# MAR IVANIOS COLLEGE (AUTONOMOUS)

# THIRUVANANTHAPURAM

# (Affiliated to the University of Kerala)

**SYLLABI & GUIDELINES**

**FIRST DEGREE PROGRAMME IN CHEMISTRY**

**UNDER CHOICE BASED CREDIT AND SEMESTER SYSTEM**

**(2017 ADMISSION ONWARDS)**

## B.Sc. CHEMISTRY (Core)

### Aim and Objective of the Syllabi

### Aim

The B.Sc. Degree Programme in Chemistry covers three academic years consisting of six semesters and aims to provide the students with an in-depth understanding of and training in chemical sciences. The syllabus has been designed to stimulate the interest of the students in chemistry and prepared in order to equip the students with a potential to contribute to the academic and industrial requirements of the society. The new, updated syllabus is based on an interdisciplinary approach and is infused with a new vigour and more depth. Chemistry being an experimental science, due importance is given to the development of laboratory and instrumentation skills.

### Objective

The main objective is to provide to the students an in-depth understanding of the basic concepts of chemical sciences and enable them with tools needed for the practice of chemistry, which remains a discipline with much stress on experimentation. It attempts to provide a detailed knowledge of the terms, concepts, methods, principles and experimental techniques of chemistry.

### Course structure

The First Degree programme in Chemistry comprises of fourteen core courses, one project course, two elective courses, one core-specific foundation course in addition to one area-specific foundation course, the complementary courses and language courses. Among the two open/elective courses, the one offered in the fifth semester is open to students from other Majors. The details of the Course Structure are given in Table I. Table II gives the details of the contact hours and credits for the Core Courses, Foundation Course II, Open Course and Elective Course, Table III gives the details of Open Courses and Table IV gives the details of the Elective Courses and Table V gives distribution of Complementary Courses in different Semesters.

## First Degree Programme in Chemistry

### Table I: Course structure, Scheme of Instruction and Evaluation

| Semester | Course Code | Study component | Instructional hrs/Week | | Credit | Duration of Uty. Exam | Evaluation marks | | Total Credit |
|---|---|---|---|---|---|---|---|---|---|
| | | | T | P | | | CE | ESE | |
| I | AUEN 111.2 | English I | 5 | | 4 | 3hrs | 20 | 80 | 18 |
| | AUFR 111.2 AUHN 111.2 AUML 111.2 AUSY 111.2 AUTM 111.2 | Additional Language I | 4 | | 3 | 3hrs | 20 | 80 | |
| | AUEN 121.2 | Foundation Course I | 4 | | 2 | 3hrs | 20 | 80 | |
| | AUMM 131.2b | Complementary Course I | 4 | | 3 | 3hrs | 20 | 80 | |
| | AUPY 131.2b | Complementary Course II | 2 | | 2 | 3hrs | 20 | 80 | |
| | | Complementary Course Lab offf AUPY131.2b | | 2 | - | - | - | - | |
| | AUCH 141 | Core Course I | 2 | | 4 | 3hrs | 20 | 80 | |
| | | Core Course Lab I of AUCH141 | | 2 | - | - | - | - | |
| | AUEN 11.2 | English II | 4 | | 3 | 3hrs | 20 | 80 | |
| | AUEN 212.2 | English III | 5 | | 4 | 3hrs | 20 | 80 | |
| | AUFR 211.2 | Additional Language II | 4 | | 3 | 3hrs | 20 | 80 | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| II | AUHN 211.2 AUML 211.2 AUSY 211.2 AUTM 211.2 | | | | | | | | 18 |
| | AUCH 221 | Foundation Course II | 2 | 2 | 3 | 3hrs | 20 | 80 | |
| | AUMM 231.2b | Complementary Course III | 4 | | 3 | 3hrs | 20 | 80 | |
| | AUPY 231.2b | Complementary Course IV | 2 | | 2 | 3hrs | 20 | 80 | |
| | | Complementary Course Lab offf AUPY 231.2b | | 2 | - | - | - | - | |

**First Degree Programme in Chemistry Course structure, Scheme of Instruction and Evaluation**

| Semester | Course Code | Study component | Instructional hrs/Week | | Credit | Duration of Uty. Exam | Evaluation | | Total Credit |
|---|---|---|---|---|---|---|---|---|---|
| | | | T | P | | | CE | ESE | |
| III | AUEN 311.2 | English IV | 5 | | 4 | 3hrs | 20 | 80 | 18 |
| | AUFR 311.2 AUHN 311.2 AUML 311.2 AUSY 311.2 AUTM 311.2 | Additional Language III | 5 | | 4 | 3hrs | 20 | 80 | |
| | AUMM 331.2b | Complementary Course V | 5 | | 4 | 3hrs | 20 | 80 | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | AUPY 331.2b | Complementary Course VI | 3 | | 3 | 3hrs | 20 | 80 | |
| | | Complementary Course Lab of AUPY 331.2b | | 2 | - | - | - | - | |
| | AUCH 341 | Core Course II | 3 | | 3 | 3hrs | 20 | 80 | |
| | | Core Course Lab I of AUCH 341 | | 2 | - | - | - | - | |
| IV | AUEN 411.2 | English V | 5 | | 4 | 3hrs | 20 | 80 | 24 |
| | AUFR 411.2 AUHN 411.2 AUML 411.2 AUSY 411.2 AUTM 411.2 | Additional Language IV | 5 | | 4 | 3hrs | 20 | 80 | |
| | AUMM 431.2 b | Complementary Course VII | 5 | | 4 | 3hrs | 20 | 80 | |
| | AUPY 431.2b | Complementary Course VIII | 3 | 2 | 3 | 3hrs | 20 | 80 | |
| | AUPY 432.2bPI | Complementary Course Lab of AUPY 131.2b, AUPY 231.2b, AUPY 331.2b & AUPY 431.2b | | | 4 | 3hrs | 20 | 80 | |
| | AUCH 441 | Core Course III | 3 | | 3 | 3hrs | 20 | 80 | |
| | AUCH 44PI | Core Course IV-Lab I of AUCH 141, AUCH 341 & AUCH 44PI | | 2 | 2 | 3hrs | 20 | 80 | |

**First Degree Programme in Chemistry Course structure, Scheme of Instruction and Evaluation**

| Semester | Course Code | Study component | Instructional | | Credit | Duration of Uty. Exam | Evaluation | | Total Credit |
|---|---|---|---|---|---|---|---|---|---|
| | | | T | P | | | CE | ESE | |
| V | AUCH 541 | Core Course V | 4 | | 4 | 3hrs | 20 | 80 | |
| | AUCH 542 | Core Course VI | 3 | | 4 | 3hrs | 20 | 80 | |
| | AUCH 543 | Core Course VII | 4 | | 4 | 3hrs | 20 | 80 | |
| | AUCH 54PII | Core Course VIII Lab II | | 5 | 3 | 6hrs | 20 | 80 | |
| | AUCH 54PIII | Core Course IX Lab III | | 4 | 2 | | 20 | 80 | |
| | AUCH 581.b1/ AUCH 581.b2/ AUCH 581.b3 | Open Course | 3 | | 2 | 3hrs | 20 | 80 | |
| | | Project | | 2 | - | - | - | - | 19 |
| VI | AUCH 641 | Core Course X | 4 | | 4 | 3hrs | 20 | 80 | |
| | AUCH 642 | Core Course XI | 3 | | 4 | 3hrs | 20 | 80 | |
| | AUCH 643 | Core Course XII | 4 | | 4 | 3hrs | 20 | 80 | |
| | AUCH 64PIV | Core Course XIII Lab IV | 4 | | 3 | 6hrs | 20 | 80 | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | AUCH 64PV | Core Course XIV Lab V | 4 | | 2 | | 20 | 80 | |
| | AUCH 691.c1/ AUCH 691.c2/ AUCH 691.c3/ AUCH 691.c4 | Elective Course | 3 | | 2 | 3hrs | 20 | 80 | 23 |
| | AUCH 644 | Core Course XV Project and Factory Visit | | 3 | 4 | Viva voce | - | 100 | |

A) Language Courses = 9, B) Foundation Courses = 2, C) Complementary Courses = 9, D) Core Courses = 14, E) Open Course = 1, F) Elective Course = 1, G) Project = 1 Total Courses = 9+2+9+14+1+1+1 = 37.

Total Credits = 18+18+18+24+19+23 =120.

**B.Sc. Degree Programme in Chemistry**

**Table II. Scheme of Instruction of Core Courses, Foundation Course II, Open Course and Elective**

**Course**

| Course number | Course Code | Course Title | Semester I | | | Semester II | | | Semester III | | | Semester IV | | | Semester V | | | Semester VI | | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Hrs | | credit | | | credit | hrs | | credit | hrs | | credit | hrs | | Credit | hours | | credit | Hrs | credit |
| | | | **T** | **P** | | **T** | **P** | | **T** | **P** | | **T** | **P** | | **T** | **P** | | **T** | **P** | | | |
| C.C. I | AUCH 141 | Inorganic Chemistry I | 2 | | 4 | | | | | | | | | | | | | | | | 2 | 4 |
| F.C. II | AUCH 221 | Methodology and Informatics | | | | 2 | 2 | 3 | | | | | | | | | | | | | 4 | 3 |
| C.C. II | AUCH 341 | Inorganic Chemistry II | | | | | | | 3 | | 3 | | | | | | | | | | 3 | 3 |
| C.C. III | AUCH 441 | Organic Chemistry I | | | | | | | | | | 3 | | 3 | | | | | | | 3 | 3 |
| C.C. IV | AUCH 44PI | Lab I of AUCH 141,AU**CH 341, AUCH 44PI** | | 2 | | | | | | 2 | | | 2 | 2 | | | | | | | 6 | 2 |

| | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | (Inorganic Qualitative Analysis) | | | | | | | | | | | | | | | | | | | |
| C.C. V | AUCH 541 | Organic Chemistry II | | | | | | | | | | | | 3 | | 4 | | | | 3 | 4 |
| C.C. VI | AUCH 542 | Physical Chemistry I | | | | | | | | | | | | 4 | | 4 | | | | 4 | 4 |
| C.C. VII | AUCH 543 | Physical Chemistry II | | | | | | | | | | | | 4 | | 4 | | | | 4 | 4 |
| C.C. VIII | AUCH 54PII | Lab Course II of AUCH 541, AUCH 542 & AUCH 543 (Inorganic volumetric analysis) | | | | | | | | | | | | | 5 | 3 | | | | 5 | 3 |
| C.C. IX | AUCH 54PIII | Lab Course III of AUCH 541, AUCH 542 & AUCH 543 (Physical chemistry experiments) | | | | | | | | | | | | | 4 | 2 | | | | 4 | 2 |
| O. C | AUCH 581.b1/ AUCH 581.b2/ AUCH 581.b3 | Any One of the Options | | | | | | | | | | | | 3 | | 2 | | | | 3 | 2 |

| | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| C.C. X | AUCH 641 | Inorganic Chemistry III | | | | | | | | | | | | | | | 3 | | 4 | 3 | 4 |
| C.C. XI | AUCH 642 | Organic Chemistry III | | | | | | | | | | | | | | | 4 | | 4 | 4 | 4 |
| C.C. XII | AUCH 643 | Physical Chemistry III | | | | | | | | | | | | | | | 4 | | 4 | 4 | 4 |
| C.C. XIII | AUCH 64PIV | Lab Course IV (Organic chemistry experiments) | | | | | | | | | | | | | | | | 5 | 3 | 5 | 3 |
| C.C. XIV | AUCH 64PV | Lab Course V (Gravimetry) | | | | | | | | | | | | | | | | **3** | **2** | 3 | 2 |
| E.C. | AUCH 691.c1/ AUCH 691.c2/ AUCH 691.c3/ AUCH 691.c4 | Any one of the options | | | | | | | | | | | | | | | 3 | | 2 | 3 | 2 |
| C.C. XV | AUCH 644 | Project | | | | | | | | | | | | | | 2 | | | 3 | 4 | 5 | 4 |
| | | Factory Visit | | | | | | | | | | | | | | | | | | | |

C.C.- Core Course, F.C.-Foundation Course, O.P.-Open Course, E.C- Elective Course T-Theory, P-Practical.

**Table III. Distribution of Open Course offered to students of other disciplines**

**In Semester V**

| Semester | No. of Hours / Week | | Credits | Course Code | Title of the Course | Instructional Hours |
|---|---|---|---|---|---|---|
| | Lectures | Practicals | | | | |
| 5 | 3 | - | 2 | AUCH 581.b1 | Essentials of Chemistry | 54 |
| | | | | AUCH 581.b2 | Fundamentals of Chemistry & Its Application to Everyday Life | |
| | | | | AUCH 581.b3 | Environmental Chemistry | |

**Table IV. Distribution of Elective Course offered in Semester VI**

| Semester | No. of Hours / Week | | Credits | Course Code | Title of the Course | Instructional Hours |
|---|---|---|---|---|---|---|
| | Lectures | Practicals | | | | |
| 6 | 3 | - | 2 | AUCH691.a | Supramolecular, Nano Particles and Green Chemistry | 54 |
| | | | | AUCH691.b | Computational, Combinatorial and Physical Organic Chemistry | |
| | | | | AUCH691.c | Polymer chemistry | |
| | | | | AUCH691.d | Biochemistry | |

**Table V**

**Distribution of Complementary Courses in different Semesters**

Complementary Courses -4, Total Credits – 14

One Semester – 18 Weeks

| Sem | Hours/Week | | Number Of Credits | Course | Title of Course | Instructional Hours |
|---|---|---|---|---|---|---|
| | Theory | Practical | | | | |
| 1 | 2 | 2 | 2 | AUMM 131.2b | | 2×18 = 36<br>2×18 = 36 |
| 2 | 2 | 2 | 2 | AUPY 131.2b | | 2×18 = 36<br>2×18 = 36 |
| 3 | 3 | 2 | 3 | AUMM 231.2b | | 3×18 = 54<br>2×18 = 36 |
| 4 | 3 | 2 | 3<br>4 | AUPY 231.2b | | 3×18 =54<br>2×18 = 36 |

## GENERAL ASPECTS OF EVALUATION

## MODE OF EVALUATION – COMMON TO CORE, ELECTIVE, COMPLEMENTARY AND FOUNDATION COURSES

Evaluation of each course shall involve Continuous Evaluation (CE) with a weightage of 20 % and End Semester evaluation (ESE) with a weightage of 80 %. A system of performance based direct grading will be used with Grades A-E and the Grade Points as shown below.

| **Performance** | **% Marks** | **Grade** |
|---|---|---|
| Outstanding | 90 and above | A+ |
| Excellent | 80-89.99 | A |
| Very Good | 70-79.99 | B |
| Good | 60-99.99 | C |
| Satisfactory | 50-59.99 | D |
| Adequate | 40-49.99 | E |
| Failure | Below 40 | F |

### 1. CONTINUOUS EVALUATION FOR LECTURE COURSES

The Continuous evaluation will have 20% percentage weightage and will be done continuously during the semester. CE components are

(i) Attendance for lecture and laboratory sessions (to be noted separately where both lecture and laboratory hours have been specified within a course);

(ii) Assignment /seminar and

(iii) Test

| **1.1 Components of CE For Lecture Courses** | | | |
|---|---|---|---|
| No | Component | Range | Marks |
| 1 | Attendance<br>(0.5 and above shall be rounded off to the exact digit and less than 0.5 shall be ignored) | < 75 % | 0 |
| | | 75% | 1 |
| | | 76% to 80% | 2 |
| | | 81% to 85% | 3 |
| | | 86% to 90% | 4 |
| | | 91% to 100% | 5 |
| 2 | Assignment/Seminar | | 0- 5 |
| 3 | One Test | | 0 - 10 |

## I. 1. 1. EVALUATION OF THE ASSIGNMENTS AND SEMINAR

The assignment typed/written on A4 size paper should be 4-6 pages. The minimum duration of the seminar is fifteen minutes and the mode of delivery may use audio-visual aids if available. Both the assignment and the seminar will first be evaluated by awarding marks 1 -5 based for each of the four components below in Table I.1.1. The seminar is to be conducted within the contact hour allotted for the course.

| **I. 1. 1. Mode of Assignments / Seminar Evaluation** | | |
|---|---|---|
| No | **Main Component** | **Marks** |
| 1 | Adherence to overall structure &submission deadline | All four main components present & satisfactory : 5<br>Only three : 4<br>Only two : 3<br>Only one : 2<br>None : 0 |
| | Content & grasp of the topic | |
| 3 | Lucidity / Clarity of presentation | |
| 4 | References / Interaction/Overall effort | |

The following explanatory guide lines in Table I.1.1.1 are suggested tentatively for the assessment of each of the above main components as satisfactory or not.

| **No** | **Main Component** | **Sub-Components** |
|---|---|---|
| 1 | Adherence to overall structure & submission deadline | i. Punctual submission<br>ii. Adequate length/duration<br>iii. Inclusion of Introduction, Discussion & Summary sections<br>iv. Absence of errors/mistakes |
| 2 | Content & grasp of the topic | i. Coverage of topic<br>ii. Understanding of topic<br>iii. Logical organization |

| | | |
|---|---|---|
| | | iv. Originality (No copying from a source) |
| 3 | Lucidity / Clarity | i. Clarity<br>ii. Effective presentation/delivery<br>iii. Neatness of presentation<br>iv. Inclusion of appropriate diagrams /equations /structures etc |
| 4 | References / Interaction/Overall effort | i. Listing of references<br>ii. Use of more than one reference source/Use of Web resource<br>iii. Correct Response to quiz /questions<br>iv.Overall effort in preparing assignment/seminar |

## I. 1. 2. DETAILS OF THE CLASS TEST

The test has duration of 3 hours.

Each question paper has four parts: A, B, C and D and the marks are shown in Table I.1.2

**1. 1. 2. Question Paper Pattern for Test**

| Part | Qn. Nos. | Type of Question | No. of questions to be answered | Total Marks |
|---|---|---|---|---|
| A | 1 – 10 | Objective/one or two sentences | 10 out of 10 | 10 |
| B | 11 – 22 | Short Answer | 8 out of 12 | 16 |
| C | 23 – 31 | Short Essay | 6 out of 8 | 24 |
| D | 32 – 35 | Long Essay | 2 out of 4 | 30 |

## I. 2. CONTINUOUS EVALUATION FOR LABORATORY COURSES

The Continuous evaluation will have 20% percentage marks. For 5th and 6th semesters, CE and ESE will be carried out in the respective semesters. The CE components are:

(i) Attendance for laboratory sessions

(ii) Experiment (Lab) Report on completion of each set of experiments

(iii) Laboratory Skill and

(iv) Quiz / Test.

These are summarized below in Table I. 2. Total marks 10.

| No | Component | Range | Marks |
|---|---|---|---|
| | Attendance | < 75 % | 0 |
| | | 75% | 1 |
| | | 76% to 80% | 2 |
| | | 81% to 85 % | 3 |
| | | 86% to 90% | 4 |
| | | 91% to 100% | 5 |
| 2 | Experiment (Lab) Report | | 0 – 5 |
| 3 | Laboratory Skill | | 0 – 5 |
| 4 | Quiz / Test | | 0 – 5 |

| | |
|---|---|
| **Maximum marks** | **20** |

The guidelines for evaluating the two main components 2-4 using sub-component are presented below.

### I. 2. 1. EVALUATION OF THE EXPERIMENT (LAB) REPORT

On completion of each experiment, a report should be presented to the course teacher as soon as the experiment is over. It should be recorded in a bound note-book and not on sheets of paper. The experimental description should include aim, principle, materials/apparatus required/used, method/procedures, and tables of data collected, equations, calculations, graphs, and other diagrams etc. as necessary and final results. Careless experimentation and tendency to cause accidents due to ignoring safety precautions will be considered as demerits.

| **I. 2. 1. Mode of EXPERIMENT (LAB) Report Evaluation** | | |
|---|---|---|
| **No** | **Sub component** | **Marks** |
| 1 | Punctual submission and Neat presentation | All four sub-components present & satisfactory : 5<br>Only three : 4<br>Only two : 3<br>Only one : 2<br>None : 0 |
| 2 | Inclusion of aim, materials, procedure etc | |
| 3 | Calculations and absence of errors/mistakes | |
| 4 | Accuracy of the result | |

## I. 2. 2. EVALUATION OFTHE LAB SKILL

| I. 2. 2. EVALUATION OFTHE LAB SKILL | | |
|---|---|---|
| **No** | **Sub component** | **Marks** |
| 1 | Punctuality and experiment completion on time | All four sub-components present & satisfactory : 5<br>Only three : 4<br>Only two : 3<br>Only one : 2<br>None : 0 |
| 2 | Lab skill & Neat arrangements of table and apparatus in lab | |
| 3 | Prompt and neat recording of observations in lab note book | |
| 4 | Experimental Skill and attention to safety | |

## I. 2. 3. EVALUATION OF THE LAB QUIZ /TEST

The test for a lab course may be in the form of a quiz and two such tests are to be conducted. Based on the performance in answering the quiz, Marks 0 – 5 may be awarded and the better grade earned in these two will be counted for CE. Two teachers, one of which is the course teacher, should conduct the quiz/test within the assigned lab contact hours.

## II. 1. END SEMESTER EVALUATION FOR LECTURE COURSES

The end semester evaluation will be done by the College at the end of the semester and it will have 80% percentage marks. End of semester theory examination will be for 80 marks of 3-hr duration.

## II. 1. 1. END SEMESTER QUESTION PAPER PATTERN

1. The theory examination has a duration of 3 hours
2. Each question paper has four parts: A, B , C and D
3. Part A contains ten questions each carrying one mark. All are compulsory.
4. Part B contains twelve questions each carrying 2 marks, out of these twelve questions, the students have to answer eight questions.
5. Part C contains nine questions of which the candidate has to answer six. Each question has 4 marks. (Short Essay type).
6. Part D contains four questions of which the candidate has to answer two. Each question has 15 marks. (Long Essay type).
7. The total marks for the entire questions to be answered is 80.

## II. 2. END SEMESTER EVALUATION FOR LABORATORY COURSES

The components to be assessed as part of ESE of Lab courses and their weightage are discussed along with the syllabi for each of such laboratory courses in the subsequent sections.

## III. Project/dissertation, Factory/R&D Institute Visit and Project based Viva-voce Evaluation of the Project & Factory/Research institution visit report

**Semester VI AUCH 644**

The Project work may be conducted individually or by a group comprising of a maximum of 5 students during semester V and VI. The work of each student/group shall be guided by one faculty member. After the completion of the work, the student shall prepare 2 copies of the Project report. The copies

certified by the concerned guide & the Head of the Department shall be submitted prior to the completion of the sixth semester. The typed copy of the report may have a minimum of 25 pages. It should contain Title page, Introduction, Review, Result and Discussion, References etc. These reports will be evaluated by a board of two Examiners appointed by the University. The examiners should affix their dated signatures in the facing sheet of the Project report. The evaluation/Viva voce of the Project report is conducted on a separate day. The students have to present their work individually before the examiners on the Viva-Voce day. The examiners shall consult each other and award grades based on the various components given in the Table 1 below. There shall be no continuous assessment for dissertation /project work.

The Factory/ research institution visit report should be submitted during the Lab course examination/Viva voce and the report must be evaluated and the examiners should affix their dated signatures in the facing sheet. A maximum of 10 marks may be given.

The marks for Project/dissertation shall be calculated by consolidating the marks secured for the submission of Project/dissertation and the project based viva-voce.

| III EVALUATION OF THE PROJECT AND FACTORY/RESEARCH INSTITUTE VISIT (CHEMISTRY) | | | | |
|---|---|---|---|---|
| No | Main Component | Max marks | Sub components | Mark distribution |
| 1 | Dissertation | 16 | Introduction, Review and Objectives | Excellent :16<br>Very good: 12<br>Good: 8<br>Average: 4<br>None: 0 |
| 2 | ,, | 16 | Materials and methods | Excellent :16<br>Very good: 12<br>Good: 8<br>Average: 4<br>None: 0 |

| | | | | |
|---|---|---|---|---|
| 3 | ,, | 16 | Results and Discussion | Excellent :16<br>Very good: 12<br>Good: 8<br>Average: 4<br>None: 0 |
| 4 | ,, | 16 | Conclusion and References | Excellent :16<br>Very good: 12<br>Good: 8<br>Average: 4<br>None: 0 |
| 5 | Project presentation | 16 | i) Clarity and understanding, ii) Effective presentation, iii) Time Management, iv) Interaction | Excellent :16<br>Very good: 12<br>Good: 8<br>Average: 4<br>None: 0 |
| 6 | Factory / research institution visit | 10 | i) Brief Description of factory/Institute ii) Figures/flow charts iii) Details of instruments/facilities iv) Neatness of presentation | All four :10<br>Three : 8<br>Two : 6<br>One :4<br>None :0 |
| 7 | Viva-voce | 10 | Understanding of the, i) Review, ii) Objectives, iii) Methodology, iv)Results | All four :10<br>Three : 8<br>Two : 6<br>One :4<br>None :0 |
| TOTAL | | 100 | | 100 |

## IV GENERAL ASPECTS OF COURSE AND CREDIT TRANSFER

As per Regulations, students from other institutions may be admitted in the 3rd and 5th by transfer subject to conditions prescribed by the College with the approval of the \university. Such transfers to a B. Sc. Chemistry Programme can be permitted only from a similar semester

based three year degree programme with Chemistry as the major and maths as a compulsory complementary course and physics as a desirable complementary course. The requirements of the language, foundation and elective courses will be decided as per views of the concerned BoS. For core course transfers, the transferable credit per course is limited to 4 (as this is at present the highest credit per course in Univ. of Kerala) even if the source Institution awards a credit >4. If, however, a core course with comparable content, contact hours and mode of evaluation has a credit <4 at the source Institution, then the transferee may be awarded a credit in par with the similar course at the University.

| **Marks Distribution for BSc Chemistry End Semester Examinations and Practicals** | | | | | |
|---|---|---|---|---|---|
| Semester | No.of Theory papers | Marks for Theory | No. of Practicals /Project | Marks for Practicals | Total |
| 1 | 6 | 6 x 100 = 600 | | | 600 |
| 2 | 6 | 6 x 100 = 600 | | | 600 |
| 3 | 5 | 5 x 100 = 500 | | | 500 |
| 4 | 5 | 5 x 100 = 500 | 2 | 2 x 100 = 200 | 700 |
| 5 | 4 | 4 x 100 = 400 | 2 | 2 x 100 = 200 | 600 |
| 6 | 4 | 4 x 100 = 400 | 2 | 2 x 100 = 200 | 600 |
| | Project + Factory visit report + viva voce | | | 80+10+10 = 100 | 100 |
| **TOTAL** | **30** | **3000** | **6+1** | **700** | **3700** |

**SYLLABUS FOR B.Sc. CHEMISTRY PROGRAMME**

Semester – I, Core Course – 1

Course Code– AUCH 141, Credit-4

**Inorganic Chemistry I**

**Course Outcomes (CO):**

| **AUCH 141: Inorganic Chemistry-I** | |
|---|---|
| **Total Teaching Hours for Semester :36** | **No of Lecture Hours/Week :2** |
| **Max Marks :80** | **Credit-4** |
| **Course Outcomes** | |
| **CO1: Familiarises the structure of atom , periodicity of elements and different concepts of acids and bases**<br><br>**CO2: Learns the chemistry of hydrogen, properties and uses of s-block elements**<br><br>**CO3: Gives a strong foundation in environmental chemistry and different types of pollution**<br><br>**CO4: Students will acquire fundamentals of non aqueous solvents** | |

**Course outline**

**Module I- Atomic Structure and Periodicity 6 hrs.**

Introduction to the structure of atom - Dual nature of electron - de Broglie equation - matter waves and electromagnetic waves - experimental verification of de Broglie relation - Heisenberg's uncertainty principle - expression and significance. Wave mechanical concept of the atom - Schrodinger equation (Derivation not required) -. Quantum numbers - Pauli's

exclusion Principle - Aufbau Principle – Hund's rule - Electronic configuration of atoms - classification of elements into s, p, d, f blocks - electronegativity- Pauling's scale, Mulliken and Allred - Rochow scale-(Including numerical problems)

**Module II-Hydrogen 6 hrs**.

Position of hydrogen in the periodic table. - Similarities and difference in properties compared with alkali metals and halogens- Atomic and physical properties of hydrogen; Preparation of hydrogen- Reactions of hydrogen. Nascent, atomic and active hydrogen- Ortho and para hydrogen -Deuterium and tritium –Uses of hydrogen- Hydrogen as next generation fuel- Hydrides- Types of hydrides, properties; water; Hydrogen bond-types-consequences of hydrogen bond. Hydrates; Hardness of water- types- different methods water softening. Heavy water- preparation and properties. Hydrogen Economy.

**Module III- s-Block Elements 9 hrs.**

General characteristics, atomic and ionic radii, ionisation enthalpy, electropositive character, formation of univalent positive ions, hydration of ions, reducing properties, Electrode potentials, characteristic flame colouration, lattice enthalpy, chemical properties, , comparison of lithium with other members of the family, resemblance of lithium and magnesium, uses of alkali metals, properties of alkali metals and their uses, compounds of elements of group 1 – comparative study-oxides, hydroxides, halides, carbonates and bicarbonates General characteristics of group II-atomic and ionic radii, ionisation enthalpy, reducing properties, electrode potentials, characteristic flame colouration, chemical properties, gradation in properties, comparison of beryllium with other members of the family, Uses of alkaline earth metals, Compounds of alkaline earth metals-Beryllium oxide, beryllium chloride, calcium oxide, calcium hydroxide, calcium cyanamide- preparation and properties. comparison of solubility products of hydroxides and sulphates, Portland cement.

**Module IV -Acids, Bases and Non Aqueous Solvents 6 hrs.**

Lowery-bronsted and Lewis concepts of acids and bases-introduction to SHAB principle. General properties- classification- self ionization and levelling effect- reaction in non-aqueous

solvents - protic and aprotic non aqueous solvents- examples- solutions of metals in liquid ammonia- self ionization of liquid ammonia- liquid SO2, liquid HF, alkali metals in liquid ammonia

**Module V - Environmental Chemistry – Air, Water and Soil Pollution 9 hrs.**

Layers of atmosphere.

Air pollution - ozone layer depletion, ozone hole, protection of ozone umbrella – the different types of pollutants - Air pollution caused by fire works, harmful effects of fireworks, acid rain, green house effect, smog –Classic and photochemical Smog- management of air pollution.

Water pollution: Causes- Heat, industrial waste, sewage water, detergents, agricultural pollutants - treatment of industrial waste water-Activated charcoal, Synthetic resin, reverse osmosis and electro dialysis - Water analysis -Quality of drinking water - Indian standard and W H O standard - Dissolved oxygen - BOD, COD.

Soil pollution - Pesticides, Fertilizers, Industrial waste, e-waste and its treatment, plastics - Control of pollution

Basics of Green Chemistry

**Text Books.**


[1]. Puri, Sharma and Kalia “Inorganic Chemistry” Milestone Publishers & Distributors/ Vishal Publishing Co.; 33rd edition edition (2016)

[2]. K. Ahluwalia and Lalita S. Kumar “Environmental Chemistry” , ANE Books, 2008

[3]. Manku , “Theoretical principles of Inorganic Chemistry” , Tata Mc Graw Hill, 2006


**References**

[1]. T.F.Gieryn, Cultural boundaries of science, Univ. Chicago Press 1999. Manas Chanda, "Atomicstructure and Chemical Bonding including Molecular spectroscopy" Tata McGraw-Hill, 2nd Edition1979
[2]. E.S. Gilreath "Fundamental concepts of Inorganic Chemistry", Tata Mc Graw Hill, 2015
[3]. M. C. Dey and J. Selbin "Theoretical Inorganic Chemistry", Affiliated East West, New Delhi, 1971
[4]. Frank Albert Cotton, Geoffrey Wilkinson, Paul L. Gaus "Basic Inroganic Chemistry". J. Wiley, 3rd edition, 1995
[5]. S. K. Banerji, "Environmental Chemistry", Princton Hall of India Pvt Ltd,Second Edition, 2005
[6]. B. K. Sharma "Air Pollution", Krishna's Educational Publishers,2014
[7]. G.W. van Loon and S. J. Duffy "Environmental Chemistry: A global perspective", Oxford University Press 2010.

Model Question Paper

**Mar Ivanios College (Autonomous)**

Semester –I, Core Course-1

Course Code - AUCH 141

**INORGANIC CHEMISTRY I**

**Time: Three Hours** **Maximum Marks: 80**

**SECTION A**

**(Answer all questions in one word/one sentence. Each question carries 1 mark)**

1. Mention about the flame colouration of II group elements.
2. Write an example of classic smog.
3. State Heisenberg's uncertainty principle.
4. What are matter waves?
5. Which is the conjugate base of HF?
6. Define covalent radius.

7. Write the reason for eutrophication?
8. In the stratosphere, fluorine from the CFC's change to which compound.
9. What is active hydrogen?
10. Mention any use of alkali metals.

(1 X 10 = 10 Marks)

## SECTION B

**(Answer any 8 questions. Each question carries 2 Marks)**

11. Calculate the wavelength of electron moving with a velocity of 106 ms-1.
12. A cricket ball weighing 100g is to be located within 0.1Ao. What is the uncertainty in its velocity?
13. What are eigen values and eigen functions?
14. How first element differs from other elements in a group?
15. What is COD?
16. What are ortho and para hydrogens.
17. Write SHAB principle?
18. Comment about the hydration of alkali metals?
19. State and illustrate Pauli's Exclusion Principle.
20. Distinguish between levelling solvents and differentiating solvents.
21. Write a note on green house effect.
22. What is acid rain? Explain the various types of hydrogen bonds.

(2 X 8 = 16 Marks)

## SECTION C

**(Answer any 6 questions. Each question carries 4 Marks)**

23. Discuss the following reactions in liquid SO2?(i) Solvation (ii) acid- base reaction
24. Discuss the structure of beryllium chloride
25. Derive Schrodinger wave equation.

26. Briefly explain about the Davisson and Germer's experimental verification of wave nature of electron.
27. What is smog? What are the different types of smog?
28. How ozone layer is depleted?
29. What is the trend of Ionization enthalpy and electron gain enthalpy in the periodic table?
30. What are hydrides? Explain.
31. Discuss about the redox property of alkali metals

(4 X 6 = 24 Marks)

## SECTION D

**(Answer any 2 questions. Each question carries 15 Marks)**

32. Briefly discuss about the various air pollutants (5 Marks), (b) Write a note on Ozone depletion (5 Marks), (c) Explain about the various water quality parameters (5 Marks)
33. What are quantum numbers? Explain (5 Marks), (b) Write a note on various electronegativity scales (5 Marks), (c) Explain about the various rules for writing electronic configuration. (5 Marks)
34. What is the difference between inter and intra molecular hydrogen bonding with example. (5 Marks), (b) Discuss the topic hydrogen as next generation fuel (5 Marks), (c)Liquid ammonia is a better solvent for organic compounds. Why? (5 Marks)
35. What are the common characteristics of solvents? (5 Marks), (b) Discuss the various methods for removal of permanent hardness (5 Marks), (c) Compare the solubility products of hydroxides and sulphates of alkaline earth metals. (5 Marks)

(15 X 2 = 30 Marks)

**SYLLABUS FOR B.Sc. CHEMISTRY PROGRAMME**

SEMESTER- II, Foundation Course – II

Course Code - AUCH 221, Credit-3

**Course Name - Methodology and Perspectives of Sciences and General Informatics**

**Course Outcome (CO):**

| AUCH 221 **Methodology and Perspectives of Sciences and General Informatics** | |
|---|---|
| **Total Teaching Hours for Semester :36** | **No of Lecture Hours/Week :2** |
| **Max Marks :80** | **Credit-3** |
| **Course Outcomes** | |
| **CO1: Familiarize with methodology and perspectives of science**<br><br>**CO2: Focuses the elementary aspects of research in chemistry and safety measures in laboratory**<br><br>**CO3: Emphasizes the role of informatics in chemistry**<br><br>**CO4: Learn computer based application in analysis of experimental data** | |

**Course outline**

**Module – 1: Methods and Tools of Science & Experimentation in Science 6 hrs.**

Laws of science - Basis for scientific laws and factual truths - hypothesis – observations and proofs. Revision of scientific theories and laws. Importance of models, simulations and virtual

testing in chemistry-Design of an experiment – experimentation - observation – data collection – types of data – examples-interpretation and deduction –repeatability and replication-units and dimensions, unit conversions. Documentation of experiments – record keeping

**Module II – Evolution of Chemistry as a discipline of science 6 hrs.**

Evolution of Chemistry - ancient speculations on the nature of matter, early form of chemistry-alchemy, Robert Boyle and the origins of modern chemistry in the latter 1600s - Antoine Lavoisier and the revolution in chemistry -Chemical atomism—background and thought of John Dalton. Atom models- Daltons, J. J. Thomson, Rutherford, Bohr model – Major contributions of Friedrich Wöhler, Mendeleev, Michael Faraday and Marie Skłodowska-Curie. Structure of chemical science: scope of chemical science, branches of chemistry. Basic ideas of interdisciplinary areas involving Chemistry

**Module III Research in Chemistry 6 hrs.**

Selecting a topic – hypothesis- Design of an experiment –- observation – data collection – experimentation. Documentation of experiments – nature and types of data – typical example. interpretation and deduction – necessity of units and dimensions – Accuracy and precision, variables, correlation and causality, sampling, use of controls, experimental bias, analysis, results, discussion of results, models., statistical analysis of experimental data using computers, mean, mode, deviation, standard deviation. -Plotting graph, preparation of seminar papers, project using computers.

Study of latest Nobel Prize topics in chemistry (only one in the year of study of S2 course from Nobel web site).

**Module IV – Overview of Information Technology & Introduction to Cheminformatics 6 hrs.**

Introduction to use of IT in teaching and learning process – Educational softwares – INFLIBNET, NICNET, BRNET, NPTEL, VIRTUAL LABS OF MHRD academic services (elementary level only).

Basics of cheminformatics, applications of cheminformatics, storage & retrieval, file formats – MOL, SDF, CML, PDB formats, SYBYL Line Notation, SMILES of simple molecules like methane, benzene , cyclohexane. Structure drawing, spread sheet and chemistry related softwares. Molecular visualization tools. Chemical Databases.

**Module V - Analytical Principles 6 hrs.**

Inorganic qualitative analysis - Common ion effect - solubility product - precipitation of cations. Microscale analysis – Advantages

Quantitative Analysis - Theory of titration - acid-base, redox, precipitation and complexometric titrations. Theory of indicators - acid-base, redox, adsorption and metallochromic indicators.

Chromatography - classification of methods - Elementary study of adsorption chromatography Column and thin layer- partition chromatography-paper- ion exchange and gas chromatographic methods.

**Module VI - Gravimetric Analysis & Safety measures in Laboratory 6 hrs.**

Gravimetric Analysis - Mechanism of precipitate formation - Factors affecting solubility of precipitates – co-precipitation and post precipitation - Effect of digestion - washing, drying and ignition of precipitates.

Introduction to lab safety-regulatory requirements-labels, material safety. Knowledge of hazard warning information and symbols. Explosive compounds (idea), potentially dangerous mixtures- Fire hazards (idea about flammable solvents, ignition sources used in laboratories, metal hydrides), Emergency procedures in chemical splashes to skin and eyes, burns and electric shock.

Reactive inorganic reactants and their toxicity (strong acids, bases, halogens, chromates). Hazards due to chemicals, toxic- solids, liquids, gases, and other harmful substances - carcinogenic substances.

**Text Books**

[1]. I. Vogel, “Text book of Quantitative Inorganic Analysis”, Wiley
[2]. Barbara Wilson, Information Technology, The Basics, Thomas Learning.
[3]. Louis Cohen, Lawrence Manion, Keith Morrison, Research Methods in Education, Routledge
[4]. Hazards in chemical laboratories and guide to safe practices in chemical laboratories published by Royal Society of Chemistry.
[5]. Arthur Israel Vogel, B. S. Furniss, P. W. Smith, Textbook of Practical Organic Chemistry, Longman Scientific & Technical.

**References**

[1]. Donald H. Sanders, Computers Today, McGraw-Hill, edited by Funda Ornek, Issa M. Saleh , Contemporary Science Teaching Approaches: Promoting Conceptual Understanding in Science, Information age publishing.
[2]. Calvin W Tayler and Frank Barron Scientific Creativity : Its Recognition and Development, Wiley.
[3]. Louise Cohen, Lawrence Manion & Keith Morrison A Guide to Teaching Practice, Routledge.
[4]. R C Mishra Teaching of information Technology, APH Publishing Corporation.
[5]. M Ravikumar Information Technology for Higher Education, Sonali Publications.
[6]. Kolasani Sunil Kumar, K Ramakrishna and Digumarti Bhaskara Rao, Methods of Teaching Chemistry, Discovery Publishing House Pvt. Ltd.
[7]. Rajaram, Introduction to Information Technology, Prentice Hall.
[8]. Newton R G, The Truth of Science-Physical Theories and Reality. Harward University Press
[9]. Andrew R. Leach and V.J. Gillet, An Introduction to Chemoinformatics, Springer.
[10]. N.C. Datta, The Story of Chemistry, University Press.
[11]. http://www.vlab.co.in
[12]. http://nptel.iitm.ac.in/
[13]. Reuben Alexander Day, Arthur Louis Underwood “Quantitative analysis: laboratory manual”. Prentice-Hall
[14]. A.H Ahluwalia, Renu Aggarwal, Comprehensive Practical organic chemistry, universities press.

**Model Question Paper**

**Mar Ivanios College (Autonomous)**

B. Sc. Chemistry Programme (2017 onwards)

Semester II Foundation Course 2

Course Code AUCH 221,

**Methodology and Perspectives of Sciences and General Informatics**

**Time:Three Hours** **Maximum Marks:80**

**Section- A**

(Answer all Questions. Answer in one word / sentence. Each question carries 1 mark.

1. Who is the father of modern chemistry?
2. Define null hypothesis.
3. What is NPTEL?
4. What you meant by plagiarism?
5. What are the contributions of Dmitri Mendeleev?
6. What are variables?
7. Define common ion effect
8. What are redox indicators?
9. Define accuracy
10. Write the name of two toxic chemicals used in chemistry laboratory.

(1 X 10 = 10 Marks)

**Section B (short answer type)**

(Answer any 8 questions from the following. Each answer carries 2 mark)

11. What is co-precipitation?
12. Define standard deviation.
13. Write a short note on a chemical which is skin irritant.

14. What is meant by data representation?
15. Name four chemistry related softwares?
16. Mention the toxicity of strong acids
17. What is a chemical database?
18. Explain basic concepts of IPR?
19. What are the features of modern personal computer?
20. What are acid base indicators ?
21. What is TLC?
22. Which are the factors affecting solubility of precipitates.

(2 X 8 = 16 Marks)

**Section C (Short essay type)**

Answer any 8 from the following. Each question carries 4 marks.

23. What is meant by revision of scientific theories and laws?
24. Explain documentation of experiments.
25. Explain the applications of cheminformatics.
26. Explain copy right and patents.
27. Explain enquiry vs discovery approach?
28. Discuss about the carcinogenic chemicals used in the laboratory.
29. What is the scope of chemical science?
30. Write a short note on the theory of an acid base indicator
31. Explain the principle of gravimetric titration with an example.

(6 X 4 = 24 Marks)

**Section D.**

Answer any 2 from the following. Each question carries 15 marks

32. (a)Explain the various types of file formats (5 marks), (b) databases used in cheminformatics? (5 marks), (c)Write the SMILES of Methane, Benzene and cyclohexane.(5 marks)

33. Discuss about chemical safety, Discuss about the theory of titration, Write a note on the knowledge of hazard warning informations.

34. Write a short note on the evolution of modern chemistry, (b) Write a note on induction-deduction methods in knowledge transfer process.

35. Explain the applications of common ion effect and solubility product in analysis of cations. (10 marks), (b) Write a short note on method to avoid accidents in chemical laboratory. (5marks)

(2 X 15 = 30 Marks)

**SYLLABUS FOR B.Sc. CHEMISTRY PROGRAMME**

SEMESTER- III, Core Course – II

Course Code - AUCH 341, Credit-3

**Course Name - Inorganic Chemistry- II**

**Course Outcome (CO):**

| AUCH 341 | |
|---|---|
| **Total Teaching Hours for Semester :54** | **No of Lecture Hours/Week :3** |
| **Max Marks :80** | **Credit-3** |
| **Course Outcomes** | |
| ● CO 1 - Thorough Knowledge in Chemical Bonding<br>● CO 2 - Learns about the Non-transition elements and their compounds in detail<br>● CO 3 - Give a strong foundation in nuclear chemistry and the applications<br>● CO 4 - Students will acquire fundamentals of nanomaterials | |

**Course outline**

**Module-1 Chemical Bonding–I** **9 hrs.**

Concept of resonance, formal charges. VSEPR theory and its applications - structure of molecules with bond pairs only, molecules with both bond pairs and lone pairs . -Valence bond theory-Conditions for overlapping-Types of overlapping (positive, negative and Zero overlapping), - hybridization - methane, ethylene, benzene, acetylene,allenes, sp3d and sp3d2– Limitations of VBT

MO theory, LCAO, homonuclear diatomic molecules- C2, B2, N2, O2 and ions like O2+- heteronuclear

diatomic molecules (HF, NO, and CO) – Bond order - comparison of VB and MO theories

**Module II : Chemical Bonding–II** **9 hrs**

Ionic bond-ionic lattice energy of ionic compounds- Bond-Lande equation, Born Haber cycle,

solvation energy and solubility of ionic solids-covalent character of ionic bond, Fajan's rules Polarity of Covalent bond- dipole moment- percentage ionic character- dipole moment and molecular structure

Metallic bonding- free energy theory, VB theory and band theory (Qualitative treatment only)- Secondary forces – hydrogen bond, inter and intramolecular hydrogen bond, intermolecular interaction –- ion –dipole van der Waals forces such as dispersion forces, dipole-dipole, ion-induced dipole, dipoleinduced dipole

**Module III Compounds of non-transition elements I 9 hrs**

Manufacture and uses of the following Glass – different types of glasses, Silicates, Zeolites and Silicones. Borax - boron hydrides, boron nitrides, borazole and carboranes. Oxides and oxyacids of phosphorus. Refractory carbides, nitrides, salt-like carbides, borides, and silicides.

**Module IV Compounds of non-transition elements II 9 hrs**

Oxides and oxyacids of halogens (structure only) – Inter halogen compounds and pseudo halogens – Compounds of noble gases (Xenon and Radon)– Uses of noble gases.

Inorganic polymers Phosphorus, boron and silicon based polymers – Structure and industrial applications.

**Module V: Nuclear Chemistry 9 hrs**

Natural radioactivity, modes of decay, decay constant(Derivation not expected), half life, average life, Disintegration series. Geiger –Nuttal rule, artificial transmutation and artificial radioactivity- nuclear stability, n/p ratio, packing fraction, mass defect and binding energy, Nuclear models –Shell model and liquid drop model. nuclear fission-atom bomb and nuclear fusion-hydrogen bomb-applications of radioactivity- 14C dating, rock dating neutron activation analysis and isotope as tracers. Study of reaction mechanism (ester hydrolysis)- application of radioactive isotopes in medicine - Radio diagnosis and radiotherapy. (Including numerical problems)

**Module VI : Chemistry of Nanomaterials 9 hrs**

Evolution of Nanoscience – Historical aspects- Preparations containing nano gold in traditional medicine. Lycurgus cup- Faraday's divided metal etc. Nanosystems in nature. Preparation of nanoparticles: Top-down approaches and Bottom to top approach Sol–gel synthesis, Colloidal precipitation, Co–precipitation, Combustion technique, Sonochemistry, Hydrothermal technique, High energy ball milling etc. Carbon nanotubes and fullerenes. Properties of nanoparticles: optical, magnetic, mechanical, thermal and catalytic properties with examples.

**Text Books**


[1]. Frank Albert Cotton, Geoffrey Wilkinson, Paul L. Gaus "Basic Inroganic Chemistry". J. Wiley, 3rd edition, 1995

[2]. J. D. Lee "Concise Inorganic Chemistry" :, Wiley, 5th Edition,1999

[3]. "Nano, The Essentials", T. Pradeep, Mc Graw- Hill Education, 2007

[4]. Puri, Sharma and Kalia "Inorganic Chemistry" Milestone Publishers & Distributors/ Vishal Publishing Co.; 33rd edition edition (2016)


**Reference:**


[1]. E.S. Gilreath "Fundamental concepts of Inorganic Chemistry", Tata Mc Graw Hill, 2015

[2]. Manku , "Theoretical principles of Inorganic Chemistry" , Tata Mc Graw Hill, 2006

[3]. M. C. Dey and J. Selbin "Theoretical Inorganic Chemistry", Affiliated East West, New Delhi, 1971

[4]. James E. Huheey, Ellen A. Keiter, Richard L. Keiter, Okhil K. Medh, "Inorganic Chemistry- Principles and Structure and Reactivity" ,5th edition, 2009

[5]. Shriver and Atkins, "Inorganic Chemistry", Oxford University Press, 5th Edition, 2010

[6]. Bosolo and Johnson, "Coordination Chemistry" 1986

[7]. Geoffrey A. Lawrance, Introduction to Coordination Chemistry, Wiley, 2010

[8]. T.F.Gieryn, Cultural boundaries of science Univ. Chicago Press 1999.

[9]. H.J. Arnikar, Essentials of Nuclear Chemistry, 4th Edition, New Age International (P) Ltd., New Delhi, 1995 (Reprint 2005).

[10]. S. Glasstone, Source Book on Atomic Energy, 3rd Edition, East-West Press Pvt. Ltd., New Delhi, 1967.

[11]. The Golem : What everyone should know about science. H.Collins and T.Pinch. Cambridge Univ Press 1993

Model Question Paper

**Mar Ivanios College (Autonomous)**

B. Sc. Chemistry Programme (2017 onwards)

Semester -III Core Course-II

Course Code – AUCH 341,

**INORGANIC CHEMISTRY II**

**Time: Three Hours** **Maximum Marks: 80**

**SECTION A**

(Answer all questions. Each question carries 1 mark)

1. What is the bond order of $O^{2+}$.
2. What is fullerenes?
3. What are nano sensors?
4. Name the hydrogen bonding in salicylaldehyde.
5. What is inorganic benzene?
6. Write an example for inter halogen compound.
7. Example for phosphorus based polymer.
8. Name a naturally occurring radioactive element.
9. Write an example of carboranes?
10. What is zeolite.

(1 X 10 = 10 Marks)

## SECTION B

(Answer any 8 questions. Each question carries 2 Marks)

11. Compare the properties of Borazole with benzene
12. Explain the method of preparation of gold nano particles
13. Applications of nano particles in medicine and electronics
14. Write a note on Fajans rule
15. Calculate the bond order of $N_2$, $B_2$, $C_2$ and $O_2$
16. What are the limitations of VBT?
17. Explain the structure of diborane
18. What is lattice energy?
19. State Geiger –Nuttal rule.
20. What are carboranes?
21. Write a note on Born-Haber cycle
22. What is nuclear fission?

(2X 8 = 16 Marks)

## SECTION C

(Answer any 6 questions. Each question carries 4 Marks)

23. Draw the MO diagram for NO and $C_2$ molecule
24. Give a comparative account of VB and MO theories using relevant examples.
25. What is meant by dipole moment? How it is helpful in explaining the structure of molecules.
26. Write a note on the preparation of nano particles using sol-gel method.
27. Explain the optical, magnetic, thermal and catalytic properties of nanoparticles with examples.
28. Write the hybridisation and structures of Xenon compounds.

29. Explain artificial transmutation with example.
30. Explain mass defect.
31. Write a note on the manufacture of glasses.

(4X 6 = 24 Marks)

**SECTION D**

(Answer any 2 questions. Each question carries 15 Marks)

32. (a) Explain VSEPR theory with example (5 marks) (b) Write a note on solvation energy and solubility of ionic solids (5 marks), (c) Write a note on secondary bond forces (5 marks)
33. (a) Explain the optical, magnetic, thermal and catalytic properties of nanoparticles with examples (b) Write a note on radio carbon dating.
34. (a) Write a note on the manufacture of glass (b) Explain the preparation and bonding of noble gases.
35. (a) Write a note on carbon nanotubes and fullerenes, (b) Explain inorganic polymers, (c) Write a note on band theory.

(15X 2 = 30 Marks)

**B.Sc. Chemistry Programme**

SEMESTER – IV (Core Course – 3)

Course Code – AUCH 441, Credit – 3

**Organic chemistry– I**

**Lecture - Tutorial – Lab: 3-0-2** **Total : 54 hrs.**

| AUCH 441- ORGANIC CHEMISTRY- I | |
|---|---|
| **Total Teaching Hours for Semester :54** | **No of Lecture Hours/Week :3** |
| **Max Marks :80** | |
| **Course Outcomes** | |
| **CO1: Introduces the concept of organic reaction mechanisms.**<br>**CO2: Understands the principles of substitution and elimination reactions.**<br>**CO3: Knowledge on arenes and aromaticity in organic molecules.**<br>**CO4: Basic knowledge on organic photochemical reactions.**<br>**CO5: Familiarisation about the synthesis, properties and applications of dyes.**<br>**CO6: Learns the concepts of stereochemistry among organic molecules** | |

**Module I: Introduction to organic reaction mechanism: 9 hrs.**

Uniqueness of carbon – classification of organic compounds – Functional groups (mention only) Review of basic rules of IUPAC nomenclature and IUPAC naming of organic compounds.

Types of reagents: Electrophiles and Nucleophiles.

Types and subtypes of organic reactions: Substitution, addition. Elimination and rearrangement (definition and simple examples only).

Definition of reaction mechanism.

Drawing of electron movements with arrows – curved arrow notation. Half headed and double headed arrows. Nature of bond fissions: Homolysis and heterolysis.

Electron displacement effects: Inductive effect, electromeric effect, mesomeric effect, resonance, hyperconjugative and steric effects.

Acidity and basicity of organic compounds based on inductive and resonance with reference to acid characters of alcohols, phenols and carboxylic acids and basic character of aliphatic

and aromatic amines.

Applications of hyperconjugative effect – stability of alkenes, alkylbenzenes, free radicals and carbocations.

Reaction intermediates: Carbocations, carbanions, free radicals and carbenes (definition, hybridization, structure, classification, formation, stability and important reactions) – rearrangement of carbocations – nitrenes (mention only).

**Module II: Reaction Mechanism II** **9 hrs.**

Aliphatic nucleophilic substitutions, mechanism of $S_N1$ and $S_N2$ reactions – Effect of structure, substrate, solvent, nucleophile and leaving goups. Stereochemistry – Walden Inversion.

Elimination reaction: Hoffmann and Saytzeff rule – cis and trans eliminations – mechanisms of E1 and E2 reactions. Substitution vs Elimination.

Addition reactions – mechanism of addition of bromine and hydrogen halides to double bonds – Markownikoff's rule and peroxide effect. Cis-hydroxylation.

Elimination – Addition mechanism – Benzyne intermediate.

Methods of determination of reaction mechanism – product analysis, intermediates, isotopic effect, kinetic and stereochemical studies.

**Module III: Arenes and Aromaticity** **9 hrs.**

Heat of hydrogenation and heat of combustion of benzene – structure of benzene, naphthalene and anthracene – Concept of aromaticity – Huckel's rule – Application to benzenoid and non-benzenoid compounds.

Reactions – Mechanism of electrophilic substitution in benzene – halogenation, nitration, sulphonation and Friedel Craft's alkylation and acylation – energy profile diagram.

Ring activating and deactivating groups with examples – orientation effect in monosubstituted benzene- -OH, $-NH_2$, $NO_2$, $-CH_3$ and halogens.

Aromatic nucleophilic substitution – bimolecular displacement mechanism – Elimination-Addition mechanism. Reactivity and orientation in Aromatic Nucleophilic substitution.

Reactivity of naphthalene towards alkylation, nitration and sulphonation. Carcinogenic polynuclear arenes.

**Module VI: Organic photochemical reactions and Dyes 9 hrs.**

Introduction – photochemical vs thermal reactions.

Photochemical reactions of olefins: Photosensitization and photodimerisation.

Photochemistry of carbonyl compounds: Norrish I, Norrish II cleavages. Photo reduction (Benzophenone to benzopinacol).

Dyes – Theory of colour and constitution – classification according to structure and method of application. Preparation and uses of methyl orange, congored, malachite green, crystal violet, phenolphthalein, fluorescein, alizarin and indigo.

**Module V: Stereochemistry I 9 hrs.**

Optical Isomerism : Chirality and elements of symmetry – DL notation – Enantiomers – optical isomerism in glyceraldehydes, lactic acid and tartaric acid – Diastereoisomers – mesocompounds – Cahn-Ingold-Prelog rules – R-S notations for optical isomers with one and two asymmetric carbon atoms. - erythro and threo representations. Racemic mixture – resolution – methods of resolution.

Enatiomeric excess – Introduction to asymmetric synthesis.

Optical activity in compounds not containing symmetric carbon atoms – biphenyls and allenes.

Geometrical isomerism – cis-trans, syn-anti and E-Z notations – geometrical isomerism in maleic and fumaric acids and unsymmetrical ketoximes – methods of distinguishing geometrical isomers using melting point, dipole moment, dehydration and cyclisation.

**Module VI: Stereochemistry II** **9 hrs.**

Representation of organic molecules: Fischer, Flying wedge, Sawhorse and Newman projection formulae.

Conformational isomerism – conformation – Dihedral angle – Torsional strain – conformational analysis of ethane and n-butane including energy diagrams – Baeyer's strain theory – Sache-Mohr theory of strainless rings – conformation of cyclohexane (chair, boat and skew boat forms) – axial and equatorial bonds – ring flipping – conformers of mono and dialkyl substituted cyclohexanes.

**Text books:**


[1]. K.S.Tewari, N.K.Vishnoi and S.N.Mehrotra, A textbook of Organic Chemisty, 2nd Edition, Vikas Publishing House (Pvt) Ltd., New Delhi, 2012.

[2]. D.Nasipuri, Stereochemistry of Organic Compounds: Principles and Applications, 3rd Edition New Age International Publizhers, New Delhi, 2014.

[3]. Morrison, R.T., Boyd, R.N. & Bhattacharjee, S.K. Organic Chemistry, 7th ed., Pearson Education, 2011.

[4]. Jagadamba Singh and Jaya Singh, Photochemistry and Pericyclic rections, 3rd Edition, New Age International, New Delhi, 2012.


**References:**


[1]. A.Bahl and B.S.Bahl, Advanced Organic Chemistry, 5th Edition, S.Chand & Company, New Delhi, 2010.

[2]. P.S.Kalsi, Organic Reactions, Stereochemistry, and Mechanism, 4th Edition, New Age International Publishers, New Delhi, 2015.

[3]. March's Advanced Organic Chemistry: Reactions, Mechanisms, and Structure, Michael B. Smith, 7th Edition, Wiley, 2013

[4]. Reaction Mechanism in Organic Chemistry, S. M. Mukherjii and S. P. Singh, 3rd Edition Macmillan India Press, New Delhi, 1976.

[5]. I L Finar, "Organic Chemistry" Vol – 1, 5th Edition, Pearson Education, New Delhi, 2010.

**Model Question Paper**

Mar Ivanios College (Autonomous), Thiruvananthapuram

2017 Admission onwards

SEMESTER IV Core Course III Course Code AUCH 441 Credit-3

**ORGANIC CHEMISTRY I**

**Time: 3 hours** **Max. Marks : 80**

**SECTION – A**

(Answer all questions. Answer in one word to maximum two sentences. Each question carries one mark)

1. What is the product formed when a bond undergoes homolytic fission?
2. Give one example for each (i) substitution reaction and (ii) elimination reaction.
3. Write an example for electrocyclic reaction.
4. Name two reagents used for cis-hydroxylation.
5. What the products obtained when naphthalene undergoes sulphonation at different temperatures?
6. Identify the orienting effect of the following functional groups –CH3, -NO2, -CHO and –OH.
7. What are chromophores?
8. What are conformers?
9. What is geometrical isomerism?
10. Explain the term chirality.

(1 X 10 =10 Marks)

**SECTION - B**

(Short answer type. Answer any 8 questions from the following. Each question carries two

marks)

11. What are electrophiles and nucleophiles? Give examples.
12. Write the structure of the following compounds (i) 3,3,4-trimethyl-4-heptene (ii) 2-ethyl-3-methyl hexanal.
13. Phenol is acidic while ethanol is not. Why?
14. Arrange the following in the decreasing order of stability. Justify your answer.
    $(CH_3)_2CH^+$, $CH_3^+$, $(C_6H_5)_2CH^+$, $C_6H_5CH_2^+$
15. Give an example and state Hofmann rule.
16. What is Walden Inversion?
17. What is Kharasch effect? Illustrate with an example.
18. When toluene is nitrated the major products are ortho and para substituted products. Why?
19. Define Huckel's rule.
20. Explain photosensitization with an example.
21. What is enantiomeric excess?
22. Explain with examples the importance of dipole moment measurements in distinguishing geometrical isomerism.

(2 X 8 = 16 Marks)

## SECTION - C

(Short essay type. Answer any 6 questions from the following. Each question carries four marks)

23. What is inductive effect? How is it affect the acidity and basicity of organic acids and bases?
24. Explain the mechanism of E1 and E2 eliminations.
25. o-Chloro toluene when treated with sodamide in liquid ammonia gives o-toluidine and m-toluidine. Explain this observation with relevant mechanism.
26. Explain Norrish I and Norrish II reactions.

27. Determine the R & S notations of the asymmetric carbon atoms in (+)-tartaric and (-) tartaric acid
28. Explain the conformational analysis of n-butane.
29. Give a brief account on optical activity due to restricted rotation.
30. Explain any two methods of determination of reaction mechanism.
31. What are non-benzenoid aromatics compounds. Explain their aromaticity with examples

(4 X 6 = 24 marks)

**SECTION – D**

(Answer any 2 question. Each question carries 15 marks)

32. (a) Explain $S_N1$ and $S_N2$ mechanisms. (b)Write the influence of structure of the substrate and polarity of the solvent on nucleophilic substitution reactions. (c) Explain Baeyer's strain theory.
33. Explain the mechanism of (i) nitration (ii) halogenation of benzene. Discuss the orientation of influence of $–NO_2$ and –OH group in aromatic electrophilic substitution. Discuss the classification of dyes on the basis of structure.
34. What is resolution? Explain different methods of resolution. What are carbenes? How are they generated? Comment on the structure of carbene. Draw conformers of dimethyl cyclohexane and discuss their comparative stability.
35. Write the synthesis and uses of the following dyes (i) Malachite green (ii) Methyl Orange. Explain the geometrical isomerism of maleic and fumaric acid. Explain the elimination-addition mechanism in halo benzenes.

(15 X 2 = 30 marks)

**B.Sc. Chemistry Programme**

Semester - V (Core Course –V)

Course Code – AUCH 541, Credit-4

## Organic Chemistry – II

**Lecture – Tutorial - Lab : 4-0-4** **72 hours**

| AUCH 541- ORGANIC CHEMISTRY- II | |
|---|---|
| **Total Teaching Hours for Semester :72** | **No of Lecture Hours/Week : 4** |
| **Max Marks : 80** | |
| **Course Outcomes** | |
| **CO1: Familiarisation of basic reactions and mechanisms of alcohols, phenols and ethers.**<br>**CO2: Knowledge about the reactions and mechanisms of aldehydes and ketones.**<br>**CO3: Information about the synthesis, properties and applications derivatives of carboxylic acids, sulphonic acids and their derivatives.**<br>**CO4: Knowledge on organic nitrogen compounds and their applications.**<br>**CO5:General idea about organic spectroscopy and their applications for the structural elucidation of organic molecules.** | |

**Module I: Alcohols, Phenols and Ethers** **12 hrs.**

Alcohols: Preparation: From alkenes (hydration. Hydroboration-oxidation, oxy-mercuration demercuaration) and carbonyl compounds (reduction and with Grignard reagent)

Chemical properties: Reactions involving cleavage of O-H bonds (acidity and esterification), oxidation (with PCC, Collins reagent, Jones reagent and $K_2Cr_2O_7$) and catalytic dehydrogenation – distinction between primary, secondary and tertiary alcohols – Ascent and descent in alcohol series. Biofuel – ethanol and biodiesel.

Dihydric alcohols: Oxidative cleavage – Lead tetra acetate, periodic acid – Pinacol-pinacolone rearrangement.

Phenols: Preparation from halobenzens, cumene and sulphonic acid. Chemical properties: Acidity of phenol - effect of substituents on acidity. Comparison of acidity with alcohol –

bromination, nitration, sulphonation, Reimer-Tiemann reaction (mechanism expected), Kolbe reaction, Liebermann's nitroso reaction and Lederer-Mannasse reaction. Distinction between alcohols and phenols.

Ethers: Preparation by Williamson's synthesis. Reactions of ethers: Cleavage by HI and Claisen rearrangement (Mechanism expected) – Ziesel's method of estimation of methoxy group. Crown ethers: Nomenclature and importance of crown ethers.

Epoxides: Preparation from alkenes – acid and base catalysed ring opening reactions.

**Module II : Aldehydes and Ketones** **12 hrs.**

Preparation: Oxidation of primary and secondary alcohols using PCC, reduction of esters using DIBAL-H, Rosenmund reduction, Gattermann-Koch formylation and Friedel-Craft's acylation.

Chemical properties: Nucleophilic addition (HCN, $NaHSO_3$, RMgX and ROH)

Addition-elimination reaction (with ammonia and ammonia derivatives)

Reduction (Metal hydrides (mechanism expected), MPV reduction, Clemmenson and Wolff-Kishner reduction)

Oxidation: with $KMnO_4$, Tollen's reagent, Fehling solution, Br2 water, Oppenaur oxidation, Baeyer-Villiger oxidation.

Acidity of α-hydrogen: Aldol, Claisen-Schmidt, Benzoin, Perkin and Knovenagel condensations (Mechanisms expected).

Haloform reaction – Iodoform test – Cannizaro reaction (mechanism expected) and Beckmann rearrangement (mechanism expected).

**Module III: Carboxylic acids, Sulphonic acid and their Derivatives** **12 hrs.**

Preparation: Hydrolysis of nitrile, carboxylation of Grignard reagent and oxidation of alkyl benzenes.

Chemical properties: Acidity – effect of substituents on the acidity of aliphatic and aromatic carboxylic acids – HVZ reaction – Decarboxylation – Kolbe electrolysis (Mechanism expected). Ascent and descent series in aliphatic carboxylic acids.

Preparation, properties and uses of anthranilic acid, cinnamic acid, citric acid, lactic acid, oxalic acid, adipic acid and phthalic acid.

Formation of acid derivatives – acid chlorides, amides, acid anhydrides and esters – comparison of reactivity of acid derivatives. Preparation of coumarin – Fries rearrangement (Mechanism expected)

Preparation and reactions of benzene sulphonic acid, toluene sulphonic acid and benzene sulphonyl chloride – Importance of tosyl group – synthesis and application of saccharin.

**Module IV: Organic Nitrogen Compounds** **12 hrs.**

Nitrocompounds: Nitro-aci tautomerism – Nef's reaction – reduction of nitrobenzene in various media – nitro compounds as explosives.

Amines: Classification – Preparation: From alkyl halides, nitro compounds, nitriles, isonitriles and amides – Hoffmann's bromamide reaction, Schmidt reaction, Gabriel phthalimide synthesis.

Chemical properties: Basicity (effect of substituents on the basicity of aliphatic and aromatic amines), Carbylamine reaction, conversion of amines to alkene (Hoffmann elimination with mechanism), acylation and reaction with nitrous acid. Electrophilic substitution reactions of aniline: halogenation, nitration and sulphonation. Benzidine rearrangement (mechanism expected).

Separation of mixture of amines – methods to distinguish primary, secondary and tertiary amines.

Preparation and synthetic applications of diazonium chloride and diazomethane.

**Module V: Organic Spectroscopy - I** **12 hrs.**

UV – Visible spectroscopy – types of electronic transitions, effect of conjugation, concept of chromophore, auxochrome, bathochromic, hypochromic shifts, hyperchromic and hypochromic effects. UV-Visible spectra of enes. Calculation of λmax of dienes and α,β-

unsaturated ketones.

IR spectroscopy – Molecular vibrations - Functional group and finger print region – group frequencies – effect of hydrogen bonding on –OH stretching frequency – factors influencing carbonyl stretching frequency. Comparison of carbonyl stretching frequency in compounds containing carbonyl group.

Interpretation of IR spectra of simple organic molecules such as salicylaldehyde, benzamide, acetophenone, nitro benzoic acid and phenyl acetate.

**Module VI: Organic Spectroscopy – II** **12 hrs.**

NMR spectroscopy – principle of proton NMR – shielding and deshielding effect, chemical shift, factors influencing chemical shift, spin-spin splitting, coupling constant, interpretation of PMR spectrum of simple molecules like $CHBr_2CH_2Br$, ethylbromide, pure ethanol and impure ethanol (acidic impurities) acetaldehyde and toluene. Structural elucidation of simple organic molecules using IR and NMR spectroscopic techniques.

Theory of Mass spectrometry – mass spectrum, base peak and molecular ion peak, types of fragmentation, McLafferty rearrangement, isotopic effect.

**Text books:**


[1]. A.Bahl and B.S.Bahl, Advanced Organic Chemistry, 5th Edition, S.Chand & Company,New Delhi, 2010.

[2]. Morrison, R.T., Boyd, R.N. & Bhattacharjee, S.K. Organic Chemistry, 7th Edition., Pearson Education, 2011.

[3]. J.Clayden, N.Greeves and S.Warren, Organic Chemistry, 7th Edition, Oxford University Press, New York, 2009.

[4]. William Kemp, Organic Spectroscopy, 2nd Edition, Macmillan, New York, 1987.


**References**


[1]. I L Finar, “Organic Chemistry” Vol – 1, 5th Edition, Pearson Education, New Delhi, 2010.

[2]. Y.R. Sharma, Elementary Organic Spectroscopy, 1st Edition, Pearson Education, New Delhi, 1997.

[3]. R.M. Silverstein and F.X.Webster, Spectrometric Identification of Organic Compounds, 6th Edition John Wiely and Sons, New York, 1997.

[4]. P.S.Kalsi, Organic Reactions, Stereochemistry, and Mechanism, 4th Edition, New Age International Publishers, New Delhi, 2015.

Model Question Paper

Mar Ivanios College (Autonomous)

2017 Admission onwards

SEMESTER V, Core Course V Credit 4

Course Code AUCH 541

**ORGANIC CHEMISTRY II**

**Time: 3 hours** **Max.Marks: 80**

**SECTION – A**

(Answer all questions. Answer in one word to maximum two sentences. Each question carries one mark)

1. What is Williamson's synthesis?
2. Which reagent is used for the oxidative cleavage of 1,2-diols?
3. Give a test to distinguish aliphatic aldehydes from aromatic aldehydes.
4. What are crown ethers?
5. What is HVZ reaction?
6. What happens when aniline is treated with bromine?
7. Identify the types of electronic transitions in CH3CHO.
8. What is base peak?
9. What is PCC?
10. Write the frequency range useful for the identification of organic compounds.

(10 X 1 =10 Marks)

## SECTION - B

(Short answer type. Answer any 8 questions from the following. Each question carries two marks.)

11. Why phenol is more acidic than methanol?
12. How can you convert isopropanol to tert.butyl alcohol?
13. What is iodoform test?
14. What is MPV reduction?
15. How coumarin is prepared?
16. How will you convert acetic acid to propionic acid?
17. Explain Nef's reaction.
18. Write the mechanism of Benzidine rearrangement?
19. What is finger print region? Give its importance.
20. Differentiate bathochromic and hypochromic shifts.
21. What is TMS? Why it is selected as a reference compound in 1H NMR spectroscopy?
22. What is DIBAL? What is its use?

(8 X 2 = 16 Marks)

## SECTION - C

(Short essay type. Answer any 6 questions from the following. Each question carries four marks)

23. Explain Zeisel's method of estimating methoxy group?
24. How can you distinguish primary, secondary and tertiary alcohol?
25. Write the importance of LiAlH4 and NaBH4 in carbonyl chemistry.
26. Comment on Clemmensen and Wolff-Kishner reduction.
27. How cinnamic acid is prepared? Explain its important properties.
28. Discuss Hoffmann elimination?
29. Explain McLafferty rearrangement with examples.
    (i) How can you distinguish inter and intra molecular hydrogen bonding using IR spectroscopy?
30. (ii) Predict the regions where salicylaldehyde give IR absoptions.
31. Explain spin-spin coupling with an example.

(6 X 4 = 24 marks)

## SECTION – D

(Answer any 2 question. Each question carries 15 marks)

32. (a) Write the mechanism of the following reactions: (a)Aldol condensation and (b) Benzoin
    condensation. Discuss the mechanism of (i) Reimer-Tiemann reaction and (ii) Claisen Condensation.
33. (a) Explain the synthesis and applications of saccharin. (b) How diazonium chloride is prepared? How is it useful to synthesis the following compounds phenol, iodobenzene, azocompounds.
34. How can you effect the following conversions
    (i) aniline to para-bromo aniline
    (ii) benzamide to aniline.
    (iii) Discuss the Woodward-Fieser for calculating λmax of dienes.
35. Explain the principle of nmr spectroscopy.
    A compound with molecular formula C8H8O shows the following absorptions:
    IR Spectrum: 3050, 2950, 1700, 1620, 1550, 690 cm-1.
    pmr spectrum: δ 7-8 ppm (multiplet, 5H), 2.5 ppm (singlet, 3H).

(i) Identify the structure of the compounds.

(ii) How primary, secondary and tertiary amines are separated?

Discuss the preparation and important reactions of benzene sulphonic acid.

(15 X 2 = 30 Marks)

**B.Sc. Chemistry Programme**

Semester – V (Core Course VI)

Course Code – AUCH 542, Credit - 4

Physical Chemistry – I

| AUCH 542- PHYSICAL CHEMISTRY- PAPER I | |
|---|---|
| **Total Teaching Hours for Semester :54** | **No of Lecture Hours/Week :5** |
| **Max Marks : 80** | |
| **Course Outcomes** | |
| **CO1: Get a firm foundation about the different states of matter.**<br>**CO2: Awareness about the basic principles of thermodynamics and thermochemistry.**<br>**CO3: General idea about group theory and determination of point groups of simple molecules.**<br>**CO4: Knowledge about liquid crystalline state and its applications.** | |

**Course outline**

**Module I – Gaseous state** **9 hrs**

Ideal gas equation, Behaviour of real gases, Deviation from ideal behaviour, Compressibility factor, Boyle temperature - van der Waal's equation of state – derivation and importance, Virial equation of state.

Critical phenomena: Isotherms of $CO_2$, continuity of states, Critical constants and their experimental determination, relation between critical constants and van der Waals constants.

Types of molecular velocities and their inter relations. Maxwell Boltzmann distribution of molecular velocities, Statement of equation and explanation (No derivation), Effect of temperature on distribution of molecular velocities- Derivation of most probable and average velocities from the equation.

Collision properties. Collision diameter, Collision number, Collision frequency and mean free path. Relation between collision parameters and viscosity and thermal conductivity of gases (no derivation).

**Module II – Solid state** **9 hrs**

Isotropy and anisotropy, Space lattice and unit cell, Elements of symmetry of crystals, Bravais lattices, Crystal systems,

Laws of rational indices, Miller indices, Representation of lattice planes of cubic crystals, Determination of Avogadro number from crystallographic data, X-ray diffraction studies of crystals, Bragg's equation– derivation and applications, Rotating crystal and powder method, Structure of NaCl and KCl Rutile, Zinc blend, Wurtzite - Imperfections in crystals, point defects– Schottky and Frenkel defects, Non-stoichiometric defects– Line defects– edge dislocation– screw dislocation.

**Module III – Liquid state and Dilute solutions** **9 hrs**

Vacancy theory of liquid state : Properties of liquids: Surface tension and its measurement by capillary rise and stalagmometer method, factors affecting Surface tension, Viscosity, Poisuelle's equation, Determination of viscosity by Ostwald's viscometer, Refractive index and its determination by Abbe refractometer.

Dilute solutions: Molarity, Molality, Normality and Mole fraction. Colligative properties, Thermodynamic derivation of $\Delta Tb = Kb \times m$ and $\Delta Tf = Kf \times m$, Osmotic pressure, van't Hoff equation and molecular mass, Isotonic solutions, Reverse osmosis- Determination of molecular mass of solutes by Beckmann's method, Rast's method and cooling curve method. Abnormal molecular mass, van't Hoff factor, Determination of degree of dissociation and association.

**Module IV – Thermodynamics I** **9 hrs**

Types of Processes, Zeroth law of thermodynamics Definition of internal energy and enthalpy. Heat capacities at constant volume (Cv) and at constant pressure (Cp), relationship between Cp and Cv. Mathematical statement of 1st law. Reversible process and maximum work. Calculation of work, heat, internal energy change and enthalpy change fo r the expansion of an ideal gas under reversible isothermal and adiabatic condition. The Joule-Thomson effect– derivation of the expression for Joule-Thomson coefficient. Sign and magnitude of Joule-Thomson coefficient, inversion temperature.

Thermochemistry – standard states. Enthalpies of formation, combustion and neutralization. Integral and differential enthalpies of solution. Hess's law and its applications. Kirchoff's equation– Flame and explosion temperatures.

**Module V – Thermodynamics II** **9 hrs**

Need for 2nd law of thermodynamics. Different statements of 2nd law, Thermodynamic scale of temperature. Carnot cycle and its efficiency, Carnot theorem. Concept of entropy- Definition and physical significance. Entropy as a function of volume and temperature, Entropy as a function of pressure and temperature. Entropy as a criterion of spontaneity and equilibrium. Gibbs and Helmholtz free energies and their significances - criteria of equilibrium and spontaneity.

Gibbs-Helmholtz equation, dependence of Gibbs free energy changes on temperature, volume and pressure. Maxwell's relations. Partial molar quantities. Chemical potential- Gibbs-Duhem equation. Clapeyron – Clausius equation. Concept of fugacity, determination of fugacity by graphical method.

**Module VI Group theory** **9 hrs**

Group theory: Elements of symmetry – Proper and improper axis of symmetry, plane of symmetry, centre of symmetry and identity element. Combination of symmetry elements, Determination of point groups of simple molecules like Acetylene, $H_2O$, $NH_3$, $BF_3$, $[Ni(CN)_4]2-$ and $C_6H_6$. Symmetry operations. Order of a group. Combination of symmetry operations. Group theoretical rules. Construction of Group multiplication table of $C_2V$.

**Liquid crystals**

Origin of liquid crystals, mesogens self-organisation, Types– smectic, nematic and cholesteric liquid crystals, characterization of liquid crystals, Swarm theory of liquid crystals, uses of liquid crystals, characterization of LC materials by DSC, PLM and X-ray.

(At least 100 problems are to be worked out from all units together. 30% of the questions for Examination shall contain problems.)

**Text books**

[1]. Puri, Sharma and Pathania, "Principles of Physical Chemistry", Millennium Edition, Vishal Publishing Co

[2]. Gurdeep Raj, "Advanced Physical Chemistry", Goel Publishing House

[3]. V Ramakrishnan and M S Gopinathan, "Group Theory in Chemistry",Vishal Publishing Co.
[4]. Salahuddin Kunju and G. Krishnan "Group Theory and its Applications in Chemistry"
[5]. S. Negi and S.C. Anand, A text book of Physical Chemistry, New Age International publishers 2nd Edition-2007.

**References**

[1]. P. W. Atkins, "Physical Chemistry", 4th Edition, Oxford University Press, Oxford, 1990.
[2]. R. J. Silbey and R. A. Alberty, "Physical Chemistry", 4th Edition, John Wiley & Sons.
[3]. G.W. Castellan, "Physical Chemistry, 3rd Edition, Narosa Publishing House, 2004
[4]. R. Stephen Berry, Stuart A. Rice, John Ross, "Physical Chemistry", 2nd Edition, Oxford.
[5]. Samuel Glasstone, "Thermodynamics for chemists" East-West Press, 1965.
[6]. L. V. Azaroff, "Introduction to Solids", McGraw Hill, 1960.
[7]. Anthony R West, "Solid State Chemistry and its Applications", Wiley Eastern, 1985.

Model Question Paper

Mar Ivanios College (Autonomous)

Semester V- Core Course-VI

Course Code AUCH 542

**Physical Chemistry –I**

**Time: 3 Hrs** **Total marks: 80**

**SECTION A.**

Answer all the questions. Each question carries 1 mark

1. Write down the van der Waal's equation for n moles of a gas.
2. In which type of liquid crystals, the colour of the material is sensitive to temperature changes?
3. What are isotonic solutions?
4. Write down the conditions at which real gases tend to approach ideal behaviour.
5. Define the term fluidity.

6. What is inversion temperature?
7. Write down the efficiency of Carnot engine.
8. The average speed of a certain gas at 27oC is 400ms-1. Calculate the temperature at which the speed will be 800ms-1.
9. What is meant by unit cell in crystallography?
10. What is the physical significance of entropy?

(1 x 10 = 10 marks)

## SECTION B

Each question carries 2 marks (Short answer). Answer any 8 questions

11. What are colligative properties?
12. Write the point group to which $NH_3$ belongs and mention the symmetry elements present in $NH_3$.
13. Explain van't Hoff factor
14. Explain first law of thermodynamics.
15. Derive the expression for Joule Thomson coefficient
16. Explain any two statements of second law of thermodynamics.
17. Maximum work is obtained from a reversible process. Substantiate.
18. What are the proper and improper axes of symmetry?
19. Draw the group multiplication table of $C_{2v}$ point group
20. Define the terms collision frequency and collision number.
21. Explain virial equation of state.
22. Explain elements of symmetry of crystals.

(2×8 = 16 marks)

## SECTION C

Each question carry 4 marks (Short essay). Answer any 6 questions

23. Derive root most probable velocity and average velocity from Maxwell- Boltzmann equation.
24. An aqueous solution containing 0.25 g of a solute dissolved in 20 g of water froze at – 0.42 $^{o}$C. Calculate the molar mass of the solute. Molar heat of fusion of ice at 0$^{o}$C is 6.025 KJ and R = 8.314 JK -1mol -1
25. Deduce the relationship between $C_p$ and $C_v$ by thermodynamics.
26. Explain different types of semi-conductors and their uses.
27. What is the law of corresponding states? How is it derived from van der Waals equation.
28. Explain Gibbs - Helmholtz equation and its significance
29. What is chemical potential and derive Gibbs Duhem equation?
30. Explain Hess's law and its applications
31. Derive the relation between depression of freezing point and lowering of vapour pressure.

(4 x 6 = 24 marks)

## SECTION D

Each question carries 15 marks (essay), Answer any two questions

32. Derive Bragg's equation (5 marks) The edge length of the unit cell of NaCl crystal lattice is 564 pm by X-ray diffraction. Compute the interionic distance between sodium and chloride ions. (5 marks). Explain point defects in a crystal (5 marks)
33.
    a) What is meant by reversible process? Derive an expression for work done in the reversible isothermal expansion of an ideal gas. (5 marks)
    b) Calculate the work done in expanding one mole of an ideal gas from a volume of 2 to 20 dm3 at 27 $^{0}$C (5 marks).
    c) Derive the relation between Cp and Cv. (5 marks)
34. a) Calculate Tc, Pc and Vc for $C_2H_2$. Given a = 4.390 atm litre mol-2, b=0.05136 litre mol-1. (5 marks), (b) Do all gases obey gas laws? Discuss some experimental results to explain deviation and point out the causes which accounts for this behaviour. (10 marks)

35. Derive thermodynamically the relation between the elevation of boiling point of a solvent and molal concentration of an electrolyte dissolved in the solvent.
(5 marks)

i. The surface tension of water at 293 K is 72.75 dyne cm-1. How high will a column of water rise in a capillary tube with a radius of 0.005 cm.
(5 marks)

ii. Illustrate the operation improper rotation.
(5 marks)

(15 x 2 = 30 marks)

**B.Sc. Chemistry Programme**

Semester – V (Core Course VII)

Course Code – AUCH 543 Credit-4

**Physical Chemistry – II**

**Lecture-Tutorial-Lab: 4-0-3** Total: **72** hours

**Course outcomes (CO)**

| **AUCH 543- PHYSICAL CHEMISTRY- PAPER II** | |
|---|---|
| **Total Teaching Hours for Semester :72** | **No of Lecture Hours/Week :4** |
| **Max Marks : 80** | |
| **Course Outcomes** | |
| **CO1: Derive essential mathematical relationships in statistical thermodynamics, quantum mechanics and spectroscopy.**<br>**CO2: Awareness about colloidal state and adsorption.**<br>**CO3: Knowledge about the concepts of quantum mechanics and its applications to physical systems.**<br>**CO4: Information about the basic principles of spectroscopy.**<br>**CO5: General idea on non-spectroscopic systems.** | |

**Module I – Thermodynamics III & Statistical thermodynamics** **12 hrs**

Nernst heat theorem, proof and its consequences. Statement of IIIrd law-Planck's statement, Lewis Randall statement. Concept of perfect crystal, evaluation of absolute entropies of solid, liquid and gas. Exception to IIIrd law with reference to examples- CO, NO, N2O and H2O. Phase space, system, assembly and ensemble-types of ensembles and uses. Thermodynamic probability, Boltzmann distribution law (no derivation). Partition function, entropy and probability. Thermodynamic functions in terms of partition functions - internal energy, enthalpy, pressure, work function and free energy function.

**Module II – Colloids and Adsorption** **12 hrs**

Colloidal state: Classification of colloids, Purification of colloids – ultra filtration and electrodialysis, Kinetic, optical and electrical properties of colloids. Ultra microscope, Electrical double layer and zeta potential. Coagulation of colloids, Hardy-Schulz rule, Gold

number. Gels: Elastic and non-elastic gels, Imbibition and synergesis, Micelles and critical micelle concentration, sedimentation and streaming potential, Application of colloids – Cottrell precipitator, purification of water and delta formation.

Adsorption: Physical and chemical adsorption, Freundlich adsorption isotherm, Derivation of Langmuir adsorption isotherm, Statement and explanation of BET and Gibbs isotherms, determination of surface area of adsorbents by BET equation. Applications of adsorption.

**Module III – Quantum mechanics** **12 hrs**

Radiation phenomena- blackbody radiation, photoelectric effect, Compton effect and atomic spectra. Planck's quantum theory and explanation of the radiation phenomena. Schrodinger wave equation – significance of Ψ, well behaved functions, Concept of operators and some operators of interest (properties of operators not required), Postulates of quantum mechanics. Application of quantum mechanics to simple systems - particle in 1 D box, normalization of wave function, Particle in 3 D box. Concept of degeneracy. Application to hydrogen atom (no derivation). Schrodinger wave equation in Cartesian and spherical polar co-ordinates, Quantum numbers.

**Module IV – Spectroscopy** **12 hrs**

Regions of electromagnetic spectrum. Different units of energy (erg, joule, calorie, cm-1, Hz, A0 and eV) and their inter conversions. Interaction of radiations with matter. Various types of molecular spectra. Born-Oppenheimer approximation.

Rotational spectroscopy: microwave spectra of diatomic molecules, energy expression, selection rule, rotational energy levels, determination of bond length.

Vibrational spectroscopy: Harmonic oscillator. IR spectra of diatomic molecules. Energy expression. Selection rules, frequency of separation, calculation of force constant, anharmonic oscillators. Morse equation. Fundamental and overtone transitions, combination bands, degree of freedom of polyatomic molecules.

Raman spectroscopy: Stoke's and antistoke's lines and their intensity difference, rotational Raman spectrum. Selection rule. Frequency of separation, vibrational Raman spectrum, Mutual exclusion principle.

**Module V – Spectroscopy – II** **12 hrs**

Electronic spectroscopy: Frank-Condon principle. Singlet and triplet states. Electronic spectra and diatomic molecules. Dissociation energy, electronic spectra of polyatomic molecules (qualitative idea only).

NMR spectroscopy: Principle of NMR, nuclear spin. Interaction of nuclear spin with external magnet. Precession. Relaxation, Chemical shift. Low resolution spectra. Delta and tau scales. Spin-spin coupling and high resolution spectra, application of NMR in MRI.

Electron spin resonance spectroscopy: principle. Types of substances with unpaired electrons, interaction of nuclear spin with external magnetic field. Energy level splitting. Lande splitting factor, presentation of ESR spectrum. The normal and derivative spectra. Hyperfine splitting. Simple examples like methyl and benzene radicals.

Introduction to Mossbauer Spectroscopy.

**Module VI – Non-spectroscopic methods** **12 hrs**

Non-spectroscopic methods: Dipole moment, Debye equation and Clausius-Mosotti equation, measurement of dipole moment by temperature method, Dipole moment and molecular structure, Diamagnetism and paramagnetism, Magnetic susceptibility and unpaired electrons, measurement of magnetic susceptibility, Molar refraction and molecular structure, Atomic refraction, Optical exaltation, Parachor and atomic equivalent of parachor.

(At least 100 problems are to be worked out from all units together. 30% of the questions for Examination shall contain problems.)

**Text Books**


[1]. Puri, Sharma and Pathania, “Principles of Physical Chemistry”,47th Edn, Vishal Publishing Co.

[2]. Gurdeep Raj, “Advanced Physical Chemistry”, Goel Publishing House

[3]. A.S.Negi and S.C.Anand, A text book of Physical Chemistry,New Age International

**References**


[1]. P. W. Atkins, "Physical Chemistry",8th Edn, Oxford University Press , 2006.

[2]. R. J. Silby and R. A. Alberty, "Physical Chemistry",4th Edn, John Wiley & Sons

[3]. G. W. Castellan,"Physical Chemistry", 3rd Edn, Narosa Publishing House, 2004.

[4]. S. Glasstone, "Thermodynamics for Chemists", Affileated East West Press Pvt Ltd, 2007.

[5]. M. C. Guptha, "Statistical Thermodynamics", New Age International (P) Ltd.

[6]. L K Nash, "Elements of Statistical Thermodynamics", 2nd Edn, Dover Publications

[7]. W. Adamson, " Physical Chemistry of Surfaces",6th Edn, John Wiley &sons.

[8]. N. K. Adam, " The Physics and Chemistry of Surfaces", Oxford University Press

[9]. M. W. Hanna, "Quantum Mechanics in Chemistry", Benjamin W.A.,Inc,Newyork-Amsterdam

[10]. I.N. Levine, "Quantum Chemistry",7th Edn, Pearson

[11]. C . Banwell, "Fundamentals of Molecular Spectroscopy", McGraw Hill Education

[12]. Manas Chanda, " Atomic structure and Chemical bonding in Molecular Spectroscopy", McGraw Hill Education India Pvt Ltd

[13]. R. Stephen Berry,Stuart A Rice & John Rose , Physical Chemistry,2nd Edn ,OUP USA


Model Question Paper

Mar Ivanios College (Autonomous)

Semester V (Core Course-VII)

Course Code AUCH 543 Credit-4

**Physical Chemistry II**

**Time:3 Hrs** **Total marks: 80**

## SECTION A

Answer all the questions. Each question carries 1 mark

1. Which of the following will give pure rotational spectrum? $H_2$, $N_2$, $CO_2$, HCl.
2. Write the mathematical definition of Laplacian operator.
3. Which branch of spectroscopy is used for the identification of free radicals?
4. What is the significance of polarizability of a molecule?
5. What is responsible for the stability of a lyophilic sol?
6. State Heisenberg uncertainty principle.
7. Give the expression for Freundlich adsorption isotherm.
8. Give the expansion of STM.
9. Give the selection rule for rotational spectroscopy.
10. What is the unit of dipole moment?

(10 x1=10 marks)

## SECTION B

(Answer any eight, 2 marks each)

11. What is meant by Critical Micelle Concentration (CMC)?
12. What is sedimentation?
13. What is the significance of wave function of a particle?
14. Give any two applications of ESR spectroscopy.
15. What do you mean by the term ‘parachor’?
16. What is meant by normal modes of vibrations?
17. What is zeta potential ?

18. Calculate the number of fundamental modes of vibrations of $CO_2$ and $SO_2$ molecules.
19. How does stokes and anti stokes lines originate in Raman spectrum.
20. Explain chemical shift.
21. Explain blackbody radiation.
22. What is hyperfine splitting in ESR?

(8 x2=16 marks)

## SECTION C

( Answer any 6 questions, Each question carries 4 marks)

23. What is an ensemble, explain the different types of ensembles.
24. Discuss the postulates of quantum mechanics.
25. Explain the underlying principle of NMR spectroscopy.
26. What is meant by Optical Exaltation? Calculate the optical exaltation of 2,6-dimethyl hepta-2,5-dien-4-one.
27. Compare physisorption and chemisorptions
28. What are the consequences of unharmonicity in vibrational spectroscopy?
29. What is Debye equation? Explain its significance.
30. Explain mutual exclusion rule with examples.
31. The fundamental vibrational frequency of carbon monoxide molecule is 2170 $cm^{-1}$ Calculate the force constant of the molecule.

(6 x4=24 marks)

## SECTION D

(Answer any two question, 15 marks each)

32. (a) Derive and explain Langmuir adsorption isotherm.
    What is meant by partition functions? Derive expressions for internal energy and enthalpy.
    The acceptable solutions to Schrodinger wave equation must have some special properties. What are these? Elaborate.
33. What is Hardy-Schulze rule and what are the principles involved in the mechanism of coagulation? Show that for a rigid diatomic rotor, the moment of inertia is given by $I = \mu r^2$

The pure rotational spectrum of a gaseous molecule CN consists of a series of equally spaced lines separated by 3.7978$cm^{-1}$. Calculate the internuclear distance of the molecule. The molar masses are; $^{12}C$=12.011 and $^{14}N$=14.007 g $mol^{-1}$.

34. (a) How can NMR spectrum distinguish between the isomers: p-xylene and ethyl benzene? Explain the shielding and deshielding mechanism in NMR. Give the hyperfine structure of ESR spectrum of hydrogen atom.Calculate the ESR frequency of an un.
paired electron in a magnetic field of 0.33T. Given ge = 2 and μB = 9.273x10-24 JT-1

35. Discuss the function of a protective colloid. Explain BET theory.

(15 x2=30 marks)

**B.Sc. Chemistry Programme**

Semester – VI (Core Course X)

Course Code – AUCH 641, Credit - 4

Inorganic Chemistry – III

| AUCH 641 **Inorganic Chemistry – III** | |
|---|---|
| **Total Teaching Hours for Semester :72** | **No of Lecture Hours/Week :4** |
| **Max Marks : 80** | **Credit-3** |
| **Course Outcomes** | |
| • CO 1 - Students will gain exposure and practice in coordination chemistry, transition and inner transition elements.<br>• CO 2 - Will be able to identify the role of organometallic compounds in organic synthesis.<br>• CO 3 - Metal ions in biological systems and its importance.<br>• CO 4 - General principles of isolation of elements help the students to understand about the experimental techniques used in chemistry and how the elements are isolated from their ores.<br>• CO 5 - Students will gain knowledge in different instrumental methods of analysis. | |

**Course outline**

**Module I- Transition and inner transition elements** **18 hrs.**

Transition elements : Electronic configuration and general characteristics – oxidation state, ionization enthalpy (variation of I, II and III ionization enthalpy across 3d series), enthalpy of atomisation, melting and boiling point, density, variation of std. electrode potentials (EoM2+/M & EoM3+/M2+ ), stability of higher oxidation states, colour, magnetic property, catalytic property and formation of complexes. Comparison of 3d, 4d and 5d transition series –Preparation, properties and uses of K2Cr2O7, KMnO4 and TiCl4. Important application of transition metals

Lanthanides and actinides: Lanthanides - electronic configuration and general properties, reactions – Occurrence and isolation of lanthanides from monazite – Lanthanide contraction – consequences of lanthanide contraction– Magnetic properties and complexation behaviour. Actinides – Oxidation states, ionic radii, colour, complex formation, actinide contraction, comparison with lanthanides.

**Module II Coordination Chemistry 18 hrs**

Nomenclature (latest version) – ligands and their classifications. EAN rule – Chelates – Stability of complexes – Factors affecting stability of complexes – Isomerism – Structural and stereoisomerism – Geometrical and optical isomerism – Bonding in complexes – V.B. Theory, CFT applied to Oh, and Td complexes. Factors affecting crystal field, — Spectrochemical series – CFSE, Magnetic properties and colour of metal complexes. Effect of crystal field splitting –Jahn -Teller effect, Tetragonal distortion of an octahedral complex- Application of coordination compounds in quantitative and qualitative analysis.

**Module III Organometallic Chemistry 12 hrs**

Organometallic Compounds : Definition – Nomenclature and classification – sigma complex – Pi complex – those containing both sigma and Pi bonds – 18 electron rule – Metal carbonyls – mononuclear and polynuclear (give examples of carbonyls of Fe, Co, Ni ) – preparation and properties of carbonyls (Fe, Ni, Mn, Cr). Vibrational frequency of CO bond in metal carbonyls – Bonding in organometallic compounds like ferrocene, dibenzene chromium, Zeise's salt (Without MOT) – Dinitrogen complexes – Application of organometallic compounds.

**Module IV- Bioinorganic Chemistry 6 hrs**

Bioinorganic Chemistry: Role of metal ions in biological systems – Biochemistry of iron, haemoglobin and myoglobin (elementary idea of the structure and mechanisms of their actions). Electron transport proteins: Cytochromes, Fe- Sulphur proteins, Storage and transport of iron. Photosynthesis – Sodium-Potassium pump - Biochemistry of magnesium and calcium (brief study only).

**Module V- General Principles of Isolation of Elements 9 hrs**

Methods of concentration of an ore - Gravity separation, Froth floatation, Magnetic separation, Leaching, electrostatic separation, automated ore sorting and dewatering, preliminary processes - calcination and roasting.

Methods of preparing metal from concentrated ore- Electro metallurgy- Metallurgy of

Aluminium, Sodium- Pyrometallurgy- Metallurgy of Iron, Zinc, Aluminothermy, Auto reduction-Hydro Metallurgy- Metallurgy of Silver, Gold

Purification of crude metal- Distillation, Liquation , Zone refining, Vapour phase refining (Monds process and van Arkel processes), Electro refining, Chromatography technique

**Module VI: Instrumental Methods of Analysis 9 hrs**

Atomic absorption spectroscopy- flame emission spectroscopy- applications – colorimetry- spectrophotometry- laws of spectrophotometry- Beer- Lambert's law- applications of spectrophotometry- thermal methods- introduction to Thermo Gravimetry (TG), DTA and Differential Scanning Calorimetry (DSC)- instrumentations and applications. Tools for measuring nanostructures: Powder X-ray Diffraction (XRD), Atomic Force Microscopy (AFM), Scanning Tunnelling Microscopy (STM), Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM)

**Text Books**


[1]. Cotton F A and Wilkinson G, Advanced Inorganic Chemistry, 3rd Edition, London, John Wiley & Sons, 1988

[2]. B. R. Puri, L. R. Sharma, Principles of Inorganic Chemistry, 6th Edition, 1976.

[3]. Willard, Merrit "Instrumental Methods of Analysis", CBS Publishers & Distributors, 6th edition, 1986


References:


[1]. Gopalan R and Ramalingam V, Concise Coordination Chemistry, Vikas Pub. House Pvt Ltd, 3rd Edition, New Delhi, 2008.

[2]. Satya Prakash, R.D. Madan, Modern Inorganic Chemistry (Revised Edition), S Chand & Co Ltd, New Delhi, 4th Edition, 2014.

[3]. J. D. Lee "Concise Inorganic Chemistry" :, Wiley, 5th Edition,1999

[4]. James E. Huheey, Ellen A. Keiter, Richard L. Keiter, Okhil K. Medh, "Inorganic Chemistry- Principles and Structure and Reactivity" ,5th edition, 2009

[5]. Shriver and Atkins, "Inorganic Chemistry", Oxford University Press, 5th Edition, 2010

[6]. Bosolo and Johnson, "Coordination Chemistry" 1986

[7]. M.N. Hughes, The lnorganic Chemistry of Biological Process (2nd edn.), Wiley, London, 1981

[8]. R.J.P. Williams and J.R.R.F. de Silva, New Trends in Bio-inorganic Chemistry, Academic Press, London, 1978

[9]. K. Srivasthava and P. C. Jain, "Chemical Analysis" S Chand & Co Ltd, New Delhi,4th Edition, 2005

**Model Question Paper**

Mar Ivanios College (Autonomous)

Semester -VI Core Course-X

Course Code – AUCH 641

INORGANIC CHEMISTRY III

**Time: Three Hours** **Maximum Marks: 80**

**SECTION A**

Answer all questions, each question carries 1 mark (answer in a word\sentence)

1. Which is more basic; $La(OH)_3$ or $Lu(OH)_3$?
2. Give the general outer electronic configuration of a transition element.
3. Which is the catalyst used in the oxidation of $SO_2$ to $SO_3$ in contact process?
4. Name the element obtained by the bombardment of $^{238}U$ with an $\alpha$ – particle.
5. What is the coordination number of Ag in $[Ag(CN)_2]$ ?
6. Give the IUPAC name of $Na_3[Co(CO_3)_3]$
7. What is the unit of magnetic moment?
8. Give the example for a tridentate ligand.
9. Write the structure of ferrocene.
10. Give the formula of a metal carbonyl which does not obey 18-electron rule.

(1 x 10 = 10 Marks)

## SECTION B

Answer any 8 questions, each question carries 2 marks (short answer questions)

11. Explain zone refining.
12. Name the metal ion, other than magnesium, involved in photosynthesis.
13. Give an example of phosphorus based polymer.
14. What is 'inorganic graphite?
15. What is the oxidation number of P in $H_3PO_4$?
16. Give the formula of a methanide.
17. Transition metals are less reactive than the alkali and alkaline earth metals - Justify.
18. Which is more stable: $Cu^{2+}$ or $Cu^{+}$ in aqueous solution. ? Substantiate your answer.
19. Which has got greater tendency to form complexes; lanthanides or actinides? Give reasons.
20. Write the difference between calcinations and roasting
21. What is an ambidentate ligand ? Give example.
22. Explain geometrical isomerism in metal complexes with suitable example.

( 2 x 8=16 Marks)

## SECTION C

Answer any 6 questions, each question carries 4 marks (short essay type)

23. What is Ziese'ssalt ? Give its structure.
24. State and explain 18-electron rule.
25. How haemoglobin differ from myoglobin.
26. What are carboranes ?
27. Purification of crude metals by Mondsproess and van Arkel processes
28. What happens when orthophosphoric acid is heated ?
29. What is lanthanide contraction? Explain its consequences.
30. What are the factors that affect stability of metal complexes?
31. Give an account of the applications of coordination compounds in quantitative and qualitative analysis.

(4 x 6=24 Marks)

## SECTION D

(Answer any 2 questions, Each question carries 15 marks) (Essay type)

32. (a)Describe the ion exchange method for the separation of lanthanides from monazite. (5 marks), (b) Describe the splitting of d-orbitals in tetrahedral and octahedral fields according to crystal field theory.(5 marks), (c) Comment on the magnetic properties of lanthanides .(5 marks)

33. (a) Give an account of the preparation, properties, structure and bonding of noble gas compounds. (10 marks) , (b) Discuss the nature of bonding in metal carbonyls. (5marks)

34. (a).How silicones are prepared ? Discuss their structure and uses. (b) Give an account of sodium-potassium pump in biological systems, (c) Explain the principle of TG with example.

35. (a) Starting from pyrolusite, how $KMnO_4$ is prepared? (b) Explain the principle and working of AFM.

( 15 x 2=30 Marks)

**B.Sc. Chemistry Programme**

Semester – VI (Core Course XI)

Course Code – AUCH 642, Credit - 4

Organic Chemistry – III

| AUCH 642 - ORGANIC CHEMISTRY- PAPER III | |
|---|---|
| **Total Teaching Hours for Semester: 54** | **No of Lecture Hours/Week: 3** |
| **Max Marks: 80** | |
| **Course Outcomes** | |
| **CO1: To have a basic understanding about carbohydrates, amino acids, proteins and nucleic acids.**<br>**CO2: To familiarise preparation and properties of heterocyclic compounds and drugs.**<br>**CO3: To understand basic facts and concepts in natural product chemistry**<br>**CO4: To introduce the chemical aspects of soaps and detergents.**<br>**CO4: Knowledge about polymers and its applications.**<br>**CO6: To learn the preparation and properties of organometallic and active methylene compounds.**<br>**CO7: To make students capable of understanding reagents used in organic synthesis.** | |

Course outline:

**Lecture – Tutorial – Lab: 3-0-4** **Total: 54 hrs.**

**Module I: Carbohydrates** **9 hrs.**

Classification and nomenclature of monosaccharides, configuration of monosaccharides. Reactions of glucose and fructose – structure of glucose and fructose – anomers and mutarotation (mechanism expected) - cyclic structure – pyranose and furanose forms – determination of ring size – Haworth projection formula – chair conformations.

Epimers and epimerization – Interconversion of aldoses and ketoses – chain lengthening and shortening of aldoses.

Disaccharides – reactions and structure of sucrose (structural elucidation not required).

Polysaccharides – Structure of starch and cellulose (structural elucidation not required).

Industrial applications of cellulose.

**Module II: Heterocyclic compounds and Drugs 9 hrs**

Heterocyclic compounds – classification – nomenclature – aromaticity.

Preparation (special reference to Paal-Knor synthesis and Hantzsch synthesis) and properties of furan, pyrrole, thiophene and pyridine. Basicity of pyridine and pyrrole.

Synthesis and reactions of quinoline, isoquinoline and indole with special reference to Skraup, Bischler-Napieralski and Fischer-Indole synthesis. Structural elucidation of quinoline.

Structure of purine and pyrimidine bases.

Chemotherapy – Drugs – introduction – classification – Synthesis of sulphanilamide, sulphathiazole and sulphapyridine. Mode of action of sulphadrugs and amphicillin. Elementary idea of the structure and application of chloroquine, paracetamol and aspirin.

**Module III: Amino acids, proteins and nucleic acids 9 hrs**

Amino acids – classification, structure and stereochemistry of amino acids, essential and non essential amino acids – zwitter ion, isoelectric point.

Synthesis of amino acids – Strecker synthesis, amido malonate synthesis, Erlenmeyer azlactone synthesis.

Peptides: Structure and synthesis (Carbobenzoxy, Sheehan and solid phase synthesis).

Proteins – classification of proteins – structure of proteins – denaturation and colour reactions.

Nucleic acids: Classification and structure of DNA and RNA. Replication of DNA. Transcription and Translation - Genetic code.

**Module IV: Natural products 9 hrs**

Terpenes – Classification - Isoprene rule - Essential oil – Source, structure (no structural elucidation) and uses of citral and geraniol, limonene and menthol. Structure of natural rubber – vulcanization and its advantages.

Alkaloids – Extraction and structural elucidation of conine and nicotine. Importance of quinine, morphine and codeine.

Vitamins: Classification, structure, functions and deficiency diseases (structure of vitamin A, B1 and C only - but no structural elucidation).

Lipids – biological functions – oils and fats – common fatty acids – hydrogenation – rancidity

- saponification value, iodine value, acid value.

**Module V: Soaps, Detergents and Polymers 9 hrs.**

Soaps and detergents: Soap – synthetic detergents – cleaning action of soap and detergents.

Polymers: General idea of monomers, polymers and polymerisation – Degree of polymerisation – polydispersity - number and weight average molecular mass.

Classification of polymers, Homopolymers and copolymers, Addition and condensation polymers, thermoplatstics and thermosets – mechanism of addition polymerization (Cationic, anionic and free radical) – Tacticity – role of Ziegler Natta catalyst in directing the tacticity in polypropylene (mechanism not required).

Addition polymerisation. Preparation and uses of (i) polyethylene (ii) PVC (iii) Teflon

Condensation polymerisation:(i) phenol-formaldehyde resin (ii) epoxy resin (iii) nylon-66 (iv) polyethylene terephthalate. Synthetic rubbers – SBR and nitrile rubbers. Biodegradable polymers Additives to polymers – Plasticisers, stabilizers and fillers.

**Module VI: Organometallics, Active methylene compounds and Reagents in Organic synthesis. 9 hrs**

Organomagnesium compounds: Grignard reagent: Preparation – Reaction with compounds containing acidic hydrogen, carbonyl compounds, cyanides and $CO_2$.

Organo lithium compounds: Preparation – Reaction with compounds containing acidic hydrogen, alkyl halides, carbonyl compounds, cyanides and $CO_2$.

Organo zinc compounds: Preparation of dialkyl zinc – Reaction with active hydrogen compounds, acid halides and alkyl halides – Reformatsky reaction (mechanism expected).

Li dialkyl cuprates – Preparation and reaction with aliphatic/aromatic/vinyl halides.

Active methylene compounds – examples – Preparation of ethyl acetoacetate by Claisen condensation (mechanism expected) – tautomerism – Synthetic applications of acetoacetic ester.

Reagents in organic synthesis: Study of the following reagents with respect to functional group transformations –

$LiAlH_4$ – reduction of -CO, -COOR and $–CONH_2$.

$NaBH_4$ and Diborane – reduction of -CO

$SeO_2$ - hydroxylation of allylic and benzylic positions, oxidation of $CH_2$ alpha to -CO

NBS: Allylic and benzylic bromination.

**Text books:**


[1]. Bahl and B.S. Bahl, Advanced Organic Chemistry, 5th Edition, S.Chand & Company, New Delhi, 2010.

[2]. R.T. Morrison, R.N. Boyd & S.K. Bhattacharjee, Organic Chemistry, 7th Edition., Pearson Education, 2011.

[3]. J. Clayden, N.Greeves and S.Warren, Organic Chemistry, 7th Edition, Oxford University Press, New York, 2009.


**References:**


[1]. S.C. Sharma and M.K.Jain, Modern Organic Chemistry, 3rd Edition Vishal Publishing Company, New Delhi, 2014.

[2]. I.L. Finar, "Organic Chemistry" Vol – 1&2, 5th Edition, Pearson Education, New Delhi, 2010.

[3]. F.W. Billmeyer., Book of Polymer Science, 2nd Edition, John Wiley and Sons, 1971.

[4]. S.M. Mukerji and S.P.Singh, 3rd Edition, Reaction Mechanism in Organic Chemistry, McMillan Publishers, 1984.

[5]. O.P. Agarwal, Chemistry of Natural Products, 38th Edition, Goel Publications, 2010.

[6]. T.L. Gilchrist, Heterocyclic Chemistry, 3rd Edition Pearson Education, New Delhi, 1997.


MODEL QUESTION PAPER

Mar Ivanios College (Autonomous), Thiruvananthapuram

Semester VI Core Course – XI

Course Code: AUCH 642 - Credit 4

**ORGANIC CHEMISTRY III**

**Time: 3 hours** **Max.Marks: 80**

## SECTION – A

(Answer all questions. Answer in one word to maximum two sentences. Each question carries one mark)

1. Draw the structure of D-Arabinose and D-Ribose?
2. What are epimers?
3. Write the IUPAC name of (i) Furan and (ii) quinoline.
4. Write the structure of chloroquine.
5. What is isoelectric point?
6. What is natural rubber chemically?
7. Write any two biological functions of lipids.
8. What is soap?
9. Write the monomers of the following polymers (i) PTFE (ii) PP.
10. What is Frankland reagent?

(10 X 1 =10 Marks)

## SECTION - B

(Short answer type. Answer any 8 questions from the following. Each question carries two marks.)

11. Explain inversion of cane sugar.
12. Write any two industrial applications of cellulose.
13. Compare the aromaticity of furan and thiophene.
14. Write the structure of pyramidine bases present in nucleic acids.
15. Define the terms (i) saponification value and (ii) iodine value.
16. What is isoprene rule?
17. What are essential and non-essential amino acids?
18. What is denaturation of protein?
19. Differentiate oils and fats.

20. Define the terms Mn and Mw.
21. What is NBS? What is its use?
22. What are active methylene compounds? Give examples.

(8 X 2 = 16 Marks)

## SECTION - C

(Short essay type. Answer any 6 questions from the following. Each question carries four marks.)

23. How can you interconvert glucose and fructose?
24. What is mutarotation? Explain its mechanism.
25. Explain the synthesis of amino acid by (i) Strecker and (ii) Amidomalonate synthesis.
26. What are vitamins? How are they classified? Write the structure of Vitamin A and C.
27. What is tacticity? Explain it by taking poly propylene as an example.
28. What is Bakelite? How is it prepared? Give its important applications.
29. Write a short note on the structure of DNA.
30. Discuss the mechanism of Reformatsky reaction.
31. Elucidate the structure of conine.

(6 X 4 = 24marks)

## SECTION – D

(Answer any 2 question. Each question carries 15 marks)

32. Discuss the cyclic structure of glucose. Briefly explain the structure of starch and cellulose. Why glucose and fructose form same osazone? How fructose reacts with the following reagents? (1)Na/Hg and $H_2O$ (2) $CH_3OH$ and dry HCl (3) Fehling's solution. Explain the Fischer-Indole synthesis.

33. What are sulphadrugs? Give examples. Explain the mode of action of sulpha drugs. What are terpenes? How are they classified? Write the structure of limonene and menthol.

34. Write brief note on the following : (a) Replication of DNA (b) Merrifield synthesis (c) Structure of protein.

35. Explain the synthetic applications of ethyl acetoacetate. How Grignard reagent is prepared? Explain its importance in the synthesis of primary, secondary, tertiary alcohols and carboxylic acid. Explain the mechanism of cationic and anionic polymerization.

(15 X 2 = 30 marks)

B.Sc. Chemistry Programme

Semester VI Core Course –XII

Course Code – AUCH 643 Credit 4

## AUCH 643 - PHYSICAL CHEMISTRY- PAPER III

| Total Teaching Hours for Semester :72 | No of Lecture Hours/Week :5 |
|---|---|
| Max Marks :75 | |

**Course Outcomes**

**CO1: Knowledge about kinetic aspects of chemical reactions and catalysis.**

**CO2: Awareness about chemical and ionic equilibria.**

**CO3: Information on thermodynamic derivation of phase rule and its applications.**

**CO4: Familiarisation of binary liquid systems and applications of distribution law, solvent extraction and CST.**

**CO5: Elementary idea about photochemistry and basic knowledge on Fluorescence, Phosphorescence and chemiluminescence.**

**CO6**: **General awareness about electromotive force and electrical conductance. Knowledge about fuel cells.**

**Lecture-Tutorial-Lab: 4-0-0**

**Module I: Chemical Kinetics & Catalysis 12 hrs**

Order of reaction, Derivation of integrated rate equation of zero, first, second and nth order reaction, determination of order of reactions:- Graphical and analytical methods using integrated rate equations, Fractional life- method, Differential rate equation method, Isolation method. Qualitative idea of Complex reactions:- (a) opposing reactions (b) first order consecutive reactions (c) parallel reactions. Qualitative idea of chain reactions. Influence of temperature on rate of reaction: Arrhenius equation, Determination of Arrhenius parameter, Energy of activation and its significance. Collision theory, Derivation of the rate equation for a second order reaction based on collision theory, unimolecular reactions- Lindemann mechanism, steady state approximation.

Catalysis:- Theories of catalysis, Intermediate compound formation theory, steady state method, Enzyme catalysis, Michaelis-Menten law.

**Module II: Chemical and Ionic Equilibria 12 hrs**

Equilibrium constant and free energy, Thermodynamic derivation of law of mass action, relation between Kp,Kc and Kx.

Le-Chatelier's Principle – Application in Haber process and dissociation of PCl5.

Reaction isotherm, Temperature dependence of equilibrium constant, Pressure dependence of equilibrium constant, Application of Clausius-clapeyron equation in physical equilibria.

Ionic equilibrium : Ionic product of water, Effects of solvents on ionic strength, levelling effect, Pka and Pkb values, solubility product and common ion effect and their applications, pH and its determination by indica tor methods, buffer solution, buffer action, Henderson's equation, buffer capacity - hydrolysis of salts of all types, degree of hydrolysis and hydrolytic constant, determination of degree of hydrolysis, relation between hydrolytic constant and ionic product of water

**Module III: Phase Equilibria 12 hrs**

Phase Equilibria:-Terminology, the phase rule, thermodynamic derivation of phase rule and its application to (a) water system (b) sulphur system (c) solid-liquid equilibria involving simple eutectic system such as Pb-Ag system, KI-water system, freezing mixtures, thermal analysis and desilverisation of lead (d) solid-liquid equilibria involving compound formation with congruent and incongruent melting points:- FeCl3- H2O system and Na2SO4-H2O system (e) solid–gas system- decomposition of CaCO3, dehydration of CuSO4.5H2O, deliquescence and efflorescence.

**Module IV: Binary Liquid Systems 15hrs**

Liquid-Liquid system:- Completely miscible, ideal and non-ideal mixtures, Raoult's law, vapour pressure- composition and temperature-composition curves, fractional distillation, deviation from Raoult's law, Azeotropic mixtures, partially miscible liquid system, critical solution temperature, Conjugate layers, example for upper, lower and upper cum lower CST, Introduction to three component system, distribution law, its thermodynamic derivation, limitations of distribution law, application of distribution law to the study of association and

dissociation of molecules, solvent extraction. (9hrs)

**Photochemistry:**

Grothus-Draper, Beer- Lambert and Stark- Einstein laws, Quantum yield, Reason for very low and very high quantum yields, Rate equation for decomposition of hydrogen iodide, Qualitative treatment of H2-Cl2 reaction and H2-Br2 reaction, Fluorescence and phosphorescence, chemiluminescence and photosensitization, Explanation and examples.

**Module V: Electromotive Force** **15 hrs** Electrochemical cells(brief explanation) Reference electrodes-standard hydrogen electrode, calomel electrode, Types of electrodes-Metallic electrodes, anion reversible electrodes and redox electrodes, Electrode reactions and cell reactions, Derivation of Nernst equation for electrode potential and cell potential, Gibb's Helmholtz equation and EMF of a cell, calculation of $\Delta G$, $\Delta H$ and $\Delta S$ from EMF data. Concentration cells with and without transference, electrode and electrolyte concentration cells, derivation of equation for the EMF of concentration cells with and without transference, Liquid Junction Potential,. Introduction to over voltage and polarization. Applications of potential measurement:- Determination of ionic product of water, hydrolysis constant and solubility product, pH value using quinhydrone and glass electrode, potentiometric titrations of acid-base and redox reaction.

Fuel cells :- Hydrogen-Oxygen fuel cell, Hydrocarbon – Oxygen fuel cell
Primary-Mercury cell, Dry cell and secondary cells –Lead acid cell, Li-ion cell Corrosion, Prevention of corrosion.

**Module VI: Electrical Conductance** **9 hrs**

Inter ionic attraction theory, Debye-Huckel-Onsager equation (Qualitative treatment only) activity and activity coefficient of electrolytes, Kohlrausch's law and its applications , Wein effect, Debye-Falkenhagen effect, Walden's rule. Ionic mobilities:- Transference number and its determination by Hittorff's and moving boundary methods, abnormal transference numbers, Applications of conductivity measurements:- Determination of degree of

dissociation of weak electrolytes, degree of hydrolysis, solubility of sparingly soluble salts, conductometric titrations involving strong acid - strong base, strong acid-weak base, weak acid- strong base, weak acid-weak base and precipitation.

(At least 100 problems are to be worked out from all units together. 30% of the questions for Examination shall contain problems.)

**Text Books**


[1]. Puri, Sharma and Pathania, "Principles of Physical Chemistry",47th Edn, Vishal Publishing Co.

[2]. Gurdeep Raj, "Advanced Physical Chemistry", Goel Publishing House

[3]. A.S.Negi and S.C.Anand, A text book of Physical Chemistry,New Age International

[4]. P.C.Rakhit, "Physical Chemistry", Sarat Book House,Calcutta

[5]. K.L..Kapoor," A Text book of Physical Chemistry "Vol 1,3 & 4, Macmillan


**References**


[1]. P . W. Atkins, "Physical Chemistry",8th Edn, Oxford University Press ,1990

[2]. R. J. Silby and R. A. Alberty, "Physical Chemistry",4th Edn, John Wiley & Sons

[3]. G. W. Castellan,"Physical Chemistry", 3rd Edn, Narosa Publishing House, 2004

[4]. R. Stephen Berry,Stuart A Rice & John Rose , Physical Chemistry,2nd Edn ,OUP USA

[5]. I.N.Levine "Physical Chemistry" ,5th Edn,Tata Mc Graw Hills


Model Question Paper

Mar Ivanios College (Autonomous)

Semester VI Core Course XII

Course Code: AUCH 643

**Physical Chemistry – III**

**Time: 3 Hours** **Total marks: 80**

## SECTION A

(Answer all the questions Each question carries 1 mark)

1. Give the Arrhenius equation.
2. Write the integrated rate equation for a first order reaction.
3. Give the relation between hydrolytic constant, dissociation constant and ionic product of water of a salt of strong acid and weak base.
4. The solubility of AgCl in water at 25 $^0$C is 0.00179 g/L. calculate its solubility product at 25 $^0$ C.
5. Write Debye- Huckel- Onsagar equation.
6. Write the reduced phase rule equation.
7. Give an example for a system having upper cum lower CST.
8. Give the Nernst equation for the potential of a copper electrode.
9. What is meant by quantum yield of a photochemical reaction?
10. Represent the electrochemical cell formed when Zn electrode is coupled with Ag electrode.

(10×1=10 Marks)

## SECTION B

(Answer any 8 questions, Each question carries 2 marks)

11. Define buffer solution and buffer index.
12. Define the term activation energy. Why different reactions proceed at different rates?
13. Give one example each for a consecutive and a parallel reaction
14. What is meant by common ion effect? Explain with an example.
15. Describe with example (i) Triple point (ii) Eutectic point
16. Explain the term congruent melting point with an example
17. Write a note on conductometric titration of acetic acid against sodium hydroxide?
18. What is Debye Falkenhagen effect?
19. How will you construct a calomel electrode?
20. What is meant by liquid junction potential? How can it be almost eliminated?
21. What are azeotropes ? Explain with an example.

22. What is critical solution temperature? How does it vary by the addition of an electrolyte?

(8×2=16 Marks)

## SECTION C

(Answer any 6 questions, Each question carries 4 marks)

23. The rate constant of a second order reaction is 5.70 x $10^{-5}$ $dm^3 mol^{-1}$ $S^{-1}$ at $25^0$C and 1.64 x $10^{-4}$ $dm^3$ $mol^{-1}$ $S^{-1}$ at $40^0$ C. Calculate the activation energy and the Arrhenius preexponential factor.
24. What would be the pH of a solution obtained by mixing 5 g of acetic acid and 7.5 g of sodium acetate and making the volume equal to 500 ml? Dissociation constant of acetic acid at $25^0$C is 1.75 x $10^{-5}$.
25. Explain the principle of freezing mixture by taking KI – $H_2O$ system as an example.
26. State and explain Nernst distribution law. What are the limitations of the law?
27. What are fuel cells? Describe $H_2$ – $O_2$ fuel cell and its cell reactions.
28. Derive Clausius- Clapeyron equation and mention its applications .
29. Explain the terms (i) Fluorescence (ii) Phosphorescence
30. What are the laws of photochemistry , explain ?
31. Explain the phase diagram of Pb-Ag system.

(6×4=24 Marks)

## SECTION D

(Answer any two questions,Each question carries 15 marks)

32. a) Using Le Chatliers Principle, describe the effect of temp, pressure and concentration for the following system in equilibria: $N_2+3H_2 \rightarrow 2NH_3$
    b) Give the applications Nernst distribution law. c) Elaborate on azeotropic mixtures.

33. a) How will you determine the transport number of ions using Hittorf method? (10 marks)
    Give the construction and working of SHE (5 marks)

34. a) Derive van't Hoff equation for temperature dependence of equilibrium constant (10 marks)

b) The equilibrium constant for a reaction is $1\times 10^5$. Calculate the standard free energy change for the reaction in kilojoules at $25^0$C (5 marks)

35. a) What is meant by CST. Explain different types of CST with examples (5 marks)

Discuss various types of concentration cells. (10 marks)

(15×2=30 Marks)

First Degree B.Sc Programme in Chemistry

Lab course Semester II,

PART B. LABORATORY

COMPUTER LABORATORY

[No ESE for this component]

Computer Lab based instruction on the use of computer and internet in learning. Use of educational softwares, information mining from internet and using INFLIBNET/NICNET, NPTEL and VIRTUAL LABS OF MHRD. Word processing and document preparation. Use of Spread sheets in Data handling and presentation. Introduction to chemical structure drawing, visualization of molecules using chemistry softwares.

First Degree B.Sc Programme in Chemistry

SEMSTER I, III & IV Core Course-IV Course Code AUCH 44PI

(Lab Course I) Core Course-IV

| **AUCH 44PI Lab Course I** | |
|---|---|
| **Total Teaching Hours for Semester :** | **No of Lecture Hours/Week :2** |
| **Max Marks :80** | **Credit-2** |
| **Course Outcomes** | |

Students completing this course will be able to:

- CO 1 - find out the ions present in the mixture of sample in a systematic way
- CO 2 - to prepare inorganic salts
- CO 3 - get a practical understanding of analytical chemistry

Three hours examination in semester IV. (Credit 2)

I. Qualitative Analysis (Micro Analysis)

Studies of the reactions of the following radicals with a view to their identification and confirmation: $Pb^{2+}$, $Cu^{2+}$, $Bi^{2+}$, $Cd^{2+}$, $Sn^{2+}$, $Sb^{2+}$, $Fe^{2+}$, $Fe^{3+}$,
$Al^{3+}$, $Cr^{3+}$, $Zn^{2+}$, $Mn^{2+}$, $Co^{2+}$, $Ni^{2+}$, $Ca^{2+}$, $Sr^{2+}$, $Ba^{2}$+, $Mg^{2+}$, $K^{+}$, $NH_4^{+}$, $CO_3^{2-}$, $S^{2-}$, $NO^{2-}$, $NO^{3-}$, $F^{-}$, $Cl^{-}$, $Br^{-}$, $I^{-}$, $BO^{3-}$ , acetate, oxalate, $CrO_4^{--}$, $PO_4^{3-}$and $SO_4^{2-}$.

Systematic qualitative analysis by microscale methods of a mixture containing two acidic and two basic radicals from the above list (not more than one interfering radical).

II. Inorganic Preparations

The following preparations are to be done:-

Potash alum

Hexaammine cobalt

Chloride

Tetraammine copper

Sulphate

Mohr's salt

Microcosmic salt

Sodium cobaltinitrate

Sodium nitropruside

Manganese phthalocyanin

Potassium trioxalatochromate and

Potassium trioxalatoferrate

Semester V

Core Course- VIII Course Code AUCH 54PII Inorganic Volumetric Analysis (Lab Course Number II) (Credit 3)

and Core Course-IX Physical Chemistry Experiments Course code 54PIII (Lab Course Number III) (Credit 2)

Six hours examination in semester V

Inorganic Volumetric analysis- one burette titration only(a) Acidimetry and alkalimetry

Preparation of carbonate free sodium hydroxide. Use of constant boiling hydrochloric acid Titrations using (1) Strong acid – strong base (2) Strong base – weak acid (3) Strong acid – weak base, determination of $Na_2CO_3$ and $NaHCO_3$ in a mixture by indicator method and $NH_3$ in an ammonium salt by direct and indirect methods.

(b) Permanganometry

The following determinations are to be done using standard permanganate solution (1) Ferrous iron (2) Oxalic acid (3) Hydrogen peroxide (4) Calcium (5) Nitrite and (6) $MnO_2$ in pyrolusite.

(c) Dichrometry

Determination of Ferrous iron using internal (& external indicator) and Ferric iron after reduction with $SnCl_2$.

(d) Cerimetry

Standardisation of ceric ammonium sulphate with Mohr's salt. Determination of oxalic acid using ceric ammonium sulphate. (e) Iodometry

Standardisation of thiosulphate using $KIO_3$, electrolytic copper and potassium dichromate. Determination of a copper salt.

(f) Precipitation titration

Determination of chloride in neutral medium. (g) Complexometry (using EDTA)

Standardisation of EDTA solution with $ZnSO_4$ – determination of Zn, Mg, Ni and Ca – determination of permanent and temporary hardness of water.

Physical Chemistry Practicals

The following experiments are to be done:

Determination of

1.Partition coefficient of iodine between $CCl_4$ and $H_2O$ or Partition coefficient of ammonia between $CHCl_3$ and $H_2O$ 2.Transition temperature of a salt hydrate. Molar mass of a solute using transition point depression of a salt hydrate.

Depression in freezing point of a solid solvent by cooling curve method. Molar mass of a solute.

Critical solution temperature of phenol – water system.

Viscosity of binary mixtures and then concentration of an unknown mixture.

Surface tension of binary mixtures and then concentration of an unknown mixture.

Conductometric titration of NaOH Vs HCl.

Potentiometric titration of $Fe^{2+}$ vs $Cr_2O_7^{2-}$

Potentiometric titration of $KMnO_4$ Vs KI

Determination of water equivalent of a calorimeter and heat of neutralisation of strong acid – strong base.

Kinetics of hydrolysis of an ester

Influence of KCl impurity on miscibility temperature of phenol – water system and then the determination of concentration of a given KCl solution.

2.COMPUTER SOFTWARE

Use of softwares and programmes in the physical chemistry experiments

1.Computer software like Scilab, Excel, etc to solve some of the plotting or calculation problems.

2.Determination of equivalence point of potentiometric and conductometric titrations using spreadsheet program.

3. Data analysis of kinetic experiments using spreadsheet program (determination of rate constant)

4.Plot scatter diagram.

Basic idea of software like Chemsketch or Chemdraw (any freely available structure drawing softwares)

Draw the structure of molecules using above mentioned software.

(Take prints and paste in the physical chemistry record)

B.Sc. Chemistry Programme Laboratory Course

Semester VI

Organic Chemistry Experiments Core Course-XIII Credit-3 Course Code AUCH 64 PIV (Lab Course IV),

and Course Code AUCH 64 PV Gravimetry Core Course-XIV (Lab Course V) Credit-2

Six hours examination in semester VI

I. Organic Chemistry Practicals (micro scale)

1.Tests for elements : Nitrogen, halogens and sulphur

Determination of physical constants

Studies of the reactions of common functional groups using known organic compounds.

Qualitative analysis with a view to characterization of the functional groups. The following compounds may be given for the analysis : chlorobenzene, benzyl chloride, phenol, o – m – p – cresols, naphthols, resorcinol, benzaldehyde, acetophenone, benzophenone, benzoic, phthalic, cinnamic and salicylic acids, ethyl benzoate, methyl salicylate, benzamide, urea, aniline, o – m, p – toluidines, dimethylaniline, nitrobenzene, o – nitro toluene p – nitro toluene, m – dinitrobenzene, naphthalene, anthracene, glucose and sucrose.

Organic preparations involving halogenation, nitration, oxidation, reduction, acetylation

benzoylation, hydrolysis and diazotisation (TLC of the reactant and Product) . Isolation of an organic compound from a natural source eg. Hippuric acid from cow's urine.

Chromatography

Paper chromatographic separation of mixture of nitroanilines, amino acids and sugars

Separation of a mixture of dyes by column chromatography.

Organic estimation

Molar mass determination of an acid and base by titration method

Determination of the phenol/aniline by bromate – bromide method

Determination of the equivalent mass of an ester

II Gravimetry

The following determinations are to be done using silica crucible

(1) Ba as $BaSO_4$ (2) Sulphate as $BaSO_4$

(3) Iron as $Fe_2O_3$ (4) Calcium as $CaCO_3$ (5) Aluminium as $Al_2O_3$ and Magnesium as $Mg_2P_2O_7$

The following determinations are to be done using sintered crucible

(1) Magnesium as oxinate (2) Nickel using dimethyl glyoxime (3) Copper as copper thiocyanate and (4) Silver as silver chloride

III Colorimetry (Using photo electric colorimeter)

Determination of Iron using thiocyanate and ammonia using Nessler's reagent.

**REFERENCE**


[1]. A.I.Vogel, "A text book of Qualitative Analysis including semi micro methods" Longmans.

[2]. V.V.Ramanujam, "Semi micro Qualitative Analysis"

[3]. E.S.Gilreath "Qualitative Analysis using semi micro method" Mc Graw Hill

[4]. A.I.Vogel, "A text book of Qualitative Inorganic Analysis" Longmass

[5]. A.I.Vogel, "Elementary Practical Organic Chemistry" Longmass

[6]. Day and Raman, “Laboratory Mannual of Organic Chemistry”. Viswanathan
[7]. Mann and Saunders, “Practical Chemistry”
[8]. A.Findlay, “Practical Physical Chemistry”
[9]. R.C.Das and E.Behara, “Experimental Physical Chemistry”, Tata Mc Graw Hill
[10]. N.K.,Vishnu, “Advanced practical organic chemistry” Vikas publishing house, New Delhi

The practical examinations of Lab course II (volumetric analysis), Lab course III (physical chemistry experiments) are conducted at the end of V semester. Lab course IV (organic analysis) and Lab course V (gravimetric analysis) are conducted at the end of VI semester with a duration of two days (6 hours duration on each day).

First Degree Programme

Semester V and VI

Chemistry Project and Factory visit

CORE COURSE XV, credit – 4

Course Code – AUCH 644

No. of credit – 4 .

Total ESE marks-100- (No CE marks) Project

Aim of the course

To develop an aptitude for research in chemistry, to learn research methodology and literature search Objective of the course

To inculcate proficiency to identify appropriate research topic and presentation Specifications Topics of chemical interest can be selected for the project. Project is to be done by a group not exceeding 5 students. Every student should submit typed (A4 paper, 12 Font, 1.5 Space, 20- 30 pages), spirally bind project report duly attested by the supervising teacher and the Head of the Department on the day of practical examination before a board of two Examiners for ESE. The viva-voce based on the project is conducted individually. Project topic once chosen shall not be repeated by any later batches of students. List of projects submitted year wise is to be maintained in a register and submitted before the examiners if requested.

The project report may contain the following sections:

1. Preliminary (Title page, declaration, certificate of the supervising teacher, content etc.)
2. Introduction with relevant literature review and objective
3. Materials and Methods
4. Results
5. Discussion
6. Conclusion / Summary
7. References.

**Study tour and Factory/ research institute visit**

Students are directed to visit one research institute/ chemical factory preferably with in the state of Kerala. Scientifically prepared hand written study tour report along with photographs of candidate at the places of visit must be submitted by each student for ESE on the day of the examination of project evaluation.

The board of examiners can decide the scheme of evaluation of project, study tour report and viva voce

**Open Course for Other Majors-**

Semester-5 Credit-2 Course-AUCH 581.b1

2017 admission onwards

| **APCH 581.b1 - Essentials of Chemistry** | |
|---|---|
| **Total Teaching Hours for Semester :54** | **No of Lecture Hours/Week :5** |
| **Max Marks :75** | |
| **Course Outcomes.** | |
| · **CO1: A general awareness on Atomic structure and Periodic Classification of Elements, Nuclear chemistry and polymer chemistry.**<br>· **CO2: Knowledge on chemistry in everyday life.**<br>**CO3: Basic knowledge on chemistry in biological processes.**<br>**CO4: A general awareness on environmental chemistry- pollution (air, water and soil) and their remedial measures.** | |

**Essentials of Chemistry**

**L– T – P: 3-0-0**

**Module 1:Atomic structure and Periodic Classification of Elements 9 hrs.**

Structure of atom- Fundamental particles, atomic mass, atomic number, isotopes. Bohr theory of atom. Orbitals- Quantum numbers, aufbau principle, Hund's rule; Pauli's exclusion principle. Electronic configuration of atoms - half and completely filled orbitals. Modern periodic table: Periods, Groups, Periodicity- valency, atomic radius, electronegativity, Ionisation potential, Electron affinity.

**Module 2 :Nuclear Chemistry 9 hrs.**

Natural radioactivity, Nature and types of radiations, Properties. Group displacement law. Radio active decay series. Decay rate. Half life period, Average life period, Unit of radioactivity. Radiation dose, artificial radioactivity, nuclear structure. Nuclear fission and Nuclear fusion. Rock dating- Radio carbon dating. (elementary idea only)

**Module 3 :Polymer Chemistry 9 hrs.**

Classification of polymer: Origin, structure, synthesis, Molecular forces. Commercially important polymers: Application of polyethylene, polystyrene, polyhaloolefines, Nylon-6, Nylon-66, Melamine, Terylene, Bakelite, Natural and synthetic rubber, vulcanization, inorganic polymer: (Examples Only).

**Module 4 :Chemistry in Biological Process 9 hrs.**

Vitamins: Vitamin-A, Vitamin-B2, Vitamin-C, Vitamin-D, Vitamin-E and Vitamin-K- Name, Source, Function and deficiency diseases. Enzymes- Classifications, characteristics, role, examples. Hormones - Sex hormones- Androgens, oestrogens, progesterone, Example, function. Cortical hormones- A few examples with function. Nucleic acid- RNA, DNA: Introduction- role in life process (No structure or chemical reactions needed)

**Module 5 : Chemistry in action 9 hrs.**

Dyes: classification based on constitution, application, examples, uses. Drugs: Antipyretic, analgesic, antiseptic, disinfectants, tranquilisers, antibiotics structure, name and uses only. Soaps and detergents: Hard and soft soaps, anionic, cationic and non-ionic detergents, cleansing action of soaps, Explosives: TNT, TNG, RDX, Gun cotton: name, structure and action. (No structure or chemical reactions needed)

**Module 6 :Environmental Chemistry 9 hrs.**

Air Pollution: Types of pollutant in air- carbon monoxide, carbon dioxide, Nitrogen oxides, Sulphur dioxides, hydrogen sulphide, $Cl_2$, CFC, particulate matter, metals, fly ash, asbestos, hydrocarbons- source and influence. Acid rain, Green house effect, ozone layer and its depletion. Water Pollution: Various factors affecting purity of water, sewage water, industrial

waste, agricultural pollution such as pesticides, fertilizers, detergents. Hard and soft water, Removal of hardness, disadvantage of hard water. Soil pollution : Due to pesticides, herbicide, fungicide, long term use of fertilizers, plastic waste.

**Textbooks**


[1]. M. C. Day and J. Selbin," Theoretical Inorganic Chemistry". Reinhold Book Corporation (1969)

[2]. H. J. Arniker," Essentials of Nuclear Chemistry: Wiley-Blackwell; 2nd Edition (1987)

[3]. B.K. Sharma "Environmental Chemistry". Krishna Prakashan Media (P) Ltd. (2011)

[4]. T. W. Graham Solomons "Fundamentals of Organic Chemistry". John Wiley & Sons; 5th Revised edition (1996)


**Reference Books**


[5]. Francis .A. Carey, "Organic Chemistry" McGraw-Hill Companies, (2006)

[6]. K. S. Tewari, N. K. Vishnoi,"A Text book for Organic Chemistry", Vikas Publishing

[7]. M. K. Jain," Principles of Organic Chemistry", S. Nagin, 2nd edn. (1978)

[8]. K. De, "Environmental Chemistry", New Age International (P) Limited, (2009)

[9] L. Finar,"Organic Chemistry", Vol. 1 Longmans (1963)


Model Question Paper

Mar Ivanios College (Autonomous)

Open Course for other Majors Course AUCH581.b1

**Essentials of Chemistry**

**Time: 3 Hrs** **Total marks: 80**

## SECTION A.

Answer all the questions. Each question carries 1 mark

1. Who discovered radioactivity?
2. Name any unit of radioactivity.
3. What is the expansion of DNA?
4. Write an example of a sex hormone.
5. Name an enzyme.
6. State Afbau principle.
7. Draw Px orbital.
8. Give an example of inorganic polymer.
9. Name any compound which causes acid rain.
10. What is the monomer of nylon-6,6?

(1x10 = 10 marks)

## SECTION B

Short answer. Answer any 8 questions (2 marks each)

11. Name the pollutants in air?
12. What are the factors affecting the purity of water?
13. Explain Hund's rule of maximum multiplicity with an example.
14. Define electron affinity, explain with an example.
15. Distinguish between half life period and average life period.
16. Explain artificial radioactivity.
17. Write the structure and applications of polyhalo olefins.
18. What is vulcanization of rubber?
19. What are corticosteroidal hormones? Explain with example.

20. Distinguish between DNA and RNA.
21. How are dyes classified?
22. Explain cleansing action of soap

(2×8 = 16 marks)

## SECTION C

Answer any 6 questions. Short essay (Each question carry 4 marks),

23. Explain the source and hazards of fly ash and asbestos.
24. Explain briefly soil pollution.
25. What are periods and groups in the periodic table? What is periodicity?
26. Explain Bohr model of atom.
27. Distinguish between nuclear fission and nuclear fusion with examples.
28. What are Nylon 66, Melamine and Terylene?
29. What are the functions and deficiency diseases of Vitamin C, Vitamin D and Vitamin E.
30. Write a note on explosives.
31. Distinguish between addition and condensation polymerization.

(4×6 = 24 marks)

## SECTION D

Answer any two question. Essay (15 marks each)

32. a) What are quantum numbers? Explain. State Pauli Exclusion Principle. Expalin their significance. Explain stability of half-filled and completely- filled orbitals. (5x3 = 15 marks)
33. a) Write a note on Group Displacement law and radioactive decay series. What is carbon dating? In an archaeological piece of wood $^{14}C$ activity is 10 % of the activity found in a fresh wood. Calculate the age of the archaeological piece (half life of $^{14}C$ is 5760 years.). Write a note on vitamin deficiency disease. (5x3 = 15 marks)

34. a) What are the different methods for the analysis of oils and fats? What is meant by DNA? Name the sugar unit present in DNA. Write a note on vat dyes. (5x3 = 15 marks)

35. a) Explain the cleansing action of soap. What is antibiotic? Give the names of the first antibiotic and the scientist who discovered it. Give an account of the green house effect. (5x3 = 15 marks)

**Open Course For Other Majors-**

Semester-5 Credit-2

Course Code-AUCH 581.b2

| **APCH 581.b2 - Fundamentals of Chemistry & Its Application to Everyday Life** | |
|---|---|
| **Total Teaching Hours for Semester : 54** | **No of Lecture Hours/Week :5** |
| **Max Marks :75** | |
| **Course Outcomes.** | |

- **CO1: A general awareness on Evolution of Chemistry, Atomic structure, Periodic classification of elements and Structure & properties of materials.**
- **CO2: Knowledge on chemicals used in everyday life.**

**CO3: A general awareness on Chemicals in food and beverages.**

**L– T – P: 3-0-0**

**Module 1 Evolution of Chemistry** **9 hrs**

Evolution of Chemistry - ancient speculations on the nature of matter, early form of chemistryalchemy, Robert Boyle and the origins of modern chemistry in the latter 1600s - origin of modern chemistry - Antoine Lavoisier and the revolution in chemistry - Role of Chemistry as a central science connecting

Physics, Biology and other branches of science. Basic ideas of interdisciplinary areas involving Chemistry

**Module 2 Atomic structure** **9 hrs**

Atom- model of Dalton- Thomson – Rutherford and Bohr. Nature of electron proton and neutron – atomic number – mass number- isotopes -state the relative charges and approximate relative masses of a proton, a neutron and an electron - describe, with the aid of diagrams, the structure of simple atoms as containing protons and neutrons (nucleons) in the nucleus and electrons arranged in shells (energy levels) (no knowledge of s, p, d and f orbitals);

**Module 3–Periodic table** **9 hrs**

The Periodic Table - Periodic trends, Group properties - describe the relationship between group number and the ionic charge of an element- similarities among the elements in the same group - metallic to non-metallic character from left to right across a period of the Period Table- Properties of elements in Group I and XVII using the Periodic Table

**Module 4 Structure and properties of materials** **9 hrs**

Elements, compounds and mixtures – elementary idea of ionic bond and covalent bond- compare the structure of simple molecular substances, e.g. methane; water, carbon dioxide, iodine, with those of giant molecular substances, e.g. poly(ethene); sand (silicon dioxide); diamond; graphite in order to deduce their properties compare the bonding structures of diamond – graphite, electrical conductivity.

**Module 5 Chemicals used in everyday life.** **9 hrs**

Household materials – Major chemical ingredients (No structural formula and preparation needed), method of action and possible hazards/toxicity of : Match Box- Household bleach – Soap- detergent— cooking gas – tooth paste – shampoo-hair dye- nail polish- whitener-moth balls –fire crackers.

**Module 6 Chemicals in food and beverages** **9 hrs**

Important chemical ingredients/ taste makers used in packed food - soft drinks - and its health hazards. Chemicals in food production - fertilizers used in natural sources - Fertilizers urea, NPK and Super phosphates - uses and hazards. Adulterants in milk, ghee, oil, coffee powder, tea, asafoetida, chilli powder, pulses and turmeric powder - identification. artificial sweeteners - food preservatives.

Model Question Paper

Mar Ivanios College (Autonomous)

Open Course for other Majors Course

Semester V Course Code AUCH 581.b2 Credit 2

**Fundamentals of Chemistry & Its Application to Everyday Life**

**Time: Three Hours** **Maximum Marks : 80**

## SECTION A

(Answer in a word / sentence) Answer all questions

1. What is superphosphate?
2. Who is the Father of Modern Chemistry?
3. How many atoms are present in a molecule of ozone?
4. Define isotopes.
5. What is a diamond made up of?
6. Which element has the electron configuration 2,1.
7. Name a liquid element.
8. What is the shape of water molecule?
9. How many valence electrons are there in carbon?
10. Name the main compound present in cooking gas.

(1×10 = 10 Marks)

## SECTION B

Each question carries 2 marks (Short answer type).Answer any eight questions.

11. Name any two Toxic Chemicals in Cosmetics
12. Obtain the electron configuration for (a) N; (b) F.
13. Explain Hund's rule of maximum multiplicity with an example.
14. Define electron affinity, explain with an example.
15. Which of the following elements Li, Be, B, C, N, O, F and Ne are metals?
16. Explain Bohr model of atom.
17. Why is the electronegativity value of most noble gases equal to zero?
18. What are the Health Effects of Drinking Soda?
19. Which do you expect to have more metallic character, Lead (Pb) or Tin (Sn)
20. What is a Match Head of match stick made of?
21. Explain why graphite conducts electricity whereas diamond doesn't.
22. Is the reactivity of group I metals increasing or decreasing down the group? Explain why?

(2×8 = 16 Marks)

## SECTION C

Each question carries 4 marks (Short essay type). Answer any six questions

23. Explain the colour of firecrackers.
24. What is the difference between covalent and ionic bonding?
25. What are periods and groups in the periodic table? What is periodicity?
26. What are adulterants?
27. How is Thomson's model of the atom different from Dalton's model of atom?
28. What's the difference between an oxidation number and an ionic charge?
29. Explain the health hazards associated with drinking soft drinks?
30. How can metallic character change across a period?
31. Describe clearly the link between increasing effective nuclear charge across a period and the changes in van der Waals radius.

(4×6 = 24 Marks)

## SECTION D

Each question carries 15 marks (essay type) Answer any two questions.

32. a.Explain about the pH changes of aqueous solutions of elements in the third period as the period is crossed. Explain how these changes are directly related to the changes in effective nuclear charge across the period. Describe the metallic character of elements in a period.
33. a.Explain the role of some chemicals in household items.(7.5 marks) b.Write a short note on food adultration. (7.5 marks)
34. a.Write a short note on the uses and hazards of fertilisers. (10 marks)
    b.Draw the structure of carbon and sodium containing nucleons. ( 5 marks)
35. a.compare the structure of substances, methane, water, carbon dioxide and iodine, with

ethane and silicon (10 marks) b.compare the bonding structures of diamond – graphite. ( 5 marks)

**Open Course for Other Majors**

Semester-V Credit-2

Course Code -AUCH 581.b3

| **APCH 581.b3 - Environmental Chemistry** | |
|---|---|
| **Total Teaching Hours for Semester : 54** | **No of Lecture Hours/Week :5** |
| **Max Marks :75** | |
| **Course Outcomes** | |
| · **CO1: A general awareness on Environmental Components.**<br>· **CO2: Knowledge on sources, types, effects and control of Soil pollution, Water pollution and Air pollution.**<br>**CO3: A general awareness on major environmental disasters.** | |

**L– T – P: 3-0-0**

**Module -I Environmental Components: 9 hrs**

Structure and composition of the, Atmosphere, hydrosphere, biosphere and Lithosphere – composition of atmosphere

**Module -II Water pollution: 9 hrs**

Sources, its effect and control; Sampling and measurement of water quality and their analysis, water quality standards, BOD and COD Hard water – soft water Eutrophication and restoration of lakes.

**Module -III Air Pollution: 9 hrs**

Types and sources of air pollution, Common Air Pollutants - Effects of air pollution; Smog –

ozone layer depletion – green house effect – acid rain

**Module –IV Soil Pollution: 9 hrs**

Sources, types, effects and control of: Land pollution, Marine pollution, Thermal Pollution and Radioactive pollution. Waste separation, storage and disposal ; Waste Reduction, Recycling and Recovery of materials.

Plastics and their misuses.

**Module -V Major environmental disasters 9 hrs**

Major environmental disasters - - mercury poisoning in Minamata, Japan ,Itaiitai disease due to cadmium poisoning in Japan - Love Canal toxic waste site, Seveso disaster chemical plant explosion - Bhopal disaster - Chernobyl incident,

**Module -VI Major environmental laws: 9 hrs**

Environment (Protection Act) – The Air (Prevention and control of pollution) Act – The water (Prevention and control of pollution) Act – The wild life protection Act – Forest conservation Act – The Ozone Depleting Substances (Regulation and Control) Rules – The Plastic Waste (Management and Handling) Rules - Rio declaration- Montreal protocol, Kyoto protocol Introduction to Green chemistry (elementary ideas only)

**Reference**


[1]. S. K. Banerji, “Environmental Chemistry”.

[2]. K. De “Environmental Chemistry - An introduction”

[3]. B. K. Sharma “Air Pollution”.

[4]. K. Ahluwalia “Environmental Chemistry”

[5]. G.W. vanLoon and S. J. Duffy “Environmental Chemistry: A global perspective”

[6]. S.K.Mohanty, Environment and Pollution Laws, Universal Law Publishing Co. Pvt Ltd

Model Question Paper

Mar Ivanios College (Autonomous)

Open Course for other Majors

Course Code AUCH 581.b3 Credit -2

**Environmental Chemistry**

Time: 3 hours Maximum marks: 80

## SECTION A

Answer all questions (Each answer carries 1 mark)

1. What you meant by Triple R in waste management ?
2. What type of pollution causes acid rain?
3. What are the misuses of plastics?
4. What are the three major man made sources of air pollution?
5. What kind of materials are discharged into the seas?
6. What increases the amount of carbon dioxide in the atmosphere?
7. Explain the action of zeolites on hard water.
8. What are freons?
9. Define pollution
10. What is fly ash (10x1=10 Marks)

## SECTION B

(Short answer type) (Answer any 8 questions, Each answer carries 2 mark)

11. How is pollution related to acid rain?

12. How does ocean pollution affect sea animals?
13. What are the main concepts of Green Chemistry
14. Write short note on Radioactive pollution
15. Discuss the major composition of earth's atmosphere
16. Write about the cause and consequence of Chernobyl incident
17. What is BOD and COD?
18. What causes radioactive pollution?
19. Distinguish between Hard water and soft water.
20. What is the goal of Forest Conservation Act?
21. What is the Greenhouse effect and what is its cause?
22. What are the types of air pollutants ?

(2×8 = 16 Marks)

**SECTION C**

(Short essay type) each question carries 4marks. Answer any 6

23. Write short note on volatile organic compounds.
24. How can thermal pollution be prevented?
25. How do you control Radioactive pollution?
26. What is smog? How does smog arise?
27. What is Eutrophication
28. Write a note on Rio-Declaration.
29. Explain the various layers of the Atmosphere
30. What is Air Pollution? How can air pollution be minimized?
31. Briefly explain about the components of atmosphere.

(6×4 = 24 Marks)

**SECTION D.**

Answer any 2 from the following. Each question carries 15 marks

32. (a) Explain Hardness of water and the different types. (5 marks) (b) Discuss about the various sources of water pollution. (5 marks). What are the control measures for water pollution ? (5 marks)

33. (a) Write short note on causes and problems of ozone layer depletion? (b) Explain the various types of smog. (c) Discuss the Ozone Depleting Substances (Regulation and Control) Rules

34. (a) Explain thermal pollution (b) Discuss about plastics and their misuses (c) Discuss about Chernobyl disasters

35. (a) Discuss about green chemistry (b) Explain Montreal protocol and Kyoto protocol (c) The water (Prevention and control of pollution) Act

(15 × 2= 30 Marks)

B.Sc. Chemistry programme

**Elective Course**

Semester-6 Credit-2 Elective Course,

Course Code – AUCH 691.c1

**Supramolecular, Nano Particles and Green Chemistry**

| ELECTIVE COURSE<br>AUCH 691.c1 - SUPRAMOLECULAR, NANO PARTICLES AND GREEN CHEMISTRY | |
|---|---|
| **Total Teaching Hours for Semester :54** | **No of Lecture Hours/Week :3** |
| **Max Marks :80** | |
| **Course Outcomes** | |
| **CO1: General awareness about proper waste management, synthesis of less hazardous chemicals and implemention of green practices in laboratories.**<br>**CO2: To understand the classification of nanomaterials, their synthesis, characterization and applications.**<br>**CO3: Familiarization with the main topics of current interest in the field of supramolecular chemistry and molecular recognition.** | |

**L– T – P: 3-0-0**

Total: **54 hrs**

**Module I Green Chemistry-1** **9hrs**

Role of Chemical Industries in polluting the environment-Limitations of conventional waste managementpollution prevention-birth of green chemistryintroduction to the principles of green chemistry-atom economy calculation(simple reactions)-production of Ibuprofen-less hazardous chemical syntheses, designing safer chemicals-Bhopal gas tragedy- new greener syntheses, safer solvents and auxiliaries ionic liquids-super critical fluids $CO_2$ and $H_2O$, advantages of SCFs

**Module II Green Chemistry-2** **9hrs**

Design for energy efficiency-principle of microwave oven, microwave assisted organic syntheses, simple examples- renewable feedstock- biodiesel, preparation, advantages, catalysis, green catalysts- inherently safer chemistry for accident prevention. Green chemistry practices in research, educational and commercial laboratories- lab safety signs- introduction

to micro scale experiments.

**Module III Chemistry of Nano Materials Part I** **9 Hrs**

Classifications of nanostructured materials, nano particles; quantum dots, nanowires, ultra - thinfilmsmultilayered materials. Synthesis of nanometre scale particles of colloidal semiconductors such as TiO2, CdS, ZnO, BaTiO3, by wet chemical methods, hydrothermal methods, and pyrolytic or high temperature methods. Carbon nanotubes fullerenes and graphene. Synthesis and purification of carbon nanotubes, Singlewalled carbon nanotubes and multiwalled carbon nanotubes, Structure-property relationships.

**Module IV Chemistry of Nano materials Part II** **9 hrs**

Preparation of self-assembled monolayers, core shell nanoparticles and quantum dots. Properties of nanoparticles: optical, magnetic, mechanical, thermal and catalytic properties, characterisation of nano particles by AFM, STM and SEM. Applications of nanomaterials: Potential uses of nanomaterials in electronics, robotics, computers, sensors, mobile electronic devices, vehicles and transportation. Medical applications of nanomaterials.

**Module V :Molecular recognition** **9 hrs**

The concepts of molecular recognition, host, guest and receptor systems. Forces involved in molecular recognition. Hydrogen bonding, ionic bonding, p-stacking, vander Waal's and hydrophobic interactions.

**Module VI Supramolecular chemistry:** **9 hrs**

Introduction to molecular receptors-design principles: Tweezers, Cryptands and Carcerands, Cyclophanes, Cyclodextrins and Calixarenes- Typical examples Molecular recognition and catalysis- catalysis by cation receptors, anion receptors and cyclophanes.

Molecular recognition in DNA and protein structure

**References**

[1]. Anastas. P.T.; Warner, J.C.,"Green Chemistry; Theory and Practice", Oxford University Press; Oxford , U.K.,1998.
[2]. Lancaster,M,"Green Chemistry; An Introductory Text",Royal Society of Chemistry; Cambridge,UK, 2003
[3]. Rashmi Sanghi and M.M Srivasthava, "Green Chemistry Environment Friendly Alternatives", Narosa Publishing House,2006
[4]. T.Pradeep, "NANO: The Essentials", 'McGraw-Hill Education'. 5. D. Nasipuri "Stereochemistry of Organic Compounds", Wiley
[5]. J M Lehn, "Supramolecular Chemistry", V C H.
[6]. H Vogtle, "Supramolecular Chemistry", W iley.
[7]. P S Kalsi, J P Kalsi,"Bioorganic, Bioinorganic and supramolecular Chemistry", New Age International

Model Question Paper

Mar Ivanios College (Autonomous)

Elective Course

Semester VI Course Code AUCH 691.c1Credit 2

**Supramolecular, Nano Particles and Green Chemistry**

**Time: Three Hours** **Maximum marks : 80**

**SECTION A.**

Answer all questions. Each question carries 1 mark.

1. Define atom economy.
2. Write an example of green catalyst.
3. Between an addition and elimination reaction which is having a better atom economy?

4. Name a colloidal semiconductor.
5. Expand SAMS.
6. What is graphene?
7. Name the different allotropes of carbon.
8. Name any two molecular receptors.
9. What are cryptands?
10. Define π stacking.

## SECTION B

Answer any eight questions. Each question carries 2 marks.

11. Write a note on Bhopal Tragedy.
12. Define Carbon efficiency.
13. Explain the limitations of conventional waste management.
14. Give any four lab safety signs with its meaning.
15. Write about the wet method of preparing colloidal semiconductors.
16. What are the magnetic properties of nanoparticles.
17. Briefly describe the catalytic properties of nano materials.
18. Explain the different types of SWCNTs.
19. What are the non-covalent bonds involved in molecular recognition?
20. Define host and guest in supramolecular chemistry.
21. Write a note on Cyclodextrins.
22. What are molecular tweezers?

## SECTION C.

Answer any six questions. Each question carries 4 marks.

23. What are secondary electrons?
24. Write a note on safer solvents and auxiliaries.
25. Explain ionic liquids.

26. Write a note on biodiesel.
27. Describe the synthesis of quantum dots and mention its optical properties.
28. Explain the preperation of SAMs.
29. Discuss the potential applications of nanomaterials in computers, sensors, and Medical applications.
30. Discuss the various aspects of molecular recognition involved in the structure of DNA.
31. Write notes on cation and anion receptors.

**SECTION D**

Answer any two questions. Each question carries 15 marks.

32. (a) Explain the twelve principles of green chemistry.(10marks)
    (b) Explain microwave assisted organic syntheses with an example.(5marks)
33. (a) Explain the principle and working of SEM
    (b) Write a note on synthesis and purification of carbon nanotubes.
34. Write short notes on (a) Calixarenes (b) Cyclodextrins (c) Cyclophanes.
35. Write short notes on (a) molecular recognition (b) preparation biodiesel(c) non bonded interactions.

B.Sc Chemistry Programme

**ELECTIVE COURSE**

Semester-6 Credit-2

Course Code – AUCH 691.c2

**Computational, Combinatorial and Physical Organic Chemistry**

| ELECTIVE COURSE<br>AUCH 691.c2-COMPUTATIONAL, COMBINATORIAL AND PHYSICAL ORGANIC CHEMISTRY | |
|---|---|
| **Total Teaching Hours for Semester :54** | **No of Lecture Hours/Week :3** |
| **Max Marks :80** | |
| **Course Outcomes** | |
| **CO1: Basic knowledge about chemistry related softwares and various computational methods.**<br>**CO2: Knowledge about combinatorial synthesis and its applications to drug discovery.**<br>**CO3: Knowledge about reaction mechanism and the factors that determine their rate.** | |

**L– T – P: 3-0-0**

**54 hrs**

**Module I Introduction to Computational Chemistry 9 hrs**

Web resources in chemistry learning Introduction to structure drawing, spread sheet and chemistry related softwares. Approximate methods in Quantum mechanics- Many electron atoms: Self consistent field method. Chemical bonding: Perturbation theory and variational principle. MO theory of hydrogen molecule ion. VB theory of hydrogen. Concept of resonance.

**Module II Computational Methods 9 hrs**

Brief description of computational methods: ab initio, semi empirical, DFT and molecular mechanics. RHF, ROHF &UHF methods Basis sets, STO &GTO. Z-matrix of simple molecules H2O, CO2& NH3. Common computational and visualization softwares

**Module III: Combinatorial Chemistry Introduction 9 hrs**

Early development, what is combinatorial synthesis, library synthesis on resin beads, solid

phase chemistry, Merrifield peptide synthesis, support for solid phase synthesis, parallel synthesis and mix and split library synthesis.

**Module IV Combinatorial Synthesis 9hrs**

Libraries on multipins, libraries on wicks, libraries on laminar solid phases (no detail study).Solution phase library synthesis- eg.-, Hantzsch synthesis of aminothiazole, peptide and nonpeptide libraries( eg. only), Applications of combinatorial chemistry in drug discovery.

**Module V : Introduction to Physical organic chemistry 9 hrs**

Classification of mechanism with suitable examples. Bond breaking mode – Heterolytic, Homolytic and Pericyclic Nature of reaction – Substitution, Elimination, Addition, Pericyclic and Rearrangement reactions. Nature of reagent – Nucleophilic,

Electrophilic and Free radical. Thermodynamic and Kinetic control of reaction. The Hammond postulate

(qualitative treatment). The thermodynamic functions – $\Delta H$, $\Delta S$ and $\Delta G$ and their determination from Arrhenius equation. Role of above thermodynamic functions in mechanistic probe of reactions. Methods of determining mechanism, Identification of products, Detection of intermediates, Catalytic study, Isotopic labeling, Stereochemical evidence, Kinetic evidence.

**Module VI Correlation of structure with reactivity 9 hrs**

The effect of substrate structure – Differences in mechanism for primary, secondary and tertiary systems. The effect of a and ß substitution – the +I and –I effects (Inductive effects of electron releasing and electron withdrawing groups at a and ß positions). Substitution of mono and bicyclic (at a and ß positions) aromatic rings (Resonance effects). Hyperconjugate effects. Neighbouring group effect nonclassical bridge head - Steric effects – B-strain, Strain in aliphatic cyclic systems. Steric inhibition of resonance – ortho effect and a-effect, The Hammett equations.

**References :**


[1]. Guy H. Grant and W.Graham Richards, "Computational Chemistry", OCP(29) 2. Christopher J.

[2]. Cramer, John Wiley,"Essentials of Computational Chemistry",

[3]. Frank Jenson, "Computational Chemistry".

[4]. Ira N. Levine," Quantum Chemistry".

[5]. David Young, "Computational Chemistry A Practical Guide for Applying Techniques to Real World Problems", Wiley Interscience.

[6]. N K Turret, "Combinatorial Chemistry", (Oxford Publication)

[7]. Jerry March "Advanced Organic chemistry", 3rd edition, Wiely International (Indian edn New Delhi) Chapter 6 and 10

[8]. P S Kalsi," Text of organic Chemistry", Mac million India ltd 1999 Ch 2

[9]. M K Jain and S C Sharma," Modern Organic Chemistry" , Vishal Publishing Co, 2004, Chapter 3,4, 15


Model Question

Elective Course-

Course Code AUCH 691.c2 Credit 2

**Computational, Combinatorial and Physical Organic Chemistry**

**Time: Three Hours** **Max. Marks : 80**

**SECTION A**

Answer all questions. Each question carries 1 mark.

1. Write Arrhenius expression and explain the terms.
2. What is RHF?

3. What are nucleophilic reagents? Give examples.
4. Name any two structure drawing softwares.
5. Write Hammett equation.
6. Give one example solution phase library synthesis.
7. Write any two examples for poly amide resin.
8. Propene is more stable than ethane. Why?
9. What is combinatorial synthesis?
10. Write any two examples for heterolytic bond breaking reaction.

(1 X 10 = 10 Marks)

## SECTION B

Answer any eight questions from the following. Each question carries 2 marks.

11. What are the web resources in learning Chemistry?
12. What is a basis set ?
13. What are the major mechanisms of organic reactions ?
14. Distinguish between STO & GTO.
15. Explain the advantages of combinatorial synthesis.
16. What is meant by electrocyclic reaction. Give one example.
17. What are the applications of combinatorial synthesis.
18. What are multipins used in combinatorial synthesis
19. Explain kinetic requirements of reaction.
20. Explain Hammond postulate.
21. Explain +I and – I effects.
22. Explain isotopic labeling in the study of organic reactions.

(2× 8 = 16 Marks)

## SECTION C

Answer any six questions from the following. Each question carries 4 marks.

23. Draw the Z matrix of $H_2O$ & $NH_3$
24. Why SEM is called parametrisation method
25. How can a eight – member dipeptide library is synthesized ?
26. Explain non-peptide libraries.
27. How are the intermediates detected?
28. Explain substitution reactions of naphthalene.
29. Explain the effect of leaving group in aliphatic substitution reactions.
30. What is self consistent field method.
31. Explain mix and split library synthesis.

(6 X 4 = 24 Marks)

## SECTION D

Answer any two questions from the following. Each question carries 15 marks

32. (a)Explain MO theory of hydrogen molecule ion. (b) Explain VB theory of hydrogen.

(10 + 5 = 15 Marks)

33. (a)Explain neighboring group participation with examples.
(b)Explain sterric effects and B-strain.

(7.5 + 7.5 = 15 Marks)

34. (a) How does the structure of substrate affect the aliphatic nucleophilic substitution?
(b) Comment on the effect of substituent on nucleophilic substitution reaction.

(7.5 + 7.5 = 15 Marks)

35. Write a brief description of methods (a) ab initio (b) DFT (c) molecular mechanics.

(5+ 5+ 5 = 15 Marks)

B.Sc Chemistry Programme

ELECTIVE-COURSE I

Semester-6 Credit-2 Elective

Course Code - AUCH691.c3

# POLYMER CHEMISTRY

| ELECTIVE COURSE<br>AUCH 691.c3 - POLYMER CHEMISTRY | |
|---|---|
| **Total Teaching Hours for Semester :54** | **No of Lecture Hours/Week :3** |
| **Max Marks :80** | |
| **Course Outcomes** | |
| **CO1: Basic knowledge about various types and methods of polymerization.**<br>**CO2: Knowledge about the chemistry of individual polymers, their preparation, properties and applications.**<br>**CO3: To understand the physical properties of polymers, their degradation and processing techniques.** | |

**L– T – P: 3-0-0** **54 hrs**

**Module I:- Introduction** **9 hrs**

Brief history of macromolecular science, general characteristics of polymers in comparison with common organic compounds. Nomenclatures. Distinction between plastics, elastomers and fibres. Natural polymers- cellulose, silk, gums and resin . Types of polymers-

thermoplastics and thermosettings, functionality concept. Concept of cross linked polymers. Types of polymerization- addition, condensation, ionic, co-ordination. Addition – polymerisation – mechanism, initiation , propagation and termination processes, initiators, inhibitors. Mechanism of ionic polymerization

**Module II : Methods of polymerization 9 hrs**

Methods of polymerization-bulk, suspension, emulsion, solution necessity of copolymers and copolymerization, blocks and graft copolymers. Detailed study of the following thermosetting polymers with respect to synthesis, chemistry, properties and applications. (a) phenol-formaldehyde resins (b) amino resins_ urea- formaldehyde and melamine-formaldehyde resins (c) polyurethanes (d) epoxy resins- grades of epoxy resins, curing process and its importance with mechanism (e) poly carbonates, silicones

**Module III: : Elastomers-1 9 hrs**

Polyisoprene, polybutadiene, neoprene. Detailed study of the following thermoplastic polymers with respect to synthesis, chemistry, properties and applications. Polyolefins ,polyethylenes_HDPE, LDP,LLDP, polyvinyl chloride-grades of PVC, Teflon, Polystyrene-homopolymers, copolymers such as SBR, ABS, SAN.

**Module IV : Elastomers-2 9 hrs**

Vinyl polymers- polyvinyl acetate and its modifications like PVA, PVB and polyacetals. Polyamides - nylon -6, nylon-66 and other nylons. Poly ethers and poly esters, terephthalates. Cellulosics such as esters, ethers, acetates, butyrates, nitrate, CMC; regenerated cellulose.

**Module V: Experimental methods-1 9 hrs**

Molecular weight and molecular weight distribution – number , weight and viscosity average molecular weights of polymers, methods of determining molecular weight, practical significance of molecular weight distribution, size of polymers. Introductory concepts of

kinetics of polymerization and Carother's relation. Glassy state, glass transition temperature, TGA, factors affecting GTT, crystallinity in polymers.

**Module VI : Experimental Methods –II** **9 hrs**

Viscosity, solubility, optical properties, electrical properties, thermal properties, mechanical properties of polymers. Degradation of polymers by thermal , oxidative ,mechanical and chemical methods. Polymer processing- compression moulding, casting, extrusion , fibre spinning, injection moulding, thermoforming, vulcanization of elastomers, polymer industry in India.

**References**


[1]. Bllmeyer, "Textbook of polymer science", John Wiley and Sons

[2]. D.D. Deshpande, "Physical chemistry of macromolecules", Vishal publications, New Delhi, 1985

[3]. V.R. Gowariker, N.V. Viswanathan and J.Sreethan, "Polymer Science", Wiley Eastern Ltd, 1986


Model Question Paper

Elective Course Semester VI

Course Code AUCH691.c3

**Polymer Chemistry**

Time: Three Hours Maximum Marks: 80

**SECTION A**

Each question carries 1 mark (Answer in one word\sentence)

Answer all questions

1. What are elastomers?
2. How is melamine-formaldehyde resin prepared?
3. Write a note on Nylon 66.
4. Mention the monomer unit of neoprene.
5. Define copolymers.
6. Explain extrusion.
7. Define fibre spinning.
8. Explain emulsion polymerisation
9. Give two examples of natural polymers
10. What is SBR and SAN?

## SECTION B

Answer any eight questions. Each question carries 2 marks.

11. Write a note on Condensation polymerisation.
12. Explain the synthesis of HDPE.
13. Write a note on Polyurethanes.
14. Explain number, weight and viscosity average molecular weight.
15. Define graft copolymers.
16. Explain the preparation of PVC.
17. What are epoxy resins?
18. Explain the vulcanisation of ealstomers.
19. Write the mechanism of ionic polymerisation.
20. Explain the chemical methods of degradation of polymers.
21. Explain polymer processing.
22. Distinguish between thermoplastics and thermosetting plastics.

## SECTION C

Answer any six questions. Each question carries 4 marks.

23. Write a short note on silicones?
24. What are the methods of determining molar mass?
25. Write notes on (1) compression (2) moulding (3) casting
26. Discuss the synthesis and application of Teflon
27. Describe the role of initiators and inhibitors in addition polymerisation
28. Distinguish between plastics, elastomers and fibres
29. Describe the TGA of polymers.
30. Discuss the various aspects of molecular recognition involved in the structure of DNA.
31. Explain kinetics of polymerization and Carothers relation

## SECTION D.

Answer any two questions. Each question carries 15 marks.

32. Discuss the methods of (a) Determining molecular weight (b)Practical significance of molecular weight distribution
33. Write a note on (a) vinyl polymers and (b) discuss about the methods of synthesis of PVA, PVB and Polyacetals.
34. (a) Explain crystallinity in polymers (b) Explain thermal, electrical and mechanical properties of polymers.
35. Write notes on (a) compression (b) moulding (c) casting

B.Sc Chemistry Programme

**Elective Course**

Semester-VI Credit-2

Course Code –AUCH 691.c4

**BIOCHEMISTRY**

| ELECTIVE-COURSE<br>AUCH 691.c4 - BIOCHEMISTRY | |
|---|---|
| **Total Teaching Hours for Semester :54** | **No of Lecture Hours/Week :3** |
| **Max Marks :80** | |
| **Course Outcomes** | |
| **CO1: Acquire knowledge about the bioinorganic molecules present in the body system.**<br>**CO2: Understanding functioning of various organs in the body and the diseases associated with them.**<br>**CO3: Get an idea about nutritional and calorific values of food.**<br>**CO4: Get basic idea about biochemical separation techniques.** | |

**L– T – P: 3-0-0** Total: **54 Hrs**

**Module - I Blood** **9 Hrs**

Constituents of blood cells and plasma, plasma proteins, albumin and globular - lipoproteins, functions (Details not expected), Coagulation - 'Coagulation factors, Hemoglobin - functions, Structure of hemoglobin, abnormal hemoglobin.

**Module II Respiration** **9 Hrs**

Chemical and physiological events, affecting diffusion of O2 and CO2 during respiration, Transport of Oxygen in Blood O2 dissociation curve, Interrelationship between O2 and CO2 transport.

**Module III Kidney Function** **9 Hrs**

Body water balance, buffers in blood, Formation of Urine, Kidney function, Renal Threshold, Constituents of Urine, diseases associated with Kidney function

**Module IV Nutrition** **9 Hrs**

Measurement of Energy Value of food, Calorific value, caloric requirement, Kilocalorie. Basal metabolic rate (BMR):- Significance, Condition, factors , measurement

**Module V Digestion and Absorption of Food 9 Hrs**

Outline study of digestion and absorption of Carbohydrates, proteins, fats and enzymes involved , composition and functions of bile - Bile pigments, Bile acids, Bile salts.

**Module VI Biochemical Techniques 9 Hrs**

Chromatography - Ion exchange, adsorption paper, TLC, GLC, affinity, Gel filtration Electrophoresis - paper, gel, ultracentrifugation.

**References**


[1]. Gyton,"Text Book of Medical Physiology".

[2]. Ganog,"Text Book of Medical Physiology ".

[3]. David Randall, "Physiology".

[4]. Dr. A.C. Deb, "Fundamentals of Biochemistry".

[5]. Swaminathan, "Advanced Text Book on Food & Nutrition".

[6]. B. Srilakshmi, "Nutrition Science".


Model Question Paper

Mar Ivanios College (Autonomous)

Elective Course

Semester VI

Course Code AUCH 691.c4

**Biochemistry**

Time: 3 hours Maximum marks: 80

## SECTION A.

Answer all questions (maximum two sentences each question carries 1 mark)

1. What is the normal pH of arterial blood?
2. What is the cause of sickle cell anemia?
3. Give an example for plasma protein.
4. What are anticoagulants?
5. Define BMR?
6. What is the renal threshold value of glucose?
7. What is NPN?
8. What is the calorific value of fat?
9. Name the bile pigments.
10. What is GLC?

(10x1=10 marks)

## SECTION B

Answer any eight, each question carries 2 marks

11. Define renal threshold and its significance?
12. What are the normal constituents of urine?
13. What are the different types of hemoglobin?
14. Write a short note on protein digesting enzymes.
15. Draw the structure of heme
16. What are the constituents of blood?

17. What are the functions of plasma protein?
18. What is difference between plasma and serum?
19. What is adsorption chromatograpy?
20. What is the composition of bile?
21. Write about abnormal hemoglobin.
22. Discuss about ion exchange chromatography.

(8 x 2 = 16 marks)

## SECTION C

Answer any six each question each question carries 4 marks

23. Explain Oxygen dissociation curve and factors affecting its shift.
24. Describe gel electrophoresis.
25. Explain thin layer chromatography.
26. Explain briefly the buffers in blood.
27. Give an account of diseases affecting kidney function.
28. Discuss about ultracentrifugation.
29. Discuss the physiological events involved in the transport of oxygen and carbon dioxide.
30. Describe briefly about the various blood cells.
31. Briefly explain about lipoproteins and their functions.

(6 x 4 = 24 marks)

## SECTION D

Answer any two (essay). Each question carries 15 marks

32. Discuss about (i) Coagulation factors (ii) Anticoagulants (iii) Mechanism of blood clotting.

33. Discuss about the principle procedure and applications of (i) SDS PAGE (ii) Affinity chromatography (iii) Gel filtration chromatography

34. Describe (i) Body water balance (ii) Functions of kidney (iii) Formation of urine.

35. Discuss about the digestion and absorption of (i) Carbohydrate (ii) Protein (iii) Fat

(15 x 2 =30 marks)