chemistry + Inorganic Chemistry Practicals-II</td>
<td>02+04</td>
<td>04</td>
<td>100</td>
<td>15 15</td>
<td>03 70</td>
</tr>
<tr>
<td>CHO HCT: 2.2.</td>
<td>Stereochemistry and Heterocyclic Chemistry + Organic Chemistry Practicals-II</td>
<td>02+04</td>
<td>04</td>
<td>100</td>
<td>15 15</td>
<td>03 70</td>
</tr>
<tr>
<td>CHP HCT: 2.3.</td>
<td>Physical Chemistry-II + Physical Chemistry Practicals-II</td>
<td>02+04</td>
<td>04</td>
<td>100</td>
<td>15 15</td>
<td>03 70</td>
</tr>
<tr>
<td>CHG HCT: 2.4.</td>
<td>Molecular Spectroscopy-II</td>
<td>03 03</td>
<td>100</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

### SOFT CORE

<table>
<thead>
<tr>
<th>Courses</th>
<th>Title</th>
<th>Contact Hours/week</th>
<th>Credit</th>
<th>Max. Marks</th>
<th>Internal Assessment Marks</th>
<th>Semester End Exams (C₃)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHA SCT: 2.51.</td>
<td>Separation Techniques + Analytical Chemistry Practicals-II</td>
<td>02+04</td>
<td>04</td>
<td>100</td>
<td>15 15</td>
<td>03 70</td>
</tr>
<tr>
<td>CHI SCT: 2.52.</td>
<td>Industrial Inorganic Chemistry</td>
<td>02 02</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHO SCT: 2.53.</td>
<td>Dyes and Insecticides Nanomaterials, Semiconductors and Superconductors</td>
<td>02 02</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHP SCT: 2.54.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### OPEN ELECTIVE (for Non-Chemistry Students only)

<table>
<thead>
<tr>
<th>Courses</th>
<th>Title</th>
<th>Contact Hours/week</th>
<th>Credit</th>
<th>Max. Marks</th>
<th>Internal Assessment Marks</th>
<th>Semester End Exams (C₃)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CH OET: 2.1/3.1.</td>
<td>Chemistry</td>
<td>04 04</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CH OET: 2.2/3.2.</td>
<td>General Chemistry</td>
<td>04 04</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note:** Each course will have three units and one tutorial class/week
## THIRD SEMESTER
### HARD CORE

<table>
<thead>
<tr>
<th>Courses</th>
<th>Title</th>
<th>Contact Hours/week</th>
<th>Credit</th>
<th>Max. Marks</th>
<th>Internal Assessment Marks</th>
<th>Semester End Exams (C₃)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHI HCT: 3.1</td>
<td>Advanced Inorganic Chemistry</td>
<td>03</td>
<td>03</td>
<td>100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHO HCT: 3.2</td>
<td>Reagents in Organic Synthesis</td>
<td>03</td>
<td>03</td>
<td>100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHP HCT: 3.3</td>
<td>Physical Chemistry-III</td>
<td>03</td>
<td>03</td>
<td>100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### SOFT CORE

<table>
<thead>
<tr>
<th>Courses</th>
<th>Title</th>
<th>Contact Hours/week</th>
<th>Credit</th>
<th>Max. Marks</th>
<th>Internal Assessment Marks</th>
<th>Semester End Exams (C₃)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHA SCT: 3.41</td>
<td>Applied Analysis I + Analytical Chemistry Practicals-III</td>
<td>02+04</td>
<td>04</td>
<td>100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHI SCT: 3.42</td>
<td>Frontiers in Inorganic Chemistry + Inorganic Chemistry Practicals- II Carbohydrates, Proteins and Nucleic Acids + Organic Chemistry Practicals-III</td>
<td>02+04</td>
<td>04</td>
<td>100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHO SCT: 3.43</td>
<td></td>
<td>02+04</td>
<td>04</td>
<td>100</td>
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<td></td>
</tr>
<tr>
<td>CHP SCT: 3.44</td>
<td>Applications of Electrochemistry and Corrosion + Physical Chemistry Practicals-III</td>
<td>02+04</td>
<td>04</td>
<td>100</td>
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<td></td>
</tr>
</tbody>
</table>

### NON-COMPOSITE

<table>
<thead>
<tr>
<th>Courses</th>
<th>Title</th>
<th>Contact Hours/week</th>
<th>Credit</th>
<th>Max. Marks</th>
<th>Internal Assessment Marks</th>
<th>Semester End Exams (C₃)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHI SCT: 3.42</td>
<td>Bioinorganic Photochemistry</td>
<td>02</td>
<td>02</td>
<td>100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHO SCT: 3.52</td>
<td>Lipids, Porphyrins, Anthocyanins and Flavonoids</td>
<td>02</td>
<td>02</td>
<td>100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHP SCT: 3.53</td>
<td>Applications of X-ray crystallography and Quantum Chemistry</td>
<td>02</td>
<td>02</td>
<td>100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### OPEN ELECTIVE

All the courses are same as that described in II Semester
# FOURTH SEMESTER
## HARD CORE

### THEORY

<table>
<thead>
<tr>
<th>Courses</th>
<th>Title</th>
<th>Contact Hours/week</th>
<th>Credit</th>
<th>Max. Marks</th>
<th>Internal Assessment Marks</th>
<th>Semester End Exams (C₃)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHI HCT: 4.1.</td>
<td>Bioinorganic Chemistry</td>
<td>03</td>
<td>03</td>
<td>100</td>
<td>15 15</td>
<td>03 70</td>
</tr>
<tr>
<td>CHO HCT: 4.2.</td>
<td>Photochemistry, Pericyclic Reactions and Organometallic Chemistry</td>
<td>03</td>
<td>03</td>
<td>100</td>
<td>15 15</td>
<td>03 70</td>
</tr>
<tr>
<td>CHP HCT: 4.3.</td>
<td>Physical Chemistry-IV</td>
<td>03</td>
<td>03</td>
<td>100</td>
<td>15 15</td>
<td>03 70</td>
</tr>
</tbody>
</table>

### SOFT CORE

All the courses are same as that described in III Semester

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## SCHEME OF EXAMINATION FOR C₁, C₂ AND C₃ COMPONENTS

### Preamble

In view of the CBCS syllabus, following is the model distribution of marks for C₁, C₂ and C₃ Components. At a glance, the model includes both HC/SC/OE as well as Composite and Non-composite courses’ assessment of marks.

The following is the scheme which will be followed for the assessment of marks for HC/SC/OE as well as Composite and Non-composite courses irrespective of the credits associated with each course. 30% of the marks will be assessed for the internals (C₁ and C₂) and remaining 70% will be for the Semester End Examinations (C₃). Each course carries 100 marks and hence 30 marks will be allotted to internals and remaining 70 marks will be for Semester End Examinations. Out of 30 marks for internals, 15 marks will be allotted to each C₁ and C₂ components. The distribution of marks for C₁ and C₂ varies with HC and SC courses.

Each course (HC/SC/OE) consists of three components namely C₁, C₂ and C₃. C₁ and C₂ are designated as Internal Assessment (IA) and C₃ as Semester End Examination. Each course (HC/SC/OE) carries **100 Marks** and hence the allotment of marks to C₁, C₂ and C₃ Components will be 15, 15 and 70 marks respectively. i.e.,
<table>
<thead>
<tr>
<th>Component</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>C₁ Component</td>
<td>15 Marks</td>
</tr>
<tr>
<td>C₂ Component</td>
<td>15 Marks</td>
</tr>
<tr>
<td>C₃ Component</td>
<td>70 Marks</td>
</tr>
</tbody>
</table>

**Internal Assessment Marks**

<table>
<thead>
<tr>
<th>Internal Test</th>
<th>Reduced to 10 Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>30 Marks (10+10+10)</td>
<td></td>
</tr>
</tbody>
</table>

**Semester End Examination**

| Total | 100 Marks |

The above will be followed in common for all the HC/SC (Composite/Non-composite)/OE courses in all the four semesters.

### 1. HARD CORE (03 CREDIT COURSES)/ OPEN ELECTIVE (04 CREDIT COURSES)

#### 1.1. Distribution of Marks for C₁ and C₂ Components:

IA consists of 15 marks; it will be divided into three parts *viz.*, **Internal Test**, **Home Assignment and Seminar**. Internal tests will be conducted during the 8th week of the semester for C₁ and 16th week of the semester for C₂. Home Assignment will be concerned for C₁ Component and Seminar for C₂ Component only. Hence, a teacher may give only one assignment (or in their personal interest one more may be given). Since each course has three units, the marks shall be divided equally. Allotment of marks for C₁ and C₂ is as follows: Out of 15 Marks for IA for C₁, Internal test will be conducted for 30 Marks (10 Marks from each unit and reduced to 10 Marks) and Home Assignment will be given for 05 Marks (Each Home Assignment from every unit will be assessed for 05 Marks and finally reduced to 05 Marks). IA for C₂ will be distributed as follows: Internal test will be conducted for 30 Marks (10 Marks from each unit and reduced to 10 Marks) and Seminar will be assigned for 05 Marks for the favor of IA. Please note that actual Seminar will be assessed for 20 Marks and finally 05 Marks will be distributed to each theory HC course. i.e.,

<table>
<thead>
<tr>
<th>C₁</th>
<th>C₂</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Internal Test</strong></td>
<td><strong>Internal Test</strong></td>
</tr>
<tr>
<td>: 30 Marks (10+10+10)</td>
<td>: 30 Marks (10+10+10)</td>
</tr>
<tr>
<td>Reduced to 10 Marks</td>
<td>Reduced to 10 Marks</td>
</tr>
<tr>
<td><strong>Home Assignment</strong></td>
<td><strong>Seminar</strong></td>
</tr>
<tr>
<td>: 15 Marks (05+05+05)</td>
<td>: 20 Marks (05+05+05+05)</td>
</tr>
<tr>
<td>Reduced to 05 Marks</td>
<td>Distributed 05 Marks to each HC course</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>Total</strong></td>
</tr>
<tr>
<td>: 15 Marks</td>
<td>: 15 Marks</td>
</tr>
</tbody>
</table>
1.2. Distribution of Marks for C3 Component (Semester End Examination)

The question paper is of 3 hr duration with Max. Marks 70. The following question paper pattern will be followed for all the theory courses (HC/SC/OE). Question paper will have FIVE main questions. All the questions will cover all the units of the course with equal marks distribution. Q. No. 1 is of Medium/Short Answer Type questions which will have nine questions and each question carries two marks. A student has to answer any seven questions. Q. No. 2 to 5 carries 14 marks each and a student has to answer all the four questions (No Choice). Each main question will have three sub-sections a, b, c. An examiner may set the questions like (4+4+6) or (5+5+4) or as his/her wish. However, sub-section ‘c’ will have an internal choice. i.e.,

Model Question Paper Pattern

Max. Duration: 3 Hr

Max. Marks: 70

Note: Answer all the questions. Each question carries 14 marks.

1. Nine Medium/Short Answer Type Questions and any seven should be answered. Each question carries TWO marks. [7 x 2 = 14]

2. to 5. All the four questions have to be answered (No Choice). Each question carries FOURTEEN marks. An examiner may set the questions like (4+4+6) or (5+5+4) or as his/her wish. However, sub-section c will have an internal choice. (Two marks questions shall be avoided for 2 to 5) [4 x 14 = 56]

a. b. c. or c.

2. HARD CORE/ SOFT CORE (04 CREDIT COURSES)

Those course which have 04 credits under HC or SC are called by ‘Composite Course’ which means that a course which contains both Theory as well as Practical components. However, evaluation will be done on the following basis. Both Theory and
Practical will be assessed for 100 marks separately (which includes $C_1+C_2+C_3$) and an average from these two will be taken for the result declaration. The assessment pattern discussed above in 1 holds good here also. For the Practical assessment please refer ‘4. Practicals’ below.

3. SOFT CORE (02 CREDIT COURSES)

3.1. Distribution of Marks for $C_1$ and $C_2$ Components

IA consists of 25 marks; it will be divided into two parts viz., *Internal Test and Home Assignment*. Internal tests will be conducted during the $8^{th}$ week of the semester for $C_1$ and $16^{th}$ week of the semester for $C_2$. As far as Home Assignment is concerned, the concerned teacher will assign one or two Home Assignments to each student. Since each course has two units, the marks will be divided equally. Allotment of marks for $C_1$ and $C_2$ is as follows: Out of 15 Marks for IA, Internal tests will be conducted for 20 marks and reduced to 10 marks, whereas Home Assignment is for 05 Marks. i.e.,

<table>
<thead>
<tr>
<th></th>
<th>$C_1$</th>
<th>$C_2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal Test</td>
<td>Internal Test: 20 Marks (10+10)</td>
<td>Internal Test: 20 Marks (10+10)</td>
</tr>
<tr>
<td></td>
<td>Reduced to 10</td>
<td>Reduced to 10</td>
</tr>
<tr>
<td>Home Assignment</td>
<td>Home Assignment: 10 Marks (05+05)</td>
<td>Home Assignment: 10 Marks (05+05)</td>
</tr>
<tr>
<td></td>
<td>Reduced to 05</td>
<td>Reduced to 05</td>
</tr>
<tr>
<td>Total</td>
<td>: 15 Marks</td>
<td>: 15 Marks</td>
</tr>
</tbody>
</table>

3.2. Distribution of Marks for $C_3$ Component (Semester End Examination)

The above discussed pattern (1.2) holds good in this case also.

4. PRACTICALS

The following scheme will be applicable for both HC and SC in all the four semesters (SC for chemistry students only).

Each practical (HC/SC) consists of three components namely $C_1$, $C_2$ and $C_3$. $C_1$ and $C_2$ are designated as Internal Assessment (IA) and $C_3$ as Semester End Examination. Each practical (HC/SC) carries **100 Marks** and hence the allotment of marks to $C_1$, $C_2$ and $C_3$ Components will be 15, 15 and 70 marks respectively. i.e.,

<table>
<thead>
<tr>
<th>$C_1$ Component</th>
<th>: 15 Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>$C_2$ Component</td>
<td>: 15 Marks</td>
</tr>
</tbody>
</table>

\} Internal Assessment Marks
4.1. Distribution of Marks for C₁ and C₂ Components

IA consists of **15 Marks**; it will be divided into three parts *viz.*, **Internal Test**, **Continuous Assessment and Record**. Continuous assessment refers to the daily assessment of each student based on his/her attendance, skill, results obtained etc. Thus, 05 marks are allotted for Continuous Assessment. Internal tests will be conducted for 05 Marks during the 8th week of the semester for C₁ and 16th week of the semester for C₂. Finally, remaining 05 Marks will be for the record. i.e.,

<table>
<thead>
<tr>
<th></th>
<th>C₁</th>
<th>C₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>IA</td>
<td>15 Mark</td>
<td>15 Mark</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Internal Test</td>
<td>05 Marks</td>
</tr>
<tr>
<td></td>
<td>Continuous Assessment: 05 Marks</td>
<td>Continuous Assessment</td>
</tr>
<tr>
<td></td>
<td>Record: 05 Marks</td>
<td>Record: 05 Marks</td>
</tr>
<tr>
<td></td>
<td>Total: 15 Marks</td>
<td>Total: 15 Marks</td>
</tr>
</tbody>
</table>

4.2. Distribution of Marks for C₃ Component (Semester End Examination)

The end examination will be conducted for **70 Marks/course** with a maximum duration of 6 hours. Two experiments will be given to each student which carries 30 Marks each. Each student will be subjected to Viva-Voce Examination for which 10 Marks is allotted. i.e.,

<p>| | |</p>
<table>
<thead>
<tr>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Two Experiments</td>
<td>30+30 Marks</td>
</tr>
<tr>
<td>Viva-Voce</td>
<td>10 Marks</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>70 Marks</strong></td>
</tr>
</tbody>
</table>

5. DISSERTATION/ PROJECT WORK (04 CREDIT COURSE)

Each student is expected to undergo Dissertation/ Project Work under the guidance of the faculty of the department during the IV Semester.

5.1. Distribution of Marks for C₁ and C₂ Components
IA consists of 15 Marks; it will be divided into three parts viz., Attendance, Continuous Assessment and Work Progress. Continuous assessment refers to the daily assessment of each student based on his or her skill, results obtained, literature survey etc. C₁ will be assessed during the 8th week of the semester and C₂ during the 16th week of the semester. Hence, the concerned guide will prepare the marks list based on the above said parameters for both C₁ and C₂ Components.

5.2. Distribution of Marks for C₃ Component (Semester End Examination)

The end examination will be conducted for 70 Marks. Every student is suppose to prepare a hard copy of the findings of the work in the form of dissertation and submitted for evaluation. This part will be assessed for 50 Marks. Each student will be subjected to Viva-Voce Examination for which 20 Marks is allotted. i.e.,

<table>
<thead>
<tr>
<th>Evaluation of Dissertation</th>
<th>: 50 Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viva-Voce</td>
<td>: 20 Marks</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>: 70 Marks</td>
</tr>
</tbody>
</table>
FIRST SEMESTER

CHI HCT: 1.1. CONCEPTS AND MODELS OF INORGANIC CHEMISTRY

UNIT – I

[16 HOURS]

Chemical Periodicity: Review of periodic properties

Structures and energetics of ionic crystals: Introduction, MX (NaCl, CsCl, ZnS) and MX₂ (fluorite, rutile, β-crystobalite and cadmium iodide) types. The perovskite and spinel structures. Thermodynamics of ionic crystal formation. Lattice energy, Born-Haber cycle, Born-Lande equation. Applications of lattice energetics. Radius ratio rules

Structures and energetics of inorganic molecules: Introduction, Energetics of hybridization. VSEPR model for explaining structure of AB, AB₂E, AB₃E, AB₂E₂, ABE₃, AB₂E₃, AB₄E₂, AB₅E and AB₆ molecules. M.O. treatment of homonuclear and heteronuclear diatomic molecules. M.O. treatment involving delocalized π-bonding (CO₃²⁻, NO₃⁻, NO₂⁻, CO₂ and N₃⁻), M.O. correlation diagrams (Walsh) for triatomic molecules

UNIT – II

[16 HOURS]

Modern concept of acids and bases: Lux-Flood and Usanovich concepts, solvent system and leveling effect. Hard-Soft Acids and Bases, Classification and Theoretical backgrounds.

Non-aqueous solvents: Classification of solvents, Properties of solvents (dielectric constant, donor and acceptor properties) protic solvents (anhydrous H₂SO₄ and HF) aprotic solvents (liquid SO₂, BrF₃ and N₂O₄). Solutions of metals in liquid ammonia, hydrated electron. Super acids.

Inner transition elements: Spectral and magnetic properties, redox chemistry.

Applications: Lanthanides as shift reagents, high temperature super conductors. Chemistry of trans-uranium elements.

References


INORGANIC CHEMISTRY PRACTICALS – I

[64 HOURS]

1. Determination of iron in haematite using cerium(IV) solution (0.02M) as the titrant, and gravimetric estimation of insoluble residue.
2. Estimation of calcium and magnesium carbonates in dolomite using EDTA titration, and gravimetric analysis of insoluble residue.
3. Determination of manganese dioxide in pyrolusite using permanganate titration.
4. Quantitative analysis of copper-nickel in alloy/mixture:
   i. Copper volumetrically using KIO₃.
   ii. Nickel gravimetrically using DMG
5. Determination of lead and tin in a mixture: Analysis of solder using EDTA titration.
6. Quantitative analysis of chloride and iodide in a mixture:
   i. Iodide volumetrically using KIO₃
   ii. Total halide gravimetrically
7. Gravimetric analysis of molybdenum with 8-hydroxyquinoline.
8. Quantitative analysis of copper(II) and iron(II) in a mixture:
   i. Copper gravimetrically as CuSCN and
   ii. Iron volumetrically using cerium(IV) solution
9. Spectrophotometric determinations of:
   a. Titanium using hydrogen peroxide
   b. Chromium using diphenyl carbazide in industrial effluents
   c. Iron using thiocyanate/1,10-phenanthroline method in commercial samples
   d. Nickel using dimethylglyoxime in steel solution
10. Micro-titrimetric estimation of:
    a) Iron using cerium(IV)
    b) Calcium and magnesium using EDTA
11. Quantitative estimation of copper(II), calcium(II) and chloride in a mixture.
12. Circular paper chromatographic separation of: (Demonstration)
    a. Iron and nickel
    b. Copper and nickel
References

4. Vogel’s Qualitative Inorganic Analysis – Svelha.
5. Macro and Semimicro Inorganic Qualitative Analysis by A.I. Vogel.

CHO HCT: 1.2. REACTION MECHANISM

UNIT – I

[16 HOURS]

Basics of organic reactions: Meaning and importance of reaction mechanism, classification and examples for each class.

Bonding in organic systems: Theories of bonding-molecular orbital approaches. Huckel molecular orbital theory and its application to simple $\pi$-systems: ethylene, allyl, cyclopropyl, butadienyl, cyclopentadienyl, pentadienyl, hexatrienyl, cyclohexatrienyl, heptatrienyl, cycloheptatrienyl systems. Calculation of the total $\pi$-energy, and M.O. coefficients of the systems.

Aromaticity: Concept of aromaticity, Huckel’s rule, Polygon rule, annulenes, heteroannulenes and polycyclic systems.

Structure and reactivity: Brief discussion on effects of hydrogen bonding, resonance, inductive and hyperconjugation on strengths of acids and bases.

Methods of determining organic reaction mechanism: Thermodynamic and kinetic requirements for reactions, kinetic and thermodynamic control. Identification of products. Formation, structure, stability, detection and reactions of carbocations (classical and non-classical), carbanions, free radicals, carbenes, nitrenes, arynes and ylides (Sulphur, nitrogen and phosphorous). Determination of reaction intermediates, isotope labeling and effects of cross over experiments. Kinetic and stereochemical evidence, solvent effect

UNIT – II

[16 HOURS]

Substitution reactions – Kinetics, mechanism and stereochemical factor affecting the rate of $S_{N1}$, $S_{N2}$, $S_{RN1}$, $S_{i}$, $S_{1}$, $S_{2}$, $S_{N1}$, $S_{N2}$, $S_{N1}$ and SRN$^{1}$ reactions, Neighbouring group participation.

Electrophilic substitution reactions – Kinetics, mechanism and stereochemical factor affecting the rate of $S_{E1}$ & $S_{E2}$
Aromatic electrophilic substitution reactions: Mechanism of nitration, halogenation, sulphonation, Friedel-Crafts alkylation and acylation, Mannich reaction, chloromethylation, Vilsmeier Haack reaction, Diazonium coupling, Gattermann–Koch reaction, Mercuration reaction.

Aromatic nucleophilic substitution reactions: $S_N^1$, $S_N^2$ and benzyn mechanism, Bucherer reaction, von Richter reaction.

Mechanism of Addition reactions: Addition to C-C multiple bonds involving electrophiles, nucleophiles. Markownikoff’s rule and anti-Markownikoff’s rule.

Additions to carbonyl compounds: Addition of water, alcohol, bisulphate, HCN and amino compounds. Hydrolysis of esters.

Elimination reactions: Mechanism and stereochemistry of eliminations - E1, E2, E1cB. cis elimination, Hofmann and Saytzeff eliminations, competition between elimination and substitution, decarboxylation reactions. Chugaev reaction.

References

ORGANIC CHEMISTRY PRACTICALS – I

[64 HOURS]

Qualitative analysis: Separation of binary mixtures, identification of functional groups and preparation of suitable solid derivatives.

References
3. An Introduction to Practical Organic Chemistry - Robert, Wingrove etc.
6. Semimicro Qualitative Organic Analysis by Cheronis, Entrikin and Hodnet.

**CHP HCT: 1.3. PHYSICAL CHEMISTRY – I**

**UNIT – I**

**[16 HOURS]**


**Partial molar properties:** Partial molar volumes and their determination by intercept method and from density measurements. Chemical potential and its significance. Variation of chemical potential with temperature and pressure. Formulation of the Gibbs - Duhem equation. Derivation of Duhem-Margules equation.

**Fugacity:** Concept of fugacity, Determination of fugacity of gases. Variation of fugacity with temperature and pressure. Activity and activity coefficients. Variation of activity with temperature and pressure. Determination of activity co-efficients by vapour pressure, depression in freezing point, solubility measurements by electrical methods.

**Thermodynamics of dilute solutions:** Raoult’s law, Henry’s law. Ideal and non-ideal solutions.

**UNIT – II**

**[16 HOURS]**

**Chemical Kinetics:** Determination of order of reactions, complex reactions - parallel, consecutive and reversible reactions. Chain reactions - Branched chain reactions- general rate expression, explosion limits.

**Theories of reaction rates:** Collision theory and its limitations, Activated complex theory (postulates -derivation) and its applications to reactions in solution. Energy of activation, other activation parameters - determinations and their significance. Lindemann theory of unimolecular reactions. Qualitative account of its modifications (no derivation).

**Potential energy surfaces:** Features and construction, theoretical calculations of $E_a$.

**Reactions in solution:** Ionic reactions - salt and solvent effects. Effect of pressure on the rates of reactions. Cage effect with an example. Oscillatory reactions.

**Fast reactions:** Study of fast reactions by continuous and stopped flow techniques, relaxation methods (T-jump and P-jump methods), flash photolysis, pulse and shock tube methods.

**Reference**
3. Elements of Physical Chemistry by Lewis and Glasstone.
11. Chemical Kinetics by Benson.

**PHYSICAL CHEMISTRY PRACTICALS – I**

[64 HOURS]

1. Study of kinetics of hydrolysis of an ester using HCl/H₂SO₄ at two different temperatures, determination of rate constants and energy of activation.
2. Study of kinetics of reaction between K₂S₂O₈ and KI, first order, determination of rate constants at two different temperatures and $E_a$.
3. To study the kinetics of saponification of ethyl acetate by conductivity method, determination of rate constant.
4. Conductometric titration of a mixture of HCl and CH₃COOH against NaOH.
5. Conductometric titration of sodium sulphate against barium chloride.
6. Determination of equivalent conductance at infinite dilution of a strong electrolytes and verification of Onsager equation.
7. Potentiometric titration of KI vs KMnO₄ solution.
8. Determination of dissociation constant of a weak acid by potentiometric method.
9. Potentiometric titration of AgNO₃ vs KCl.
10. To obtain the absorption spectra of coloured complexes, verification of Beer’s law and estimation of metal ions in solution using a spectrophotometer.
11. Spectrophotometric titration of FeSO₄ against KMnO₄.
13. Kinetics of photodegradation of indigocarmine (IC) using ZnO/TiO₂ as photocatalyst and study the effect of [ZnO/TiO₂] and [IC] on the rate of photodegradation.
14. Determination of the molecular weight of a polymer material by viscosity measurements (cellulose acetate/methyl acrylate).
15. Analysis of a binary mixture (Glycerol & Water) by measurement of refractive index.

Reference
2. Experimental Physical Chemistry – F. Daniels et al.

CHG HCT: 1.4. SYMMETRY, GROUP THEORY AND CHEMICAL SPECTROSCOPY

UNIT – I

[16 HOURS]

Molecular symmetry and group theory: Symmetry elements and symmetry operations. Concept of a group, definition of a point group. Classification of molecules into point groups. Subgroups. Schoenflies and Hermann-Maugin symbols for point groups. Multiplication tables (C_n, C_{2v} and C_{3v}). Matrix notation for the symmetry elements. Classess and similarity transformation.

Representation of groups: The Great Orthogonality theorem and its consequences. Character tables (C_s, C_1, C_2, C_{2v}, C_{2h} and C_{3v}). Symmetry and dipole moment.

Applications of group theory: Group theory and hybrid orbital. Group theory to Crystal field theory and Molecular orbital theory (octahedral and tetrahedral complexes). Determining the symmetry groups of normal modes (both linear and non-linear molecules).

UNIT – II

[16 HOURS]

Microwave spectroscopy: Rotation spectra of diatomic Molecules - rigid and non rigid rotator model. Rotational quantum number and the selection rule. Effect of isotopic substitution on rotation spectra. Relative intensities of the spectral lines. Classification of polyatomic molecules based on moment of inertia - Linear, symmetric top, asymmetric top and spherical molecules. Rotation spectra of polyatomic molecules (OCS CH₃F and BCl₃).
Moment of inertia expression for linear tri-atomic molecules. Applications - Principles of determination of Bond length and moment of inertia from rotational spectra. Stark effect in rotation spectra and determination of dipole moments.


**UNIT – III**

**Raman spectroscopy:** Introduction, Raman and Rayleigh scattering, Stokes and anti-Stokes lines, polarization of Raman lines, depolarization factor, polarizability ellipsoid. Theories of Raman spectra - classical and quantum theory. Rotation-Raman and vibration-Raman spectra. Comparison of Raman and IR spectra, rule of mutual exclusion principle. Vibration modes of some simple molecules and their activity in Raman.


**References**


CHA SCT: 1.51 FUNDAMENTALS OF CHEMICAL ANALYSIS

UNIT – I

[16 HOURS]

Analytical Chemistry: Meaning and analytical prospective, scope and function: Analytical problems and their solutions, trends in analytical methods and procedures.

Language of analytical chemistry - Analysis, determination and measurement. Techniques, methods, procedures and protocols. Classifying analytical techniques. selecting an analytical method - accuracy, precision, sensitivity, selectivity, robustness and ruggedness. Scale of operation, equipment, time and cost. Making the final choice

**Acid-base titrations in non-aqueous media:** Role of solvent in acid-base titrations, solvent systems, differentiating ability of a solvent, some selected solvents, titrants and standards, titration curves, effect of water, determining the equivalence point, typical applications - determination of carboxylic acids, phenols and amines.

**UNIT – II**

[16 HOURS]

**Titrimetric analysis:** An overview of titrimetry. Principles of titrimetric analysis. Titration curves. Titrations based on acid-base reactions - titration curves for strong acid and strong base, weak acid and strong base and weak base and strong acid titrations. Selecting and evaluating the end point. Finding the end point by visual indicators, monitoring pH and temperature. Quantitative applications – selecting and standardizing a titrant, inorganic analysis - alkalinity, acidity and free CO₂ in water and waste waters, nitrogen, sulphur ammonium salts, nitrates and nitrites, carbonates and bicarbonates.

**Precipitation titrations:** Titration curves, feasibility of precipitation titrations, factors affecting shape - titrant and analyte concentration, completeness of the reaction, titrants and standards, indicators for precipitation titrations involving silver nitrate, the Volhard, the Mohr and the Fajan’s methods, typical applications.

**Complexometric titrations:** Complex formation reactions, stability of complexes, stepwise formation constants, chelating agents, EDTA - acidic properties, complexes with metal ions, equilibrium calculations involving EDTA, conditional formation constants, derivation of EDTA titration curves, effect of other complexing agents, factors affecting the shape of titration curves - completeness of reaction, indicators for EDTA titrations - theory of common indicators, titration methods employing EDTA - direct, back and displacement titrations, indirect determinations, titration of mixtures.

**References**

1. Determination of total acidity of vinegar and wines by acid-base titration.
2. Determination of purity of a commercial boric acid sample, and Na₂CO₃ content of washing soda.
3. Analysis of chromate-dichromate mixture by acid-base titration.
4. Determination of replaceable hydrogen and relative molecular mass of a weak organic acid by titration with NaOH.
5. Determination of aspirin in their tablet preparations by residual acid-base titrimetry.
6. Determination of purity of aniline
8. Determination of carbonate and bicarbonate in a mixture by pH-metric titration and comparison with visual acid-base titration.
9. Determination of benzoic acid in food products by titration with methanolic KOH in chloroform medium using thymol blue as indicator.
10. Analysis of water/waste water for acidity by visual, pH metric and conductometric titrations.
11. Analysis of water/waste water for alkalinity by visual, pH metric and conductometric titrations.
14. Flame emission spectrometric determination of sodium and potassium in river/lake water.

References

UNIT – I

[16 HOURS]


The Group 1 elements: Occurrence, extraction and uses. Simple compounds: Hydrides, halides, oxides, hydroxides, oxoacids, nitrides, solubility and hydration and solutions in liquid ammonia. Coordination and organometallic compounds. Applications.

The Group 2 elements: Occurrence, extraction and uses. Halides, hydrides and salts of oxoacids. Complex ion in aqueous solution and complexes with amido and alkoxy ligands.

The Group 17 elements: Occurrence, recovery and uses. Trends in properties and pseudohalogenes.

UNIT – II

[16 HOURS]

Interhalogens: Physical properties and structures, chemical properties, cationic interhalogens, halogen complexes and polyhalides.

Compounds with oxygen: Halogen oxides, oxoacids and oxoanions.

Trends in rates of redox reactions and redox properties of individual oxidation states.

Chemistry of astatine.

The Group 18 elements: Occurrence, recovery and uses. Synthesis and structure of xenon fluorides, Reaction of xenon fluorides, xenon-oxygen compounds, Organoxenon compounds, Other compounds of noble gases.

M-M bonds: Multiple metal-metal bonds.

Cluster compounds: carbonyl and carbide clusters.

References

7.
UNIT – I

[16 HOURS]

**Vitamins:** Introduction, constitution, synthesis and biological significance of thiamine, riboflavin, pyridoxine, biotin, ascorbic acid, vitamine A₁ & A₂, E₁ and E₂, B₁₂ and K groups.

**Green chemistry:**
Definition and principles, planning a green synthesis in a chemical laboratory, Green preparation-Aqueous phase reactions, solid state (solvent less) reactions, photochemical reactions, Phase transfer catalyst catalyzed reactions, enzymatic transformations & reactions in ionic liquids.

UNIT – II

[16 HOURS]

**Medicinal Chemistry-Chemotherapy:** Definition, History, and Evolution of Chemotherapy
Classification of drugs on the basis of therapeutic action, pharmacophonic, API (active pharmaceutical ingredient) chiral drugs, development of new drugs, procedures followed in drug design, concept of lead and lead-compounds and lead modifications, molecular modeling, concept of pro-drug and soft drug, factor affecting bioactivity.

Theories of drug activity, occupancy-theory, rate theory, induced-fit theory. Quantitative structure-activity relationship, history and development of QSAR, concept of drug receptors, elementary treatment of drug receptor interactions.

Physiochemical parameters: lipophilicity, partition-coefficient, electronic ionization constant, steric, Shelnitz and surface activity parameters and redox potential.


References

1. Introduction to medicinal chemistry, A Gringuage, Wiley-VCH.

**CHP SCT: 1.54. BIOPHYSICAL CHEMISTRY AND PHARMACOKINETICS**
UNIT – I

[16 HOURS]


UNIT – II

[16 HOURS]


One compartment open model: Intravenous route of administration of drug, elimination rate constant, apparent volume of distribution and significance. Calculation of elimination rate constant from urinary excretion data, clinical application.

Two compartment model: Plasma level-time curve, relationship between tissue and plasma drug concentrations, Apparent volumes of distribution. Drug clearance, clinical example. Plasma level-time curve for a three compartment open model.


References


SECOND SEMESTER

CHI HCT: 2.1. COORDINATION CHEMISTRY

UNIT – I

[16 HOURS]

Preparation of coordination compounds: Introduction, Preparative methods - simple addition reactions, substitution reactions, oxidation-reduction reactions, thermal dissociation reactions. Geometries of metal complexes of higher coordination numbers (2-12).

Stability of coordination compounds: Introduction, trends in stepwise stability constants, factors influencing the stability of metal complexes with reference to the nature of metal ion and ligands, the Irving-William series, chelate effect.


Crystal field theory: Salient features of CFT, d-orbital splitting in octahedral, tetrahedral, square planar and tetragonal complexes, Jahn-Teller distortions, measurement of 10 Dq and factors affecting it. Evidences for metal-ligand covalency.

Molecular Orbital Theory: MOT to octahedral, tetrahedral and square planar complexes without and with pi-bonding.

UNIT – II

[16 HOURS]

Electronic spectra: Introduction, selection rules and intensities, electronic spectra of octahedral and tetrahedral complexes, Term symbols for dⁿ ions, Orgel and Tanabe-Sugano diagrams, charge-transfer spectra.

Magnetic properties: Introduction, magnetic susceptibility and its measurements, spin and orbital contributions to the magnetic moment, the effects of temperature on μeff, spin-cross over, ferromagnetism, anti-ferromagnetism and ferrimagnetism.

Kinetic consequences of Reaction pathways - Dissociation, interchange and association. Experimental evidence in octahedral substitution - Dissociation, associative mechanisms, the conjugate base mechanism, the kinetic chelate effect.

Substitution reactions of square-planar complexes - kinetics and stereochemistry of square-planar substitutions, evidence for associative reactions, explanations of the trans effect.

**Electron-transfer processes:** Inner-sphere mechanism and outer-sphere mechanism, conditions for high and low oxidation numbers. Photochemistry of Coordination Compounds: Overview and General Concepts.

**References**


**INORGANIC CHEMISTRY PRACTICALS – II**

[64 HOURS]

**PART – I**

1. Determination of bismuth, cadmium and lead in a mixture: Analysis of a low melting alloy (Wood’s alloy).
2. Simultaneous spectrophotometric determination of chromium and manganese in a steel solution.
3. Gravimetric determination of copper(II) and nickel(II) using salicylaldoxime.
4. Preparation of mercurytetrathiocyanatocobaltate(II) and estimation of mercury by gravimetry.
5. Preparation of tris(oxalato)ferrate(III) and estimate the metal ion.

**PART – II**
Semimicro qualitative analysis of mixtures containing **TWO** anions and **TWO** cations (excluding sodium, potassium and ammonium cations) and **ONE** of the following less common cations: W, Mo, Ce, Th, Ti, Zr, V, U and Li.

**References**

4. Vogel’s Qualitative Inorganic Analysis – Svelha.
5. Macro and Semimicro Inorganic Qualitative Analysis by A.I. Vogel.

**CHO HCT: 2.2. STEREOCHEMISTRY AND HETEROCYCLIC CHEMISTRY**

**UNIT – I**

[16 HOURS]

**Stereoisomerism:** Projection formulae [flywedge, Fischer, Newman and sawhorse], enantiomers, diastereoisomers, mesomers, racemic mixture and their resolution, configurational notations of simple molecules, DL and RS configurational notations.

**Optical isomerism:** Conditions for optical isomerism: Elements of symmetry-plane of symmetry, centre of symmetry, alternating axis of symmetry (rotation-reflection symmetry). Optical isomerism due to chiral centers and molecular dissymmetry, allenes and biphenyls, criteria for optical purity.

**Geometrical isomerism:** Due to C=C, C=N and N=N bonds, E, Z conventions, determination of configuration by physical and chemical methods. Geometrical isomerism in cyclic systems.

**Conformational analysis:** Elementary account of conformational equilibria of ethane, butane and cyclohexane. Conformation of cyclic compounds such as cyclopentane, cyclohexane, cyclohexanones and decalins. Conformational analysis of 1,2-, 1,3- and 1,4- disubstituted cyclohexane derivatives and D-Glucose, Effect of conformation on the course and rate of reactions.

**Stereoselectivity:** Meaning and examples of steroespecific reactions, stereoselective reactions, diastereoselective reactions, regioselective, regiospecific reactions, enantioselective reactions and enantiospecific reactions.

**UNIT – II**
Nomenclature of heterocyclic compounds. Structure (no elucidation), reactivity, synthesis (minimum three synthesis) and reactions (minimum three reactions) of furan, pyrrole, thiophene, indole, pyridine, quinoline, isoquinoline, pyrazole, imidazole, pyrone, coumarin, chromones, pyrimidines, purines.

References
8. Stereochemistry and Mechanism through Solved Problems by P.S Kalsi.

ORGANIC CHEMISTRY PRACTICALS – II

Multistep synthesis
1. Preparation $p$-bromoaniline from acetanilide.
2. Preparation of $n$-butyl bromide from $n$-butyl alcohol.
3. Oxidation of cyclohexanol to adipic acid via cyclohexanone.
5. Diazotization (Sandmeyer’s reaction): Preparation of $p$-chlorobenzoic acid from $p$-toluidine.
6. Molecular rearrangement: Preparation of $o$-chlorobenzoic acid from phthalic anhydride.
7. Preparation benzilic acid from benaldehyde.
8. Preparation of $o$-hydroxy benzophenone from phenyl benzoate via Fries rearrangement.
10. Synthesis of $m$-chloroiodobenzene from $m$-dinitrobenzene.

References
3. An Introduction to Practical Organic Chemistry - Robert, Wingrove etc.

CHP HCT: 2.3. PHYSICAL CHEMISTRY – II

UNIT – I

[16 HOURS]


**Irreversible electrode process:** Introduction, reversible and irreversible electrodes, reversible and irreversible cells. Polarization, over voltage - concentration over voltage, activation over voltage and ohmic over voltage. Experimental determination of over voltage. Equations for concentration over potential, stationary and non-stationary surface. Polarography- Half wave potential, application in qualitative and quantitative analysis. Butler-Volmer equation, Tafel equation. Hydrogen oxygen over voltage. Effect of temperature, current density and \( pH \) on over voltage.

UNIT – II

[16 HOURS]

**Quantum Chemistry:** A brief resume of black body radiation, and atomic spectra-Bohr’s theory of hydrogen atom. Photoelectric and Compton effects, de-Broglie concept, uncertainty principle. Operators - algebra of operators, commutative and non-commutative operators, linear operator, Laplacian operator, Hermitian operator, Hamiltonian operator, turn over rule.

Wave equation for stretched strings, Schrodinger wave equation for particles, Eigen values and Eigen functions, postulates of quantum mechanics. Application of Schrodinger equation to a free particle and to a particle trapped in a potential field (one dimension and three dimensions). Degeneracy, Wave equation for H-atom, separation and solution of \( R \), \( \phi \) and \( \theta \) equations. Application of Schrodinger equation to rigid rotator and harmonic oscillator.

**Reference**

2. Elements of Physical Chemistry by Lewis and Glasstone.
5. Introduction to Electrochemistry by S. Glasstone.
15. Quantum Chemistry – D.A. McQuarrie.

PHYSICAL CHEMISTRY PRACTICALS – II

[64 HOURS]

1. Study of kinetics of reaction between CAT and indigocarmine spectrophotometrically and determination of rate constant.
2. Kinetics of reaction between sodium formate and iodine, determination of energy of activation.
3. Determination of energy of activation for the bromide-bromate reaction.
4. Determination of dissociation constant and mean ionic activity coefficient of weak electrolytes by conductivity method.
5. Conductometric titration of oxalic acid against NaOH and NH₄OH.
6. pH titration of (a) CH₃COOH vs. NaOH and determination of Kₐ.
7. Potentiometric titration of a mixture of halides (KCl+KI) against AgNO₃.
8. Determination of redox potential of Fe²⁺ ions by potentiometric method.
9. Determination of activity of 0.1 M HCl by EMF method.
10. Determination of partial molar volume of NaCl-H₂O/KCl- H₂O/KNO₃/ H₂O systems.
12. Verification of inverse square law using gamma emitter.
13. Determine the concentration of KI potentiometrically by calibration method.
14. To study the kinetics of reaction between acetone and iodine - determination of order of reaction w.r.t. iodine and acetone.
15. To determine the eutectic point of a two component system (Naphthalene- m-dinitrobenzene system).
16. Coulometric titration I₂ vs Na₂S₂O₃.

Reference
2. Experimental Physical Chemistry – F. Daniels et al.

**CHG HCT: 2.4. MOLECULAR SPECTROSCOPY – II**

**UNIT – I**

[16 HOURS]

**NMR Spectroscopy:** Magnetic properties of nuclei (magnetic moment, g factor, nuclear spin), effect of external magnetic field on spinning nuclei, Larmor precession frequency, resonance conditions, population of nuclear magnetic energy levels, relaxation processes, relaxation time, line width and other factors affecting line width. Chemical Shift: Standards employed in NMR, factors influencing chemical shift: electronegativity, shielding and deshielding, van der Walls deshielding magnetic anisotropy, H-bonding, diamagnetic and paramagnetic anisotropies, spin-spin coupling, chemical shift values and correlation for protons bonded to carbon and other nuclei, Instrumentation. Chemical shift equivalence and magnetic equivalence, effects of chiral centre, Karplus curve-variation of coupling constants with dihedral angle. Complex NMR Spectra: Simplification of complex spectra-isotopic substitution, increased magnetic field strength, double resonance and lanthanide shift reagents; Nuclear Overhauser Effect (NOE), variable temperature probe, FT-NMR, Spectroscopy and advantages. $^{13}$C-NMR Spectroscopy: Comparison of $^1$H-NMR and $^{13}$C-NMR, multiplicity-Proton decoupling-Noise decoupling-Off resonance decoupling-Selective proton decoupling -Chemical shift, application of CMR. NMR of $^{19}$F, $^{31}$P, $^{11}$B and $^{15}$N Applications of NMR: Structural diagnosis, conformational analysis, keto-enol tautomerism, H bonding. Two dimensional NMR Spectroscopy: COSY, NOESY, MRI.

**UNIT – II**

[16 HOURS]
Electron Spin Resonance Spectroscopy: Basic principles, hyperfine couplings, the ‘g’ values, factors affecting ‘g’ values, isotropic and anisotropic hyperfine coupling constants, Zero Field splitting and Kramer’s degeneracy. Measurement techniques and Applications to simple inorganic and organic free radicals and to inorganic complexes.

NQR Spectroscopy: Quadrupolar nuclei, electric field gradient, nuclear quadrupole coupling constants, energies of quadrupolar transitions, effect of magnetic field. Applications.

Mössbauer spectroscopy: The Mössbauer effect, chemical isomer shifts, quadrupole interactions, measurement techniques and spectrum display, application to the study of Fe$^{2+}$ and Fe$^{3+}$ compounds, Sn$^{2+}$ and Sn$^{4+}$ compounds, nature of M-L bond, coordination number and structure), detection of oxidation states and inequivalent Mössbauer atoms.

UNIT – III

[16 HOURS]

IR spectroscopy: Introduction, instrumentation, sample handling, modes of vibrations, Hooks law, Characteristic group frequencies and skeletal frequencies. Finger print region, Identification of functional groups- alkenes, aromatics, carbonyl compounds (aldehydes and ketones, esters and lactones), halogen compounds, sulphur and phosphours compounds, amides, lactums, amino acids and amines, Factors affecting group frequencies and band shapes, conjugation, resonance and inductance, hydrogen bonding and ring strain. tautomerism, Cis-trans isomerism. Applications of IR spectroscopy.


References
11. NMR spectroscopy-Powai.

**CHA SCT 2.51: SEPARATION TECHNIQUES**

**UNIT – I**

[16 HOURS]

**Fundamentals of chromatography:** General description, definition, terms and parameters used in chromatography, classification of chromatographic methods, criteria for selection of stationary and mobile phase-nature of adsorbents, factors influencing the adsorbents, nature and types of mobile phases and stationary phases.

**Column chromatography:** Theories – plate theory, rate theory, band broadening-eddy diffusion, longitudinal diffusion and resistance to mass transfer, column efficiency, Van Deemter’s equation and its modern version, optimization column performance, interrelationships-capacity factor, selectivity factor, column resolution, distribution constant and applications of conventional column chromatography, advantages and limitations.

**Thin layer chromatography (TLC):** Definition, mechanism, efficiency of TLC plates, methodology –selection of stationary and mobile phases, preparation of micro and macro plates, development, spray reagents, identification and detection, reproducibility of Rf values, qualitative and quantitative analysis.

**Paper chromatography (PC):** Definitions, theory and principle, techniques; one, two-dimensional and circular PC, mechanism of separation, types of paper, methodology-preparation of sample, choice of solvents, location of spots and measurement of Rf value, factors affecting Rf values, advantages and applications.
High performance liquid chromatography (HPLC): Instrumentation, pumps, column packing, characteristics of liquid chromatographic detectors-UV, IR, refractometer and fluorescence detectors, advantages and applications.

UNIT – II

[16 HOURS]

Gas chromatography (GC): Principle, instrumentation, columns, study of detectors –thermal conductivity, flame ionization, electron capture and mass spectrometry, factors affecting separation, retention volume, retention time, applications.

Ion exchange chromatography (IEC): Definitions, principle, requirements for ion-exchange resin and its synthesis, types of ion-exchange resins, basic features of ion-exchange reactions, resin properties-ion-exchange capacity, resin selectivity and factors affecting the selectivity, applications of IEC in preparative, purification and recovery processes.

Solvent extraction: definition, types, principle and efficiency of extraction, sequence of extraction process, factors affecting extraction-pH and oxidation state, masking and salting out agents, techniques-batch and continuous extraction, applications.

Size-exclusion chromatography: Theory and principle of size-exclusion chromatography, experimental techniques of gel-filtration chromatography (GFC) and gel-permeation chromatography (GPC), materials for packing - factors governing column efficiency, methodology and applications.

References
1. Determination of percentage of chloride in a sample by precipitation titration - Mohr, Volhard and Fajan’s methods.
2. Determination of silver in an alloy and Na₂CO₃ in soda ash by Volhard method.
3. Mercurimetric determination of blood or urinary chloride.
5. Analysis of commercial hypochlorite and peroxide solution by iodometric titration.
6. Determination of ascorbic acid in vitamin C tablets by titrations with KBrO₃ and of vitamin C in citrus fruit juice by iodimetric titration.
7. Determination of iron in pharmaceuticals by visual and potentiometric titration using cerium(IV) sulphate.
8. Determination of total cation concentration of tap water by ion-exchange chromatography.
9. Determination of magnesium in milk of magnesium tablets by ion-exchange chromatography.
10. Cation exchange chromatographic separation of cadmium and zinc and their estimation by EDTA titration.
12. Determination of aspirin, phenacetin and caffeine in a mixture by HPLC.
13. Anion exchange chromatographic separation of zinc and magnesium followed by EDTA titration of the metals.
15. Thin layer chromatographic separation of amino acids.

References

CHI SCT 2.52: INDUSTRIAL INORGANIC CHEMISTRY

UNIT – I

Metal Carbides: salt like, covalent and industrial carbides. Intercalation compounds of graphite, alkali metals. Industrially important reactions of oxides with carbon.
Silicone polymers: Introduction, nature of chemical bonds containing silicon, general methods of preparation (fluids and resins) and properties of silicones. Applications. Industrial uses of silicon, silicon carbide and silicon dioxide.
Chemical reactivity and group trends of germanium, tin and lead: Applications, metallic tin and alloys, lead alloys and oxides of lead.
Compounds of arsenic, antimony and bismuth: Intermetallic compounds and alloys and their uses.
Ceramics: Raw materials used in ceramics and ceramic insulators.

UNIT – II

[16 HOURS]

Inorganic fibers: Introduction, properties, classification, asbestos fibers, optical fibers, carbon fibers, Applications.
Zeolites: Introduction, types of zeolites, manufacture of synthetic zeolites and applications.
Mineral fertilizers: Phosphorous containing fertilizers - Economic importance, importance of superphosphate, ammonium phosphates and their synthesis.
Nitrogen containing fertilizers - Importance and synthesis of ammonium sulfate, ammonium nitrate and urea.
Potassium containing fertilizers - Economic importance and manufacture of potassium sulfate.
Inorganic pigments: General information and economic importance.
White pigments – titanium dioxide pigments, zinc oxide pigments.
Colored pigments – Iron oxide, chromium oxide, mixed-metal oxide pigments and ceramic colorants.
Corrosion protection pigments, luster pigments, luminescent pigments, magnetic pigments.

References

CHO SCT 2.53: DYES & INSECTICIDES

UNIT – I

[DYSES] [16 HOURS]

Dyes: Introduction, modern theories of colour and chemical constitution. A general study of the following: Direct azo dyes (congored, rosanthrene O, procion dyes), acid azo dyes (ponceau2R, Naphthol blue black 6B), basic azo dyes (chrysoidin G, bismark brown), developed dyes, mordent dyes, vat dyes, disperse dyes, fibre reactive dyes, sulphur dyes and solvent dyes. Fluorescent brightening agents (tinopal B.V), cyanine dyes (classification, application in photography, quinoline blue and sensitil), chemistry of colour developer, and instant colour processes.
Synthesis and applications of malachite green, rhodamine-B, phenolphthalein and methyl orange.
Triphenylmethane dyes: crystal violet, pararosaniline, aurin, chromeviolet.
Application of dyes: i. photography ii. DVD, CD and LCD iii. Biological studies and iv. Electronics.

UNIT – II

[INSECTICIDES] [16 HOURS]

Insecticides: Introduction, classification, mode of action and synthesis of chlorinated insecticides (DDT, chlordane, heptachlor and hexachlorocyclohexane), Naturally occurring insecticides-pyrethrins-natural pyrethrins-isolation and structures, synthetic pyrethroids, allethrin, cypermethrin, phenvalerate.
Organophosphorous insecticides: Malathion, parathion, DDVP, diazenon.
Carbamate insecticides: Sevin, carbofluron, aldicab, beygon.
Herbicides: Introduction, study of sulfonyl ureas, heterocyclic sulfonamides, heterocyclic amines, dihydropyran[2,3-b]pyridylimidazolinones,pyrrolopyridylimidazolinones,1,2,4-triazine- 3,5-diones, hydroxyoxazolidinones & hydroxypyrrolidinones, pyridine herbicides &
1,3,4-oxadiazoles. Mechanism of action and toxicities of insecticides, fungicides and herbicides.

References
1. A Text Book of Fertilizers, Ranjan Kumar Basak.
2. Agronomy - Theory & Digest, Bidhan Chandra, Krishi Vishwavidyalaya, Mohanpur.
11. Advances in Pesticide Formulation Technology, ACS.
12. Chemicals for Crop Protection and Pest Managements, M B Green, G.S. Hartley West, Pergamon.

CHP SCT: 2.54. NANOMATERIALS, SEMICONDUCTORS AND SUPERCONDUCTORS

[16 HOURS]


Synthesis: Chemical vapour deposition (CVD), sol-gel, silica-gel, solvothermal, hydrothermal methods, microwave, electrochemical, laser ablation, biological and bacterial methods. Characterization (X- ray, IR, UV and SEM).

Applications of Nanomaterials : Renewable energy (nano solar cells), coloured glasses (gold and silver ruby glasses), chemical sensors, biosensors, SAM, electrical and electronics (RAM). Chemical and photocatalytic applications. Lithography, drug delivery targeting and medical applications, micro-electrochemical machines (MEMS). Inorganic and organic nano porous gel.
UNIT – II

[16 HOURS]

**Semiconductors:** Band theory, energy bands, intrinsic and extrinsic semiconductors. Conductivity: electrons and holes, temperature dependence on conductivity, Optical properties: absorption spectrum, photoconductivity, photovoltaic effect and luminescence. Junction properties: metal-metal junctions, metal-semiconductor junctions, p-n junctions, transistors, industrial applications of semiconductors: Mixed oxides, spinels and other magnetic materials.

**Superconductors:** Meissner effect, type I and II super conductors, isotope effect, basic concepts of BCS theory, manifestations of the energy gap, Josephson devices.

**Reference**
1. Hand Book of Nanotechnology, Bharat Bhushan, Springer Publisher.

OPEN ELECTIVE (FOR NON-CHEMISTRY STUDENTS ONLY)

CH OET: 2.1/3.1- CHEMISTRY

UNIT – I

[16 HOURS]

**Periodic Table and chemical Periodicity:** Periodic properties of elements, State of Matter, their resources. Important periodic properties of the elements, covalent radii, ionic radii, ionization potential, electron affinity and electronegativity.

**Structure and Bonding:** Properties of ionic compounds, structure of crystal lattices (NaCl, CsCl, ZnS, Wurtzite and rutile), Lattice energy, Born-Haber Cycle, radius ratio rules and their limitations. MO treatment for homo- and heteronuclear molecules. VSEPR model to simple molecules.

Ionic Bond: Properties of ionic substances, structures of crystal lattices (NaCl, CsCl, and ZnS). Lattice energy, Born-Haber cycle, uses of Born-Haber type calculations, Born-Lande equation. Ionic radii, factors affecting the radii of ions, radius ratio effects, covalent character in ionic bonds, hydration energy and solubility of ionic compounds.

UNIT – II

[16 HOURS]

Purification: Crystallization, sublimation, fractional crystallization, distillation techniques (simple distillation, steam distillation, distillation under reduced pressure, fractional distillation).

Separation techniques: Solvent extraction, continuous extraction, chromatography (principles of TLC, PC, column, GC, ion exchange chromatography) and electrophoresis


Reaction Mechanism: Basics of organic reactions: Meaning and importance of reaction mechanism, classification and examples for each class.

Structure and reactivity: Brief discussion on effects of hydrogen bonding, resonance, inductive and hyperconjugation on strengths of acids and bases.

Methods of determining organic reaction mechanism: Thermodynamic and kinetic requirements for reactions, kinetic and thermodynamic control. Identification of products.

UNIT – III

[16 HOURS]


Factors affecting group frequencies and band shapes, conjugation, resonance and inductance, hydrogen bonding and ring strain, tautomerism, cis-trans isomerism. Applications of IR spectra to co-ordinatation compounds,

**NMR Spectroscopy:** Magnetic properties of nuclei (magnetic moment, g factor, nuclear spin), effect of external magnetic field on spinning nuclei, Larmor precession frequency, resonance conditions, population of nuclear magnetic energy levels, relaxation processes, relaxation time, line width and other factors affecting line width. Chemical Shift: Standards employed in NMR, factors influencing chemical shift: electronegativity, shielding and deshielding, application of NMR.

**CH OET: 2.2/3.2 - GENERAL CHEMISTRY**

**UNIT – I**

**Periodic Table. Chemical Periodicity:** Periodic properties of elements, State of Matter, their resources. Important periodic properties of the elements, covalent radii, ionic radii, ionization potential, electron affinity and electronegativity.

**Structure and Bonding:** Properties of ionic compounds, structure of crystal lattices (NaCl, CsCl, ZnS, Wurtzite and rutile), Lattice energy, Born-Haber Cycle, radius ratio rules and their limitations. MO treatment for homo- and heteronuclear molecules. VSEPR model to simple molecules.

**Concepts of Acids and Bases:** Lux-Flood and solvent system concepts. Hard-soft acids and bases.

**Ionic Bond:** Properties of ionic substances, structures of crystal lattices (NaCl, CsCl, and ZnS). Lattice energy, Born-Haber cycle, uses of Born-Haber type calculations, Born-Lande equation. Ionic radii, factors affecting the radii of ions, radius ratio effects, covalent character in ionic bonds, hydration energy and solubility of ionic compounds.

**UNIT – II**

**Spectroscopy:** Rotation spectra of diatomic molecules (rigid and non-rigid rotator model). Principles of determination of bond length and moment of inertia from rotation spectra. **Infrared spectroscopy:** Vibration of diatomic molecules, vibrational energy curves for simple harmonic oscillator. Theory of IR absorption, types of absorption bands. Number of fundamental vibrations and theoretical group frequencies. Important spectral regions, characterization of functional groups and structure of simple molecules – CO₂, H₂O and CH₃COOH.

**UNIT – III**

**Fundamentals of chromatography:** General description, definition, terms and parameters used in chromatography, classification of chromatographic methods, criteria for selection of stationary and mobile phase-nature of adsorbents, factors influencing the adsorbents, nature and types of mobile phases and stationary phases. **Column chromatography:** Theories – plate theory, rate theory, band broadening-eddy diffusion, longitudinal diffusion and resistance to mass transfer, column efficiency, Van Deemter’s equation and its modern version, optimization column performance, interrelationships-capacity factor, selectivity factor, column resolution, distribution constant and applications of conventional column chromatography, advantages and limitations. **Thin layer chromatography (TLC):** Definition, mechanism, efficiency of TLC plates, methodology – selection of stationary and mobile phases, preparation of micro and macro plates, development, spray reagents, identification and detection, reproducibility of Rf values, qualitative and quantitative analysis. **Gas chromatography (GC):** Principle, instrumentations, columns, study of detectors – thermal conductivity, flame ionization, electron capture and mass spectrometry, factors affecting separation, retention volume, retention time, applications.

**References**

2. Morison and Boyd. Organic chemistry..
8. Stereochemistry and mechanism through solved problems – P. S. Kalsi.
12. Elements of Physical Chemistry by Lewis and Glasstone.

**THIRD SEMESTER**

**CHI HCT: 3.1. ADVANCED INORGANIC CHEMISTRY**

**UNIT – I**

[16 HOURS]

**Fundamental concepts:** Introduction, Classification of organometallic compounds by bond type, nomenclature, the effective atomic number rule, complexes that disobey the EAN rule, common reactions used in complex formation.

**Organometallics of transition metals:** Preparation, bonding and structures of nickel, cobalt, iron and manganese carbonyls. Preparation and structures of metal nitrosyls in organometallics. **Ferrocene and ruthenocene:** Preparation, structure and bonding.

**Complexes containing alkene, alkyne, arene and allyl ligands:** preparation, structure and bonding. The isolobal principles.

**UNIT – II**

[16 HOURS]

**Homogeneous catalysis - Industrial Applications:** Alkene hydrogenation, hydroformylation, The Wacker’s process, Monsanto acetic acid process and L-DOPA synthesis, alkene oligomerizations, water-gas shift reactions.

**Heterogeneous catalysis - Commercial Applications:** Alkene polymerization: Ziegler-Natta catalysis, Fischer-Tropsch carbon chain growth.

**Alkene metathesis,** hydroboration, arylation or vinylation of olefins (Heck reaction).

**Biological and Medicinal Applications:** Organomercury, boron, silicon and aresenic compounds

**Zeolites as catalysts for organic transformation:** Uses of ZSM – 5.

**UNIT – III**

[16 HOURS]

**Chemistry of main group elements:** Diborane and its reactions, polyhedral boranes (preparation, properties, structure and bonding). Wade’s rules, carboranes and borazines. Inorganic chains, rings and cages of boron, carbon and phosphorous.
Silicates: Structure, classification - silicates with discrete anions, silicates containing chain anion, silicates with layer structure, silicones with three dimensional network and applications.
Silicone: General methods of preparation, properties. Silicone polymers - silicone fluids, silicone greases, silicone resins, silicone rubbers and their applications.
Heterocyclic inorganic ring system: Sulphur-nitrogen ring, nitrogen-phosphorous ring
Phosphonitrilic or phosphazine polymers: Preparation, properties, structure and applications.

References

CHO HCT: 3.2. REAGENTS IN ORGANIC SYNTHESIS

UNIT – I

[16 HOURS]

Oxidation: Oxidation with chromium and manganese reagents (CrO₃, K₂Cr₂O₇, PCC, PDC, Sarret reagent, MnO₂, KMnO₄, ozone, peroxides and peracids, periodic acid, OsO₄, SeO₂, NBS, Oppenauer oxidation, Sharpless epoxidation.

Reduction: Catalytic hydrogenation (homogeneous and heterogeneous) – catalysts (Pt, Pd, Ra-C, Ni, Ru, Rh), solvents and reduction of functional groups, catalytic hydrogen transfer reactions. Wilkinson catalyst, LiAlH₄, NaBH₄, DIBAL-H, Sodium cyanoborohydride,

Reactions with aldehydes or ketones (E and Z-alkenes).

UNIT – II

[16 HOURS]

Reagents and reactions in organic synthesis: Use of following reagents in organic synthesis and functional group transformations: Lithium diisopropylamide (LDA), Gilmann reagent, dicyclohexyl carbodimide (DCC), dichlorodicyanquinone (DDQ), Silane reagents- trialkylsilyl halides, trimethylsilyl cyanide, trimethyl silane, phase transfer catalyst, crown ethers, cyclodextrins, Ziegler-Natta catalyst, diazomethane, Woodward and Prevost hydroxylation, Stark enamine reaction, phosphorous ylides - Wittig and related reactions, sulphur ylides – reactions with aldehydes and ketones, 1,3-dithiane anions - Umpolung reaction, Peterson reaction. Palladium reagents: Suzuki coupling, Heck reaction, Negishi reaction

UNIT – III

[16 HOURS]


Retrosynthesis: Introduction to disconnection approach: Basic principles and terminologies used in disconnection approach. One group C-X and two group C-X disconnections. Synthons and synthetic equivalents. Retrosynthesis and synthesis of benzofurans, p-methoxy acetophenone, saccharine, α-bisabolene, nuciferal, tetralone, ibuprofen, functional group transformations in organic synthesis; nitro to keto, nitro to aniline, acid to alcohol etc..

References
7. CHP HCT: 3.3. PHYSICAL CHEMISTRY – III

UNIT – I

[16 HOURS]


Kinetics of Polymerization - Condensation, addition, free radical, ionic, co-ordination polymerization.

Phase transitions in polymers and thermal characterization: Glass transition, crystallinity and melting- correlation with the polymer structure.

Polymers in solution: Criteria of polymer solubility. Thermodynamics of polymer solutions.


Micelles: Surface active agents – micellation, hydrophobic interaction, critical micellar concentration (CMC), factors affecting the CMC of surfactants. Micellar catalysis.

UNIT – II

[16 HOURS]


Radiation chemistry: Introduction, units, interaction of electromagnetic radiation with matter, G-value, LET of radiation. Chemical dosimetry - Fricke and ceric sulphate dosimeters. Radiolysis - cysteine, and biphenyl. Radioisotopes as tracers, use of isotopic tracers in the elucidation of reaction mechanism, structure determination and solubility of sparingly soluble
substances. $^{14}$C dating, medical applications of isotopic tracers. Physico-chemical applications – isotope dilution method, activation analysis and radiometric titrations. Hazards in radiochemical work and radiation protection.

UNIT – III

[16 HOURS]


**Radiochemical separation techniques**: carriers, solvent extraction and ion ion-exchange methods.


**Nuclear power reactors**: Types of nuclear power reactors, basic features and components of nuclear power reactors. An introduction to breeder reactors.

**References**

CHA SCT 3.41: APPLIED ANALYSIS – I

UNIT – I

[16 HOURS]


Air Pollution control: Atmospheric cleaning processes, approaches to contaminant control-detection and control at source.

Control devices for particulates: Gravitational settlers, centrifugal collectors, wet collectors, electrostatic precipitation and fabric filtration.

Control devices for gaseous pollutants: adsorption, absorption, condensation and combustion processes. Automotive emission control-catalytic converters.

UNIT – II

[16 HOURS]

Water pollution and analysis: Water resources, origin of wastewater, types of water pollutants; their sources and effects, chemical analysis for water pollution control - objectives of analysis, parameters of analysis, sample collection and preservation. Environmental and public health significance and measurement of colour, turbidity, total solids, acidity, alkalinity, hardness, chloride, residual chlorine, chlorine demand, sulphate, fluoride, phosphates and different forms of nitrogen in natural and waste/polluted waters, heavy metal pollution - public health significance of Pb, Cd, Cr, Hg, As, Cu, Zn and Mn, general survey of the instrumental techniques for the analysis of heavy metals in aquatic systems, organic loadings - significance and measurement of DO, BOD, COD, TOD, and TOC, phenols, pesticides, surfactants and tannin and lignin as water pollutants and their determination.
References


ANALYTICAL CHEMISTRY PRACTICALS – III

PART – III

[64 HOURS]

1. Determination of calcium in limestone by redox, acid-base and complexation titrations.
2. Determination of vitamin C in orange juice by titration with cerium(IV) and with 2,6-dichlorophenol indophenol.
3. Determination of aluminium and magnesium in antacids by EDTA titration.
4. Determination of saccharin in tablets by precipitation titration.
5. Determination of sulpha drugs by potentiometry using NaNO₂ and iodometric assay of penicillin.
6. Determination of iron in mustard seeds and phosphorus in peas by spectrophotometry.
7. Analysis of waste water for anionic detergents and phenol by spectrophotometry.
8. Determination of manganese in steel by extraction-free spectrophotometry and molybdenum in steel by extractive spectrophotometry.
10. Analysis of a ground water sample for sulphate by titrimetry (EDTA) and turbidimetry.
11. Catalytic determination of traces of selenium in biological materials and iodide in blood serum.
12. Photometric and potentiometric titration of iron(III) with EDTA.
13. Analysis of brackish water for chloride content by a) spectrophotometry (mercuric thiocyanate method), b) conductometry (silver nitrate) and c) potentiometry (silver nitrate).
14. Conductometric titration of sodium acetate with HCl and NH₄Cl with NaOH.
15. Determination of fluoride in drinking water/ground water by spectrophotometry (alizarin red lake method).
16. Analysis of waste water for
   a) phosphate by molybdenum blue method
   b) ammonia-nitrogen by Nessler’s method
   c) nitrite-nitrogen by NEDA method
15. Analysis of a soil sample for
   a) calcium carbonate and organic carbon by titrimetry.
   b) calcium and magnesium by EDTA titration.
16. Analysis of a soil sample for
   a) Available phosphorus by spectrophotometry.
   b) Nitrate-nitrogen/nitrite nitrogen/ammonia nitrogen by spectrophotometry.
   c) sodium and potassium by flame photometry.
17. Analysis of urine for
   a) urea and uric acid by titrimetry and spectrophotometry.
   b) Sulphate by precipitation titration after ion-exchange separation.
   c) Sugar by Benedict’s reagent.
18. Analysis of blood for
   a) cholesterol by spectrophotometry
   b) bicarbonate by acid-base titration

References


17. **CHI SCT 3.42: FRONTIERS IN INORGANIC CHEMISTRY**

**UNIT – I**

**[16 HOURS]**

**Materials chemistry**

**General principles**- Defects, non-stoichiometric compounds and solid solutions, atom and ion diffusion, solid electrolytes. Synthesis of materials - The formation of extended structures, chemical deposition.

**Metal oxides, nitrides and fluorides:** Monoxides of the 3d metals, higher oxides and complex oxides, oxide glasses, nitrides and fluorides.

**Chalcogenides, intercalation chemistry and metal rich phases:** Layered MS$_2$ compounds and intercalation, Chevrel phases.

**Framework structures:** Structures based on tetrahedral oxoanions, structures based on octahedral and tetrahedral.

**Inorganic pigments:** Coloured pigments, white and black inorganic materials.

**Molecular materials and fullerides:** Fullerides, Molecular material chemistry.

**Silicates:** Structure, classification - silicates with discrete anions, silicates containing chain anion, silicates with layer structure, silicones with three dimensional net work and applications.

**UNIT – II**
Nanomaterials, nanoscience and nanotechnology

Fundamentals - Terminology and history, novel optical properties of nanomaterials.


Artificially layered materials: Quantum wells and multiple quantum wells. Solid state superlattices. Artificially layered crystal structures.


Inorganic-organic nanocomposites: Uses and design strategies. Polymer nanocomposites.

References


INORGANIC CHEMISTRY PRACTICALS – III

[64 HOURS]

PART – I

1. Electrogravimetric determination of:
   a) Copper in copper sulphate
   b) Nickel in nickel sulphate
   c) Copper and nickel in alloy solution
   d) Lead in lead nitrate.
2. Flame photometric determination of the following metal ions from different samples:
   a) sodium b) potassium c) calcium d) lithium and d) sodium and potassium in a mixture.
4. Determination of iron as the 8-hydroxyquinolate by solvent extraction method.
5. Quantitative determination of nickel using dithizone and 1,10-phenanthroline by synergistic extraction.
6. Spectrophotometric determination of the $p$Ka value of methyl red.
7. Determination of chromium(III) and iron(III) in a mixture: Kinetic masking method.

**PART – II**

9. Preparation and characterization of:
   a) Chloropentammine cobalt(III) chloride
   b) Estimation of chloride in a complex by potentiometric or ion-exchange method
   c) Record the electronic absorption spectrum of a complex and verify Tanabe Sugano diagram.
10. Using chloropentamine cobalt(III) chloride, prepare nitro and nitritopentamine cobalt(III) chloride. Record the IR spectra of the isomers and interpret.
11. Estimate the chloride ion in a given complex by silver nitrate titration after ion-exchange separation.
12. Preparation of cis- and trans-dichlorobis(ethylenediammine) cobalt(III)chloride. Record the UV-Vis spectra and compare it with cis-form. Measure the molar conductance.
13. Preparation of hexamine cobalt(III) chloride and estimate cobalt ion.
15. Determination of the composition of iron-phenanthroline complex by:
    (a) Job’s method
    (b) mole-ratio method and
    (c) slope-ratio method
17. Demonstration Experiments:
    (a) Recording and interpretation of IR and NMR spectra of complexes.
    (b) Spectrochemical series - Evaluation of $Dq$ value.
    (c) DNA interaction with metal complexes by UV-visible absorption and viscosity methods.

**References**

CHO SCT 3.43: CARBOHYDRATES, PROTEINS AND NUCLEIC ACIDS

UNIT – I

[16 HOURS]


UNIT – II

[16 HOURS]


References


**ORGANIC CHEMISTRY PRACTICALS – III**

**PART – I**

[64HOURS]

**Isolation of natural products & estimations:**
1. Fractional crystallization: separation of mixture of naphthalene and biphenyl
2. Thin layer chromatography: Separation of plant pigments
3. Isolation of piperine from pepper
4. Isolation of caffeine from tea
5. Isolation of azeleic acid from castor oil
6. Estimation of ketones by haloform reaction
7. Estimation of sugars by Bertrand’s method
8. Estimation of nitro groups
9. Estimation of amino group
10. Determination of iodine value of an oil or fat
11. Determination of saponification value of an oil
12. Determination of equivalent weight of carboxylic acid by silver salt method

**PART – II**

**Spectral analysis:** Structural elucidation of some simple organic compounds by UV, IR, NMR and mass. Spectra have to be provided by the teachers.

**References**

4.

**CHP SCT: 3.44. APPLICATIONS OF ELECTROCHEMISTRY AND CORROSION**

**UNIT – I**

[16 HOURS]
Electrochemical cells and batteries: Introduction, galvanic and electrolytic cells, schematic representation of cells. Faraday’s law, faradaic and non-faradaic current, mass transfer in cells. Batteries: Classification, characteristics, primary, secondary and lithium batteries. Fuel cells.

Energetics of cell reactions: Effect of temperature, pressure and concentration on energetics of cell reactions (calculation of $\Delta G$, $\Delta H$ and $\Delta S$).

Electrochemical measurements: Amperometry, coulometry at controlled potential and at constant current. Cyclic voltammetry – basic principles, instrumentation and applications. Electrogravimetry: Theory, electrode reactions, electroplating of metals, electro-deposition of alloys, characteristics of good deposit, completeness of deposition, separation of metals at controlled cathode potential. Determination of copper and nickel in Cu-Ni alloy.

UNIT – II

[16 HOURS]


Reference
2. Elements of Physical Chemistry by Lewis and Glasstone.
4. Introduction to Electrochemistry by S. Glasstone.

PHYSICAL CHEMISTRY PRACTICALS – III

[64 HOURS]

1. To study the kinetics of saponification of ethyl acetate by conductivity method, determination of the energy of activation.
2. Study of kinetics of reaction between K₂S₂O₈ and KI, second order, determination of rate constants at two different temperatures and $E_a$.
3. Study the salt effects on kinetics of reaction between K₂S₂O₈ and KI.
4. Conductometric titration of thorium nitrate with potassium tartarate.
5. Conductometric titration of orthophosphoric acid against NaOH.
6. Conductometric titration of a mixture of HCl, CH₃COOH and CuSO₄ against NaOH.
7. Potentiometric titration of mixture of weak acids against NaOH.
8. Conductometric titration of potassium iodide with mercuric perchlorate.
9. To study the acid catalysed kinetics of oxidation of glycine by chloramine-T (CAT) - determination of order of reaction w.r.t. [CAT] and [glycine].
10. Potentiometric titration of Pb(NO₃)₂ vs EDTA.
11. Potentiometric titration of mixture of KCl+KBr+KI vs AgNO₃.
12. Study of phase diagram of a three component system (e.g. acetic acid-chloroform water and system).
13. Study of corrosion rate of mild steel in the presence of corrosion inhibitor by mass loss method at different temperature – determination of thermodynamic parameters.
15. Spectrophotometric kinetics of oxidation of indigocarmine by chloramine-T (CAT) – (a) Determination of order of reaction w.r.t. [CAT] (b) Effect of pH and determination of order w.r.t. [H⁺].
16. Kinetic study on Ru(III) catalysed reaction between primary amine and CAT (a) Determination of order of reaction w.r.t. [amine] and [CAT] (b) Determination of $E_a$ and thermodynamic parameters.
17. Kinetics of saponification of ethyl acetate by conductivity method and study the effect of dielectric constant of the medium (using CH₃OH).
18. Study of photolysis of uranyl oxalate (a) determination of intensity of light source (b) study of photocatalysis of oxalic acid.
21. Spectrophotometric analysis of a mixture of (a) KMnO₄ and K₂Cr₂O₇.
22. Study of complex formation between ferric salt and salicylic acid.
23. Determination of half-wave potential of metal ions in a mixture (Mn²⁺, Cd²⁺ and Zn²⁺).
24. Estimation of metal ion in solution by polarographic method.
26. Determination of energy gap of a semiconductor by four probe method.
27. Synthesis of nanomaterial (ZnO) by electrochemical method and its application for photodegradation studies.

References
2. Experimental Physical Chemistry – F. Daniels et al.

NON-COMPOSITE

CHI SCT 3.51: BIOINORGANIC PHOTOCHEMISTRY

UNIT – I

[16 HOURS]

Introduction, Philosophy of bioinorganic photochemistry

Fundamentals: Light and matter
Nature of light, Accessible light sources and Interaction between light and matter.

Formation and properties of electronic excited states: Wave mechanics and quantum numbers and Electronic excitation.
Photophysical deactivation of electronic excited states: Spontaneous deactivation, Quenching and Coordination and organometallic compounds.

Photochemical reactions: Photochemical reaction channels, Intramolecular photoreactions, Photodissociation and photoionization, Photoisomerization, Intermolecular photoreactions, The coordination compound specificity. Ligand field photochemistry, Photochemistry from LC or LLCT states, Inner-sphere charge transfer photochemistry, Outer-sphere charge transfer photochemistry, Photosensitized reactions, Homogeneous photocatalysis.

Natural photoprocesses involving inorganic compounds
From interstellar space to planetary atmospheres: Homogeneous systems: from interstellar space to planetary atmospheres and primitive soup models. Heterogeneous photochemistry in ice phases.

UNIT – II

[16 HOURS]

Applications: Fluorescent and chromogenic sensing and labeling: Cations as targets in biochemical sensing Cations common in biological systems, Fluorescent detection of toxic cations, Fluorescent and chromogenic sensing of anions, Common anions and Toxic anions. Optical detection of neutral molecules. Nanoparticles in biochemical sensing and labeling.

Therapeutic strategies; Photobiostimulation, Photoactivation of drugs, Photodynamic therapy, Mechanisms of PDT and PTT. Photosensitizers, Inorganic photosensitizers, Supporting role of metal ions in photodynamic therapy, and Combination of polypyrrolic photosensitizers and metallopharmaceuticals, Recent PDT development and Nanomedical methods.

Photodynamic inactivation of microorganisms: Bacteria, Viruses, Fungi and Parasites.

Phototoxicity and photoprotection: Chemical and physical photoprotection. Inorganic sunscreens.


References:


CHO SCT 3.52: LIPIDS, PORPHYRINS, ANTHOCYANINS AND FLAVONOIDS
UNIT – I

[16 HOURS]

Lipids: Nomenclature, classification, purification, structure and synthesis of fatty acids, phospholipids, sphingolipids. Biological importance of lipids (Lecithin, sphingolipids, oils and fats).


UNIT – II

[16 HOURS]

Porphyrlins: Introduction, structure and biological functions of haemin. Vitamin B$_{12}$ structure and as coenzyme in molecular rearrangement reactions; Chlorophyll: structure and biological importance.

Flavonoids and Isoflavonoids: Occurrence, nomenclature and general methods of structure determination. Isolation and synthesis of Apigenin, Luteolin, Kaempferol, Quercetin, wedelolactone, Butein, Daidzein.

Biosynthesis of flavonoids and isoflavonoids: Acetate Pathway and Shikimic acid Pathway. Biological importance of flavonoids and isoflavonoids


References


CHP SCT: 3.53 APPLICATIONS OF X-RAY CRYSTALLOGRAPHY AND QUANTUM CHEMISTRY
UNIT – I  


UNIT – II 

Applications of quantum mechanics: Application of variation theorem to a particle in one dimensional box, linear oscillator, H and He-atoms, SCF method for many electron atom. Slater Orbitals –Effective nuclear charge (ENC), expressions for slater orbitals for 1s, 2s, 3s, 2p and 3d electrons (no derivation), Slater’s rules for calculation of ENC-Slater’s orbitals for He, Carbon and nitrogen. Theories of valence – Introduction, linear and non-linear variation functions, secular equations, coulombic, exchange, normalization and overlap integrals, secular determinants.

References
1. Structure determination by x-ray crystallography by Mark Ladd & Rex Palmer
2. An Introduction to X-ray crystallography by M. M. Woolfson
7. Crystal Structure Analysis: A Primer by Jenny Pickworth Glusker, Kenneth N. Trueblood
8. Crystal Structure Analysis for Chemists and Biologists by Jenny P. Glusker, Mitchell Lewis, Miriam Rossi
11. A Practical Guide to solving single crystal structures by Manuel A. Fernandes
FOURTH SEMESTER

CHI HCT: 4.1. BIOINORGANIC CHEMISTRY

UNIT – I

[16 HOURS]

**Structural and molecular biology:** Introduction, The structural building blocks of proteins, the structural building block of nucleic acids. Metal ion interactions with nucleosides and nucleotides. General features of DNA - metal complex interaction.

**Bioenergetics:** Introduction, Redox reactions in metabolism, the central role of ATP in metabolism. Kinetic stability of ATP, Mitochondrial flow of electrons from NADH to O₂. Oxidative phosphorylation and respiratory chain.

**Sodium and potassium-channels and pumps:** Introduction, transport across membranes. Potassium and sodium channels, The sodium-potassium ATPase, Macro cyclic crown ether compounds, cryptands and ionophores.

**Biochemistry of calcium:** Introduction - comparison of Ca²⁺ and Mg²⁺. Biological roles of calcium, binding sites of calcium and proteins, storage of calcium, calcium in muscle contraction, calcium in blood clotting process.

**Vitamin B₁₂ and Coenzymes:** Structural feature, names of different forms, chemistry of cobalamin, biochemical functions of cobalamins, model compounds. Special characteristics of B₁₂ co-enzyme. Photosystems.

UNIT – II

[16 HOURS]

**Metal ion transport and storage:** Iron storage and transport: Transferrin, ferratin, phosvitin and gastroferrin. Iron transport in microbes: siderophores, *in vivo* microbial transport of iron

**Oxygen transport and oxygen uptake proteins:** Properties of dioxygen (O₂): Thermodynamic and kinetic aspects of dioxygen as an oxidant, activation of dioxygen through complexation with metal ions.

Haemoglobin (Hb) and Myoglobin (Mb) in oxygen transport mechanism: Introduction to porphyrin system, substituent effects on porphyrin rings, functions of Hb and Mb. Characteristics of O₂⁻ binding interaction with Hb and Mb. Model compounds for oxygen carriers (Vaska’s complex and cobalt(III) – Schiff base complexes). Hemerythrin and hemocyanin.
**Electron transport proteins and redox enzymes:** Iron – sulfur proteins (rubredoxins and ferredoxins) and cytochromes including cytochrome P450. Catalase and peroxidase: Structure and reactivity.

Superoxide dismutase: Structure and reactivity.

Molybdenum containing enzymes: Aspects of molybdenum chemistry, Xanthine oxidase, aldehyde oxidase, sulfite oxidase, nitrogenase and nitrite reductase.

**Non-redox metalloenzymes - Structure and reactivity:** Carboxypeptidase-A, alcohol dehydrogenase, leucine aminopeptidase and carbonic anhydrase.

**UNIT – III**

**Therapeutic uses of Metals - Metals in medicine:** Introduction, metals and human biochemistry, general requirements.

**Disease due to metal deficiency and treatment:** Iron, zinc, copper, sodium, potassium, magnesium, calcium and selenium.

**Metal complexes as drugs and therapeutic agents:** Introduction, antibacterial agents, antiviral agents, metal complexes in cancer therapy, metal complexes for the treatment of rheumatoid arthritis, vanadium diabetes, metal complexes as radio diagnostic agents.

**Treatment of toxicity due to inorganics:** General aspects of mechanism of metal ion toxicity,

(i) Mechanism of antidote complex with poison, rendering it inert: arsenic, lead, mercury, iron, copper

(ii) Antidote accelerated metabolic conversion of poison to non-toxic product: cyanide and carbon monoxide

**References**

10. The Biological Chemistry of the Elements: The Inorganic Chemistry of Life - 2nd
CHO HCT: 4.2. PHOTOCHEMISTRY, PERICYCLIC REACTIONS AND ORGANOMETALLIC CHEMISTRY

UNIT – I

[16 HOURS]


UNIT – II

[16 HOURS]

Chemistry of organometallic compounds: Synthesis and reactions of organolithium (n-BuLi, PhLi), organocadmium, organomagnesium (Grignard reagent), organomanganese, organoselenium and organotellurium. Organoaluminium reagents: Preparation, site selective and stereoselective additions of nucleophiles mediated by organoaluminum reagents, reaction with acid chlorides, allyl vinyl ethers, 1,2-addition to imines and application in the synthesis of natural products. Organocopper reagents: Gilmann reagent, preparation, reactions with aldehydes, ketones and imines. Application in the synthesis of brevicomin, Organozinc reagents: Preparation - oxidative addition and transmetallation, addition reactions of alkyl, aryl, allylic and propargylic zinc reagents, diastereoselective and enantioselective addition reaction with aldehydes, Reformatsky reaction. Organosamarium reagents: Reactions promoted by samarium diiodide and dicyclopentadienyl samarium – Barbier type reaction, Reformatsky type reactions, ketyl- alkene coupling reactions, pinacolic coupling reactions, acyl anion reactions. Organotin reagents: tributyltin hydride, Barton decarboxylation reaction, Barton deoxygenation reaction, Stille coupling, Stille-Kelley coupling reactions, Barton McCombie reaction, Keck stereoselective allylation and other applications.
UNIT – III

Asymmetric synthesis: Definition, importance, mechanism, energy consideration, advantages and limitations, methods of determination of enantiomeric excess. Methods of asymmetric induction.
  i. Topocity - Prochirality- Substrate selectivity - Diastereoselectivity and enantioselectivity-Substrate controlled methods-use of chiral substrates - examples
  ii. Auxiliary controlled methods- Use of chiral auxiliaries - Chiral enolates-alkylation of chiral imines - Asymmetric Diels - Alder reaction

Reagent controlled methods- Use of chiral reagents - Asymmetric oxidation –Sharpless epoxidation - Asymmetric reduction - Use of lithium aluminium hydride and borate reagents.

Synthesis and applications of oxazaborolidines, IPC-BBN, IPC₂BH, (S)-BINAP-DIAMINE and (R)-BINAL-H. Use of (R,R)-DIPAMP, (S,S)-CHIRAPHOS, (R,R)-DIOP, SAMP, RAMP, S-Proline, S-PBMgCl, (-)-BOAlCl₂, (+) and (-)-DET.

References
2. Organic Chemistry - Morrison and Boyd

CHP HCT: 4.3. PHYSICAL CHEMISTRY – IV
UNIT – I

Homogenous Catalysis: Acid-Base catalysis, specific acid and base catalysis. General acid and base catalysis. Oxidation of amino acids and carbohydrates in presence of acid and base catalysis. Acidity functions - Bronstead, Hückel, Hammett and Bunnett hypothesis.


Surface reactions: Langmuir unimolecular and bimolecular reactions.


UNIT – II

Phase rule studies: Thermodynamic derivation of phase rule. Application of phase rule to the two component systems - compound formation with congruent melting point and incongruent melting points, Roozeboom’s classification. Application of phase rule to three component systems- systems of three liquids and systems of two salts and water.


UNIT – III

Solid state chemistry: Types of imperfections, classification of imperfections, point defects, Schottky defects, Frenkel defects, disordered crystals, line defects, dislocation types, plane defects, small-angle and large-angle boundaries, stacking faults, crystal growth and twinning.

Fundamentals of X-ray crystallography: law of interfacial angles, laws of symmetry, Miller indices, Bragg equation, Experimental methods – powder and rotating crystal methods,

References
2. Chemical Kinetics by Frost and Pearson.
5. Chemical Kinetics by Benson.
7. Elements of Physical Chemistry by Lewis and Glasstone.
8. Phase Rule, Gurthu and Gurthu.
15. Introduction to Solids – Azaroff.
20. Molecular Structure by Wheatley
21. Physical Chemistry by Barrow
22. Physical Chemistry by Glasstone & Lewis